Active Healthy Kids Global Alliance "Global Matrix" Initiative:

Process, Results, Impact and Evaluation

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Abstract

In response to growing concern about physical inactivity among children, the Report Card on Physical Activity for Children and Youth was created in Canada in 2005. The Report Card is a public-facing document reporting letter grades, updated scientific information, research gaps, and recommendations for improvement on physical activity indicators for children and youth (0 to 17 years old). In 2014, the Report Card process was replicated in 14 additional countries, constituting the Global Matrix 1.0, opening the door to standardized international comparisons. Following the release of the Global Matrix 1.0, the Active Healthy Kids Global Alliance (AHKGA, www.activehealthykids.org), a network of researchers, health professionals and stakeholders working together to advance physical activity in children and youth from around the world, was created. The AHKGA led the development of the Global Matrix 2.0, involving the replication of the Report Card process in 38 countries. The Global Matrices highlighted strengths, disparities, inequities, research and surveillance gaps, and showed that no participating country had all the solutions to tackle the physical inactivity issue. The initiative facilitated the cross-fertilization of innovative solutions for countries with low grades to learn from those with high grades in particular areas/indicators. In November 2018, the Global Matrix 3.0, involving the concurrent development of Report Cards with 10 common physical activity indicators from 49 countries was released at the Movement to Move event in Adelaide, Australia.

The aim of this dissertation was to investigate how the Global Matrix initiative has contributed to global childhood physical activity promotion. To achieve this goal, the history of the development process from the Global Matrix 1.0 to Global Matrix 3.0 was detailed and explained; correlates of the physical activity grades from the Global Matrix 3.0 and trends of the physical activity grades over time were studied; the international impact of the past editions of the Global Matrices and Report Cards were assessed using both quantitative and qualitative methods;

and an evaluation of the Global Matrix 3.0 process from its development to its launch was performed and analyzed to formulate recommendations for future editions.

The report of the development process history from Global Matrix 1.0 to Global Matrix 3.0 showed that the Global Matrix of physical activity grades for children and youth has experienced great expansion since its creation. Despite the great variability of the data (e.g., in terms of benchmarks, measurement instruments, age range, sample size, quality, quantity) informing the grades between the countries for each indicator, the participation of 49 countries in the Global Matrix 3.0 allowed studying the potential associations between the childhood physical activity indicator grades and potential correlates with greater statistical power than in the past. A significant negative correlation was observed between the Overall Physical Activity indicator and several sociodemographic indicators including the Human Development Index (HDI) and Gross National Income per capita. Higher behavioural grades and lower sources of influence grades were generally observed in the low and medium HDI countries, whereas lower behavioural grades and higher sources of influence grades were observed for the very high HDI countries, and generally low average grades for each indicator in the high HDI countries. The Global Matrix 3.0 provided new evidence showing that the situation regarding the physical activity of children and youth is a universal concern worldwide. A case study of the 2018 French Report Card is provided, and the characteristics of the physical activity grades within the very high HDI countries were explored in greater detail. The Report Cards and the Global Matrices had demonstrable impact on the promotion of children's physical activity globally, in various ways. The international comparisons of physical activity indicators from 49 countries highlighted disparities, inequities, remaining research and surveillance gaps, and contributed to raising awareness, cross-fertilizing successes, and stimulating policy and practice changes to promote physical activity within and across jurisdictions. In addition, the evaluation of the impact of the Report Cards and the Global Matrix projects showed that they have initiated a movement

worldwide that is contributing to decrease surveillance gaps in childhood physical activity indicators. Finally, the evaluation of the Global Matrix 3.0 allowed for the identification of strengths and areas for improvement in the Global Matrix approach and to formulate recommendations for future editions of the Global Matrix.

The work presented in this thesis shows that the Report Cards and Global Matrices contributed to advancing knowledge concerning the characteristics of physical activity in terms of behavioural and sources of influence physical activity indicators for children and youth at the global level. Findings from the Global Matrix 3.0 highlighted the need for strategic public investments to implement effective interventions within families, communities, and schools to increase physical activity opportunities for all children. The need for the development and international adoption of standardized methods to conceptualize and measure the 10 physical activity indicators was also emphasized in this work. Finally, this thesis demonstrated that this international initiative has the potential to raise awareness concerning the physical inactivity issue, facilitate the development of new physical activity data collection protocols, and support the development of physical activity promotion policies, even among countries with low quality or missing data.

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List of Abbreviations

AHKC: Active Healthy Kids Canada

AHKGA: Active Healthy Kids Global Alliance

AP: Active Play

AT: Active Transportation

AVG: Average

CDC: Centers for Disease Control and Prevention

CHEO: Children's Hospital of Eastern Ontario

CHMS: Canadian Health Measures Survey

COM: Community and Environment

CSEP: Canadian Society for Exercise Physiology

DEDIPAC: Dedicated Diet and Physical Activity Knowledge Hub

ELANS: Latin American Study of Nutrition and Health

ENERGY: EuropeaN Energy balance Research to prevent excessive weight Gain among Youth

ESTEBAN: French Health Study of the Environment, Biosurveillance, Physical Activity, and Nutrition

EYHS: European Youth Heart Study

FAM: Family and Peers

GAPA: Global Advocacy for Physical Activity

GAPPA: Global Action Plan for Physical Activity

GDP: Gross Domestic Product

GII: Gender Inequality Index

GHO: Global Health Observatory

GNI: Gross National Income

GOV: Government

GSHS: Global School-based student Health Survey

HALO: Healthy Active Living and Obesity research group

HBLPY: Health Behaviour and Lifestyle of Pacific Youth

HBSC: Health Behaviour in School-aged Children

HDI: Human Development Index

HELENA: Healthy Lifestyle in Europe by Nutrition in Adolescence

HICs: High-Income Countries

ICAD: International Children's Accelerometry Database

IDEFICS: Identification and prevention of Dietary- and lifestyle-induced health EFfects In Children and infantS

INC: Incomplete

INCA3: French National Study of Individual Nutritional Consumption 3

IPAQ-A: modified International Physical Activity Questionnaire for Adolescents

IPEN: International Physical Activity and the Environment Network

ISAAC: International Study of Asthma and Allergies in Childhood

ISCOLE: International Study of Childhood Obesity, Lifestyle and the Environment

ISPAH: International Society of Physical Activity and Health

JPAH: Journal of Physical Activity and Health

LICs: Low-Income Countries

LMICs: Low-Middle-Income Countries

METs: Metabolic Equivalents

MVPA: Moderate- to Vigorous-intensity Physical Activity

N/A: Not Applicable

NA = Not Assigned

NCDs: Non-communicable Diseases

OECD: Organisation for Economic Co-operation and Development

ONAPS: Observatory for Physical Activity and Sedentary Behaviors

PA: Physical Activity

PAFCTYS: Physical Activity and Fitness in China—The Youth Study

PE: Physical Education

PeNSE: National Adolescent School-based Health Survey from Brazil

PF: Physical Fitness

SB: Sedentary Behaviors

SCH: School

SD: Standard Deviation

SDGs: Sustainable Development Goals

SES: Socioeconomic Status

SEYLE: Saving and Empowering Young Lives in Europe

SP: Organized Sport and Physical Activity

SUNRISE: International Surveillance Study of 24-hour movement behaviours in the Early Years

TBD: to be determined

UN: United Nations

UNESCO: United Nations Educational Scientific and Cultural Organization-UNESCO

UNICEF: United Nations Children's Fund

USD: United States Dollars

USEN: French Surveillance and Nutritional Epidemiology Unit

WHO: World Health Organization

YRBS: Youth Risk Behavior Survey

Preface

This dissertation is submitted for the degree of Doctor of Philosophy at the University of Ottawa. The work included herein was conducted between September 2015 and August 2019 under the supervision of Doctor Mark Tremblay, Director of the Healthy Active Living and Obesity Research Group (HALO), Children's Hospital of Eastern Ontario (CHEO) Research Institute, Ottawa, Canada.

This dissertation should be of interest to researchers interested in contributing to the development of a Report Card on the physical activity for children and youth in their country, and in participating to the Active Healthy Kids Global Alliance (AHKGA) Global Matrix initiative. This work should also be of interest to guide the future decisions of the Active Healthy Kids Global Alliance Board of Directors, to support future grant applications related to the Report Cards of the Global Matrix initiatives, and to inform physical activity behaviour promotion and surveillance program development.

During this work I was supported, in part, by two MITACS scholarships, through a partnership with the not-for-profit organisation ParticipACTION, by the HALO, and by the AHKGA.

Chapter 1: Introduction

Physical inactivity is a leading risk factor for global mortality in adults, along with high blood pressure, tobacco use, and high blood glucose, and ahead of overweight and obesity.[1] In 2008 physical inactivity was estimated to be responsible for 9% of premature mortalities or more than 5.3 million deaths worldwide.[2] Based on these statistics, physical inactivity has been described as one of "*the biggest public health problems of the 21st century*".[3,4] The most recent global prevalence of physical inactivity (i.e., not meeting physical activity guidelines) was estimated to be 27.5% for adults (≥ 18 year-olds)[5] and 81% for youth (11- to 17 year-olds).[6] Some studies have shown that individuals who engaged in low levels of physical activity during childhood were more likely to continue these behaviours into adulthood, and more likely to become adults with obesity.[7,8] There has also been an overall diminution in cardiorespiratory fitness in children and adolescents since 1975,[9] yet performance on the 20m shuttle run test was found to be favorably associated with indicators of adiposity and some indicators of cardiometabolic health.[10] These findings provide compelling evidence that a significant increase in premature disease and disability can be anticipated across the globe if the physical inactivity crisis is not addressed.[11]

In response to growing concern of physical inactivity in children, the Report Card on Physical Activity for Children and Youth was created in Canada in 2005. The Report Card is a document available to the general population, reporting letter grades, updated scientific information, research gaps, and recommendations for improvement on physical activity indicators for children and youth (0 to 17 years old). For this first edition, grades were available for 14 common indicators: three daily behaviours (i.e., Physical Activity/Inactivity level, Screen time, and Sport Participation), nine settings and sources of influence (i.e., Family: Family Physical Activity, and "Ensuring Kids are Active"; Community Environment: Access to and Quality of Programs, and Community Infrastructure; School: Daily Physical Education, Trained Personnel, and School-

based Physical Activity Opportunities; and Policy: Federal Strategies and Investment, and Provincial/Territorial/Municipal Strategies and Investment) and two health indicators (i.e., Overweight/Obesity, and Chronic Disease Risk Factors).

In 2014, the Report Card process was replicated in 14 additional countries, constituting the Global Matrix 1.0,[12] opening the door to standardized international comparisons. Following the release of the Global Matrix 1.0 at the Global Summit on Physical Activity for Children in Toronto, the AHKGA (www.activehealthykids.org), a network of researchers, health professionals and stakeholders who are working together to advance physical activity in children and youth from around the world, was created. The AHKGA led the development of the Global Matrix 2.0,[13] this time involving the replication of the Report Card process in 38 countries, that was released in 2016 in Bangkok, Thailand. The Global Matrices highlighted strengths, disparities, inequities, research and surveillance gaps, and showed that no participating country had all the solutions to tackle the physical inactivity issue. The initiative facilitated the cross-fertilization of innovative solutions for countries with low grades to learn from those with high grades in particular areas/indicators. In May 2018, the AHKGA became an incorporated not-for-profit organization to facilitate its activities. In November 2018, the Global Matrix 3.0, involving the concurrent development of Report Cards with 10 common physical activity grades in 49 countries was released at the Movement to Move event in Adelaide, Australia.

The aim of this dissertation was to investigate how the Global Matrix initiative is contributing to global childhood physical activity promotion. To achieve this goal, the history of the development process from the Global Matrix 1.0 to Global Matrix 3.0 was detailed and explained; correlates of the children and youth physical activity grades from the Global Matrix 3.0 and trends of the physical activity grades over time were studied; the international impact of the past editions of the Global Matrices and Report Cards were assessed using both quantitative

and qualitative methods; and an evaluation of the Global Matrix 3.0 from its development to its launch was performed and analyzed to formulate recommendations for future editions.

1. Thesis Overview and Research Questions

This PhD thesis aimed to examine a large international research and data synthesis initiative to address the following specific questions:

a. How has the development process from Global Matrix 1.0 evolved to today?

The Global Matrix of physical activity grades for children and youth has experienced great expansion since its creation. The development process history from Global Matrix 1.0 to Global Matrix 3.0 and an analysis of their content is described and explained to chronicle the evolution.

b. How do the report card grades vary across countries and why?

The participation of 49 countries in the Global Matrix 3.0 allowed studying the potential associations between the childhood physical activity indicator grades and potential correlates with a greater statistical power than in the past. It was hypothesized that the physical activity grades would be associated with socio-demographic indicators (i.e., Human Development Index (HDI), Gross National Income per capita, public health expenditure, Gender Inequality Index (GII), life expectancy at birth, mean years of schooling, Gini index, Global Food Security Index, child poverty rate, urban population percentage, population density, summer Olympic medal count) and environmental indicators (i.e., improved drinking water coverage, distance from equator). A case study of the 2018 French Report Card is provided, and the characteristics of the physical activity grades within the very high HDI countries were explored in greater detail. The three Global Matrix time points (2014, 2016, 2018) available for the physical activity grades allowed studying trends of the physical activity grades over time. It was expected that the physical activity grades would be stable globally over that short period of time, but some positive or negative trends might be observed at the country or continental level.

c. What has been the international impact of the Global Matrices and country Report Cards?

It was hypothesized that the Report Cards and the Global Matrices had measurable impact on the promotion of children's physical activity globally, in various ways. It was expected that the international comparisons of physical activity indicators from 49 countries would highlight disparities, inequities, remaining research and surveillance gaps, and contribute to raise awareness, cross-fertilize successes, and stimulate policy and practice changes to promote physical activity within and across jurisdictions. It was anticipated that there would be a number of success stories reported related to these international projects in terms of capacity building and creation of interventions and policies for the promotion of childhood physical activity. In addition, it was expected that the evaluation of the impact of the Report Cards and the Global Matrix projects would show that they have initiated a movement worldwide that is contributing to decrease surveillance gaps in childhood physical activity indicators.

d. What can we learn from the Global Matrix 3.0 evaluation to further advance global childhood physical activity promotion efforts in the future?

The evaluation of the Global Matrix 3.0 was based on the collection of both objective and subjective indicators that reflected on the process, the impact, and the outcomes of this international project. It was hypothesized that several process indicators such as the responsiveness, engagement, and organization of the country participants would contribute to explaining the positive and negative outcomes of the Global Matrix 3.0. The reports of the Global Matrix methods over time and the findings from the Global Matrix 3.0 evaluation led to the creation of recommendations for future editions of the Global Matrix.

2. Dissertation Organization and Outline

This dissertation is organized in an article format, following the University of Ottawa dissertation guidelines. A brief overview of each chapter is presented below:

- Chapter 1 briefly introduces this dissertation and presents its research questions, organization and conceptual framework.
- Chapter 2 provides a review of the literature that presents the current state of physical activity surveillance for children and youth globally, the key and emerging issues for the future, and some recommendations for research and practice. This is a book chapter entitled *Global Surveillance of Physical Activity of Children and Youth* that is currently under editor's review for publication in *The Handbook of Youth Physical Activity* by Routledge Publishers.
- Chapter 3 describes the evolution of the Global Matrix methods over three time points (Global Matrix 1.0, 2014; Global Matrix 2.0, 2016; Global Matrix 3.0, 2018).
- Chapter 4 is the first manuscript of this dissertation, entitled *Results from France's 2018 Report Card on Physical Activity for Children and Youth*. This article presents a short summary of France's 2018 Report Card findings. It was published online in November 2018 in the *Journal of Physical Activity and Health* along with similar articles from all 49 participating countries.
- Chapter 5 is the second manuscript of this dissertation entitled *France's 2018 Report Card on Physical Activity for Children and Youth: Results and International Comparisons*. This article was accepted for publication in the *Journal of Physical Activity and Health*. It provides a more thorough examination of France's 2018 Report Card findings and comparisons of France's Report Card grades with other Global Matrix 3.0 country grades.
- Chapter 6 is the third manuscript of this dissertation entitled *Global Matrix 3.0 Physical Activity Report Card Grades for Children and Youth: Results and Analysis from 49*

Countries. This article was published in November 2018 in the *Journal of Physical Activity and Health*.

- Chapter 7 is the fourth manuscript of this dissertation entitled *Report Card Grades on the Physical Activity of Children and Youth Comparing 30 Very High Human Development Index Countries*. This article was published in November 2018 in the *Journal of Physical Activity and Health*.
- Chapter 8 is the fifth manuscript of this dissertation entitled *The International Impact of the Active Healthy Kids Global Alliance Physical Activity Report Cards for Children and Youth*. This article was published in September 2019 in the *Journal of Physical Activity and Health.*
- Chapter 9 is the sixth manuscript of this dissertation entitled *Evaluation of the Global Matrix 3.0 of Physical Activity Grades for Children and Youth: Methods, Findings, and Recommendations*. This is article is currently submitted for publication in the *Journal of Exercise Sciences and Fitness*.
- Chapter 10 is the final chapter of this dissertation. It provides the general discussion including the strengths and limitations and the recommendation for the development of the future Global Matrices.

3. Conceptual Framework

A conceptual model describing the relationships among health-related fitness, physical activity, and health was published by Bouchard and Shephard in 1994.[14] A modified version of this model, presented in Figure 1, was created by Lang et al. to be adapted to the pediatric population.[15]

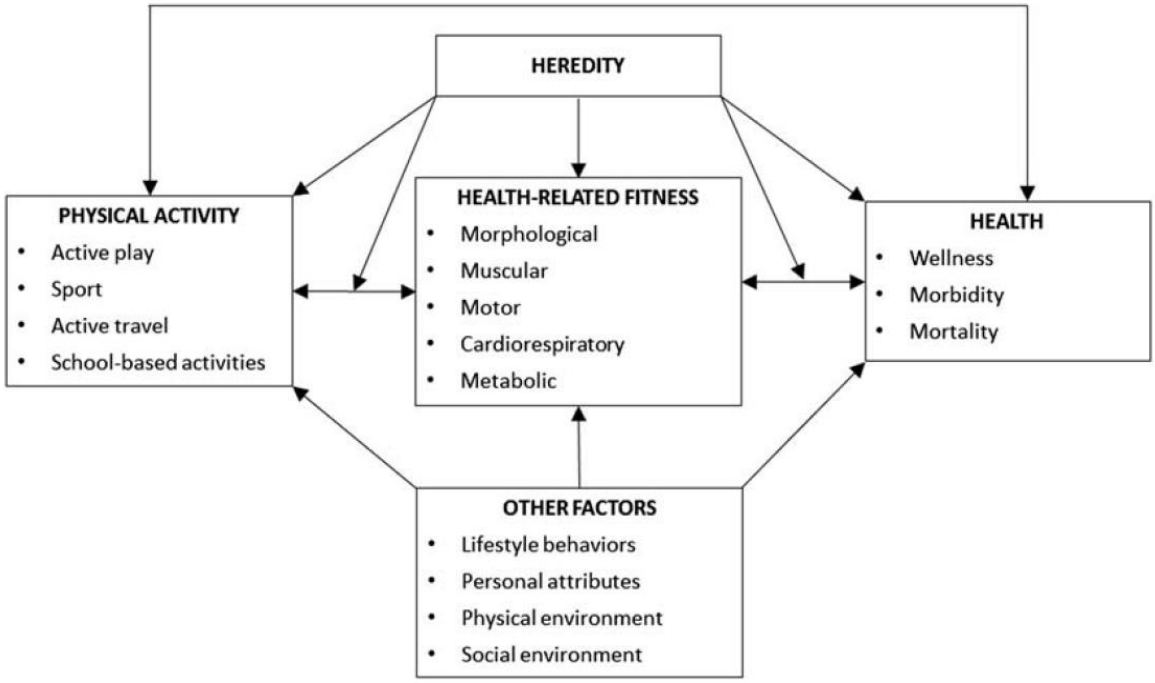

Figure 1: Modified version of Bouchard and Shephard's health-related fitness, physical activity, and health model.[15] Copyright © 2018 Wolters Kluwer Health, Inc., used with permission.

Physical activity of children and youth is described in this model as a behaviour that takes place during active play, organized sport, active transportation, and opportunities occurring at school such as physical education. The health-related fitness indicators such as muscular strength, motor ability, and cardiorespiratory fitness are bi-directionally associated with physical activity behaviours.[15] For example, a significant positive association between total physical activity and cardiorespiratory fitness was found by Ruiz et al. in a cross-sectional study of 780 children aged 9 to 10 years.[16] A low to moderate relationship was also found between physical activity and other health-related fitness characteristics among children and youth at the population level.[17–20]

The health indicators used in this model – wellness, morbidity and mortality – as well as lifestyle related non-communicable diseases (NCDs) are not commonly studied in the pediatric population.[15] But the relationships between physical activity and health indicators in school-aged

children and youth have been studied in several recent systematic reviews.[17,18] Overall, physical activity was found to be associated with numerous health benefits that were more consistent and robust for higher intensity activity.[17,18] The relationship between the 20 m shuttle run performance – a progressive cardiorespiratory fitness test where children and youth are asked to run laps back and forth between two parallel lines 20 m apart - and health indicators among children and youth has also been studied in a recent systematic review.[10] The authors found that 20 m shuttle run performance was favourably associated with indicators of adiposity, and some indicators of cardiometabolic, cognitive, and psychosocial health in boys and girls.

Physical activity, health-related fitness, health, and their mutual relationships are influenced by heredity. It is also recognized that, in the pediatric population, health, physical activity, and physical fitness are also influenced by lifestyle behaviours such as sedentary behaviour[21–27] and sleep.[23,25–28] Finally, health, physical activity, and physical fitness are also impacted by other factors such as personal attributes (e.g., sex, age, genetics), the physical environment (e.g., availability of green space and playgrounds, urban density, pollution), the social environment (e.g., parent support, peer's interest in physical activities), and local norms and policies (e.g., speed limits in residential areas, physical education curricula).[29–31]

The Global Matrix 3.0 is an international research synthesis project that is guided by the framework of the modified version of Bouchard and Shephard's health-related fitness, physical activity, and health model.[15] In the Report Cards of physical activity grades for children and youth, representing the best and most recent available evidence are compiled and analyzed to grade the physical activity of the children and youth at a national level.[32] Based on this approach, ten common indicators were assessed to better understand the characteristics and context of the physical activity of children and youth: physical activity and its main sub-sections (i.e., organized sport participation, active play, active transportation), physical fitness, and other factors of

influence (i.e., sedentary behaviours, family and peers, school, community and the built environment, and government strategies and investments).

The Global Matrix is guided by three of the principles from the Toronto Charter: building capacity and support training in research, practice, policy, evaluation and surveillance (guiding principle 5); addressing environmental, social and individual determinants of physical inactivity (guiding principle 3); and ensuring cultural sensitivity and adapting strategies to accommodate various 'local realities', contexts and resources (guiding principle 8).[33] The Global Matrix is the main activity of the AHKGA, a not-for-profit organization incorporated in Canada. AHKGAs mission is to be committed to powering the global movement to get kids moving through thought leadership, knowledge translation and mobilization, capacity building, and advocacy. This will be facilitated by sustainable partnerships and cross-sectoral collaborations that enable best-practice exchanges, networking and cross-fertilization.

The development and the publication of the individual country Report Cards and the Global Matrices aimed to facilitate capacity building among the involved researchers and stakeholders, decrease surveillance gaps and increase understanding of childhood physical activity, and create relevant networks and partnerships. It is hoped that in the longer term, AHKGA activities will contribute to the creation of relevant policy actions for the promotion of physical activity in various contexts to help attain the third global target of the Action Plan for the Global Strategy for the Prevention and Control of NCDs: "a 10% relative reduction in prevalence of insufficient physical activity".[34]

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Chapter 2: Review of the Literature

This book chapter has been written and formatted following the publication standards of *The Routledge Handbook of Youth Physical Activity,* which is being edited by Dr Timothy Brusseau, Dr Stuart Fairclough, and Dr David Lubans. It appears in its submitted format.

Title:

Global Surveillance of Physical Activity of Children and Youth

Citation:

Aubert S, González SA, Manyanga T, Tremblay MS. Global Surveillance of Physical Activity of Children and Youth. Submitted in: *The Routledge Handbook of Youth Physical Activity*. Abingdon: Routledge; 2020.

This book chapter presents some of the available global and national surveillance systems, their findings, and highlights the needs for their improvement. It is a narrative review of the available information and scientific knowledge that informed part of the work presented in this dissertation. I am the primary (first) author on this chapter. I lead the conception of the outline of this chapter in consultation with Silvia González, Taru Manyanga, and my supervisor. Once the outline was approved by the editors, I drafted the first two parts ("Overview" and "Current State of Surveillance"); and I distributed the responsibilities to draft sub portions of the last two parts ("Key/Emerging Issues for the Future" and "Recommendations for Research and Practice") among Silvia González, Taru Manyanga, and me. All co-authors contributed significantly and met the International Committee of Medical Journal Editors guidelines for authorship. They all edited the manuscript for content and approved the final version of the manuscript before it was submitted for editor review. I handled the revisions suggested by the editors, and this chapter is now re-submitted, waiting for final approbation and editorial formatting.

Global Surveillance of Physical Activity of Children and Youth

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Overview

1. Concepts and key terms

The benefits of physical activity for the health of individuals of all ages and for the health of the societies are now well recognized by the international scientific community. Physical inactivity is identified as the fourth leading risk factor for global mortality (World Health Organization, 2009). Consequently, surveillance of physical activity/inactivity is important for understanding the scope and distribution of the public health impact, and informing and assessing future strategies and interventions.

Taking into account the benefits of physical activity in the global context of increasing rates of non-communicable diseases (NCDs) (World Health Organization, 2018e), estimating what proportion of the population is active (i.e., is meeting the recommended amount of physical activity) is of obvious importance. This is achieved through physical activity surveillance. In public health, surveillance is defined as the "ongoing, systematic collection, analysis, and interpretation of outcome-specific data for use in the planning, implementation, and evaluation of public health practice" (Thacker & Berkelman, 1988). Based on this definition, the surveillance of physical activity encompasses the collection, analysis and interpretation of physical activity data, including the complexities of this behavior, in order to assess the physical activity status of populations, identify trends in the levels of physical activity, evaluate policies and interventions, define priorities in physical activity promotion and identify potential areas of further investigation. Therefore, the objective of the global surveillance of physical activity of children and youth is to estimate the prevalence of (in)active children and youth worldwide.

2. Physical activity measurement methods

Physical activity surveillance relies on objective (directly measured) and subjective (reported) measurement methods for the assessment of physical activity among children and youth. Objective

methods of assessing physical activity include measures based on energy expenditure or oxygen uptake (Schutz et al, 2001), heart rate monitoring (Schutz et al., 2001), and motion sensors using accelerometry (Schutz et al., 2001) or pedometers measuring step counts (Lubans et al., 2015). Despite providing more accurate measures of movement, motion sensors, like accelerometers, have several limitations: 1) Accelerometry data do not provide information about the type of activity or the context in which it is performed (Fulton & Carlson, 2012); 2)The different available cut-points to estimate the intensity of physical activity measured with accelerometers produce different conclusions about the proportion of individuals meeting physical activity guidelines, and there is a lack of consensus on cut-points selection (Migueles et al., 2018); 3) Objective monitoring of physical activity at the population level may not be a feasible approach for several low- and middle-income countries (LMICs) because of the associated costs, logistic challenges, and expertise required (Lee & Shiroma, 2014).

Subjective measurement of physical activity involves quantitative, qualitative and/or descriptive recall of active behaviors through the use of interviews, questionnaires or surveys, and diaries or logs. With these methods, the physical activities of a past period of time (e.g., previous week) are reported by children and youth, or by a proxy (e.g., parent, teacher, coach). While objective methods provide a more valid estimation of the physical activity of individuals but are costly, time consuming, and more invasive; subjective methods are less valid, and tend to provide an overestimation of physical activity levels, but they enable collection of physical activity data among large study samples at low cost and provide details characterizing the activity (Sallis & Saelens, 2000; Sylvia et al., 2014). The surveillance of the physical activity of children and youth at the population level is challenged by this trade-off between accuracy and feasibility. Questionnaires are today the most commonly used tools to evaluate physical activity at the population level (Ainsworth et al., 2015).

A thorough presentation and discussion of physical activity measurement procedures and techniques is provided in Section D, chapters 14-19.

3. International calls for action and the need for surveillance

Over the past few decades, insufficient levels of physical activity have been observed internationally among children and youth (Boothet et al., 2015; Brodersen et al., 2007; Dollman et al., 2005; Guthold et al., 2018; Kalman et al., 2015), raising concerns for their general health and for the future prevalence of NCDs. In response to this concerning global public health situation, in 2010, the Global Advocacy for Physical Activity (Titze & Oja, 2013), Council of the International Society of Physical Activity and Health (ISPAH) developed the *Toronto Charter for Physical Activity* (Bull et al., 2010). The *Toronto Charter* is a global call to strive for greater political and social commitment to support health-enhancing physical activity for all countries, regions and communities, and an advocacy tool that outlines four actions based upon nine guiding principles for a population-based approach to support health-enhancing physical activity for all (Bull et al., 2010). The concerted actions for successful population change include: implementing a national policy and action plan, introducing policies that support physical activity, and reorienting services and funding to prioritize physical activity and develop partnerships for action. The *Toronto Charter* specifically encourages countries and organizations to build capacity and support physical activity surveillance processes.

One year later, the United Nations (UN) hosted a high-level meeting of the General Assembly to discuss the prevention and management of NCDs. In their declaration, the UN acknowledged that the global burden of NCDs is a major threat to the global economy and leads to increasing social inequalities, so is a major threat to global development (United Nations, 2012). The UN stated that it is the responsibility of governments and the international community to promote focused efforts and to engage all sectors of society to address the common risk factors of NCDs including physical inactivity. The UN underlined the importance for Member States to continue addressing common risk factors for NCDs through the implementation of the *World Health Organization (WHO)'s 2008–2013 Action Plan for the Global Strategy for the Prevention and Control of NCDs* and to monitor and report on progress (World Health Organization, 2008).

The *Action Plan for the Global Strategy for the Prevention and Control of NCDs* was re-edited by the WHO with new goals and targets for 2013-2020 (World Health Organization, 2013). The new action plan has six main objectives: raise the priority for prevention and control of NCDs; strengthen national capacity, leadership, governance, multi-sectoral action and partnerships; reduce modifiable risk factors and underlying social determinants; promote and support high quality research and development; monitor trends and determinants of NCDs; and evaluate progress. Additionally, this action plan has nine main targets to achieve by 2020, which include a global relative reduction of 10% in the prevalence of insufficient physical activity levels.

During the historic UN Summit on September 25th, 2015 in New York (USA), world leaders adopted a set of *Sustainable Development Goals* (SDGs) to end all forms of poverty, fight inequalities and tackle climate change, while ensuring that no one is left behind as part of a new global sustainable development agenda. The 17 SDGs, which are divided into 169 specific targets, are aimed to be achieved over the next 15 years (United Nations, 2015), the progress of which requires valid and reliable surveillance.

Building on those SDGs, the *Bangkok Declaration on Physical Activity for Global Health and Sustainable Development* was launched in Bangkok at the 2016 ISPAH Congress (ISPAH, 2016). The *Bangkok Declaration* was developed by delegates, ISPAH members and Congress co-hosts, and provides a new position statement on the importance of physical activity for global health, the prevention of NCDs, and how the co-benefits of population-based actions on physical activity can contribute to achieving eight of the 17 SDGs. The *Bangkok Declaration* calls upon governments, policy-makers, donors and stakeholders including the WHO, UN, and all relevant non-governmental organizations to contribute to the achievement of these targets by following the guiding principles and recommendations. This requires appropriate surveillance.

The *Report of the Commission on Ending Childhood Obesity* was also built on the UN SDGs. The *Commission on Ending Childhood Obesity* was created in 2014 by the WHO in order to better inform and fashion a comprehensive response to childhood obesity. The Commission published a report in 2016, including a set of recommendations to successfully tackle childhood and adolescent obesity in different contexts around the world, after consultation with over 100 WHO Member States and comments by nearly 180 online reviewers. One of the six main recommendations is to "*implement comprehensive programmes that promote physical activity and reduce sedentary behaviors in children and adolescents*" (World Health Organization, 2016).

In response to the 17 UN SDGs and the *Bangkok Declaration on Physical Activity for Global Health and Sustainable Development*, the WHO published in 2018 a *Global Action Plan on Physical Activity 2018-2030* (World Health Organization, 2018a). This *Action Plan* is designed to provide guidance to support the implementation of national multi-sectoral physical activity actions that leverage the links and benefits to sectors beyond health, to national economic and sustainable development. Four strategic objectives (1. creating an active society, 2. creating active environments, 3. creating active lives, and 4. creating active systems) and a specific target of a 15% relative reduction in the global prevalence of physical inactivity in adults and adolescents using a baseline of 2016 were formulated in this *Action Plan*. Enhancing data systems and capabilities at national levels to support regular population surveillance of physical activity, across all ages and multiple domains was identified as one of the strategic actions to reach these objectives.

Within this rich tapestry of international calls for action, the global surveillance of physical activity plays a crucial role. Besides being one of the priority actions for most of these documents, it provides evidence to inform the assessment of the achievement of goals and objectives.

Current State of Surveillance

1. Global physical activity guidelines for children and youth

The WHO recommends that children and youth aged 5–17 years should accumulate at least 60 minutes of moderate- to vigorous-intensity physical activity (MVPA) daily, consisting mostly of aerobic physical activity, and including vigorous-intensity activities, and activities that strengthen muscle and bone at least three times per week (World Health Organization, 2010).

Furthermore, the WHO physical activity guidelines for the early years (0-4 years) (World Health Organization, 2019) state that:

- Infants (less than 1 year) should be physically active several times a day in a variety of ways, particularly through interactive floor-based play; more is better. For those not yet mobile, this includes at least 30 minutes in prone position (tummy time) spread throughout the day while awake;
- Children 1-2 years of age should spend at least 180 minutes in a variety of types of physical activities at any intensity, including MVPA, spread throughout the day; more is better;
- Children 3-4 years of age should spend at least 180 minutes in a variety of types of physical activities at any intensity, of which at least 60 minutes is MVPA, spread throughout the day; more is better.

A thorough presentation and discussion of physical activity recommendations and guidelines is provided in Chapter 5.

2. Available international surveillance surveys and studies

Implementing and effectively monitoring progress towards benchmarks set out in the various global calls to action requires systematic and standardised surveillance systems. To this end, frameworks such as the WHO STEPwise approach to NCD risk factor surveillance (World Health Organization, 2017)

have helped to track the prevalence of physical activity among children and youth worldwide. The use of standardised surveys (e.g., the Modified International Physical Activity Questionnaire for Adolescents (IPAQ-A) (Hagströmer et al., 2008), the Global school-based Student Health Survey (GSHS) (World Health Organization, 2018c), Health Behaviour in School-Aged Children (HBSC) survey (Roberts et al., 2009) can facilitate international comparisons. Although standardized surveillance of physical activity among children and youth has substantially increased in the recent past, gaps exist especially in LMICs and physical activity trend data are scarce (Hallal et al., 2012). *Table 1* presents results from a scoping review that identified 14 international surveillance systems or studies. These international surveillance systems collected physical activity data using standardized methods across three or more countries over the past 20 years.

To the best of our knowledge, most of the international data on the physical activity of children and youth comes from specific studies rather than a given physical activity surveillance system. The GSHS, developed by and part of the WHO STEPwise framework, is the most widely adopted surveillance system, with a total of 98 countries having physical activity data available, obtained in a standardized manner (World Health Organization, 2018c). Six international surveys only focus on European and North American countries (Ahrens et al., 2011; Garaulet et al., 2011; McMahon et al., 2017; Riddoch et al., 2005; C. Roberts et al., 2009; van Stralen et al., 2011), and six others have more geographically distributed study sites across the world (Anderson et al., 2017; International Physical Activity and the Environment Network, 2017; Katzmarzyk et al., 2013; Strachan et al., 2017; University of Wollongong, 2019; World Health Organization, 2018c). Of the two remaining surveys, one focuses on Latin American countries (Fisberg et al., 2015), and the other one on three South Pacific countries (Phongsavan et al., 2005). A large majority of these international surveys (n = 12/14) collected physical activity data on children and youth aged between 10 and 18 years-old, while 3 surveys included 6-9-year-old children, and only two included children below 5 years-old. Only one of these surveys (HBSC) has an officially established frequency of data collection (every four years) (Roberts et al., 2009) and data collection in two other international surveys (GSHS and IPEN) are resource dependent (Centers for Disease Control

and Prevention, 2016; International Physical activity and the Environment Network, 2015). The majority of these international surveys are cross-sectional, designed for respondents to answer specific questions at a given time and without any longitudinal follow-up. Finally, self or proxy reported physical activity data were collected among seven international surveys (Anderson et al., 2017; McMahon et al., 2017; Phongsavan et al., 2005; Roberts et al., 2009; Strachan et al., 2017; van Stralen et al., 2011; World Health Organization, 2018c), objectively measured data using accelerometers were collected in the samples or subsamples of three of these surveys (Ahrens et al., 2011; Riddoch et al., 2005; University of Wollongong, 2019), and five collected both objective and subjective (reported) data (Fisberg et al., 2015; Garaulet et al., 2011; International Physical Activity and the Environment Network, 2017; Katzmarzyk et al., 2013; University of Wollongong, 2019).

3. National surveys and surveillance systems

In some countries, physical activity monitoring has been a priority and has been successfully implemented in regular surveillance systems. In the following paragraphs we describe a few examples of good quality surveillance systems that have provided not only national data, but also have been recommended as a reference for other countries to model their own surveys.

Youth Risk Behavior Surveillance System (YRBSS)

Developed in 1990, and implemented since 1991, the YRBSS is a nationally representative school-based surveillance system for the United States (Fulton & Carlson, 2012; U.S. Centers for Disease Control and Prevention, 2018a). Informed by multiple sources of data, such as ongoing surveys conducted every 2 years, one-time national surveys, special population surveys and methods studies, the main objective of YRBSS is to determine the national prevalence and trends of key health risk behaviors among high-school students (grades 9 to 12) (Centers for Disease Control and Prevention, 2013). The surveys are conducted by the Centers for Disease Control and Prevention (CDC) and by education and health agencies. The system monitors six categories of health behaviors associated with the leading

causes of morbidity and mortality in youth and young adults from the United States, one of which is physical inactivity (U.S. Centers for Disease Control and Prevention, 2018a). This standardized survey provides comparable data at the national, state, territorial tribal and local levels (Fulton & Carlson, 2012) and is used to monitor the progress toward achieving national health related goals, like the Healthy People Objectives (US Department of Health and Human Services, n.d.). The questionnaires used in the YRBSS were developed by a steering committee that included scientific experts from federal agencies, academic institutions and survey experts from the CDC (Centers for Disease Control and Prevention, 2013). Questionnaires have marginally evolved over time to include adjustments in wording and design to provide better data according to the surveillance priorities. The specific component on physical activity currently includes questions that assess: a) the frequency of engagement in minimum 60 minutes of MVPA in the last 7 days; b) frequency of engagement in muscle strengthening in the last 7 days; c) participation in Physical Education classes; d) involvement in sports teams in the last year; and e) frequency of concussions from playing sports or being active in the last year (U.S. Centers for Disease Control and Prevention, 2018b). In order to ensure the harmonization of the surveys, a handbook and technical assistance are provided by the CDC to each of the study-sites (Centers for Disease Control and Prevention, 2013). Besides the contribution to the US surveillance of physical activity, YRBSS instruments have been adapted and widely used by several countries for the assessment of physical activity (Aubert et al., 2018; González et al., 2018).

Canadian Health Measures Survey (CHMS)

This survey was developed in response to the lack of comprehensive population-representative health measures in Canada, and to the need for surveillance of public health indicators to follow-up program and policy initiatives (Tremblay et al., 2007). Statistics Canada, in partnership with Health Canada and the Public Health Agency of Canada, and in consultation with a team of experts from multiple sectors, spent 3.5 years in the design of this nationally representative survey, with the aim to contribute direct physical measures to advance the Health Information Roadmap Initiative in the country

(Canadian Institute for Health Information, 2000). Conducted in two-year cycles, since 2007, the CHMS has several objectives, among those, the most relevant for the topic of this chapter is to estimate the prevalence, distribution and trends of certain health-related conditions, like physical activity. The survey comprises a household questionnaire and objective measurements at a mobile examination center and includes a nationally-representative sample of Canadian people between 6 and 79 years old. The physical activity component for children and youth includes physical activity questions (self-reported for ages ≥12 years or reported by the parents for <12 years) and objective measures with accelerometry. A standardized accelerometry protocol was implemented for the monitoring of physical activity for seven days, using *Actical* accelerometers, on the right hip. The physical activity variables assessed in CHMS include: a) adherence to physical activity recommendations; b) average minutes of MVPA per day; c) adherence to the Canadian 24-Hour Movement Guidelines for Children and Youth (Tremblay et al., 2016); d) amount of hours of physical activity at the school environment; e) sports participation in the last year; f) active play participation per week; and g) active travel participation and time in the last seven days (Roberts et al., 2017).

National Adolescent School-based Health Survey from Brazil (PeNSE)

Developed since 2004 as part of the Brazilian Surveillance of Risk and Protective Factors for Chronic Diseases, PeNSE is a nationally-representative school-based survey. The design was led by the Secretary of Health Surveillance of the Ministry of Health, and brought together a group of experts from different academic institutions (Oliveira et al., 2017). This survey has been conducted every three years since 2009, by the Ministry of Health and the Brazilian Institute of Geography and Statistics, with support of the Ministry of Education from Brazil and currently is already part of the national surveillance agenda (Oliveira et al., 2017). Since 2015, PeNSE includes the school-enrolled population between 13 to 17 years, from public and private schools, in the morning and afternoon shifts, and from urban and rural areas. In the previous versions only 9th grade students were involved. This change in the sampling was implemented in order to improve the comparability of data at the international level (Oliveira et al.,

2017). The objective of PeNSE is to monitor risk and protective factors related to the health of Brazilian adolescents, and it is one of the main sources of information to track public policies targeted at this population. The data from this survey is representative of the 13 to 17 year-old students in the 26 state capitals of the five Brazilian macro-regions and Brazil (Oliveira et al., 2017). The survey comprises two components, one questionnaire about the school environment administered to the school principal, and one student's questionnaire. Each of these has a specific component of physical activity. The school questionnaire assesses the available infrastructure for physical activity, and the student's questionnaire assesses the practice of physical activity in the previous seven days and the attendance to Physical Education classes at least twice per week in the previous seven days. The questionnaires were adapted from the GSHS (World Health Organization, 2018c) and the YRBSS (U.S. Centers for Disease Control and Prevention, 2018b). In order to ensure the quality and comparability of data, standardized training and supervision to the local teams are regularly conducted during the data collection (Oliveira et al., 2017).

4. Global initiatives

In response to the global physical inactivity pandemic (Kohl III et al., 2012), research experts, policy makers and other stakeholders with an interest in promoting physical activity, have been mobilising and establishing initiatives that are designed to systematically compile and synthesize the best available evidence on the levels of physical activity. These initiatives are helping to further our collective understanding of the extent of global physical inactivity, expose data gaps, and identify the most urgent research, interventions or policy needs. The initiatives include, but are not limited to, the Global Matrix on Physical Activity of Children and Youth (Aubert et al., 2018; Tremblay et al., 2016; Tremblay et al., 2014), WHO Global Health Observatory (GHO) (World Health Organization, 2018b), physical activity factsheets (World Health Organization, 2018f), and the Dedicated Diet and Physical Activity Knowledge Hub (DEDIPAC Determinants of diet & physical activity, 2016b). Details about each of these initiatives are presented in *Table 2*. These initiatives necessarily involve partnerships, enlist experts from multiple jurisdictions and follow harmonized protocols. The initiatives' particular strength is their adherence to

harmonized protocols, reliance on similar appraisal of data either from standalone studies or national surveys, and the collective critical evaluation and interpretation of these data by teams of experts. The involvement of local experts (Active Healthy Kids Global Alliance, 2018; ISPAH, 2019) in collating and appraising the best available evidence, including unpublished data, theses and reports, bypasses the academic purity and 'gatekeeping' of relying on mostly peer-reviewed literature, and doing so without compromising the quality of the reported findings. This is arguably an innovative approach because it can potentially reduce the publication bias that might arise from the high rejection of articles from LMICs which would have relied on limited and less robust data. Furthermore, the consensus building and consultations among teams of experts during the appraisal and interpretation of data enables them to be thorough, thus formulating recommendations and producing reports that could paint a more complete picture of the status of physical activity in each of the involved countries.

5. Global prevalence of physical (in)activity among youth

Major relevant findings publicly available from the international surveys and global initiatives previously presented are summarized by categories of interest in this section. When necessary, the presented information was completed with results from specific countries.

Early years (0-4 years)

- IDEFICS study: Objective data from eight European countries collected in 2007-2010 show that on average, 2.0–2.9 year-olds (boys and girls) engaged in 24 minutes of MVPA per day, 3.0–3.9 year-olds engaged in 27 (girls) to 34 (boys) minutes of MVPA per day, and 4.0-4.9 year-olds engaged in 33 (girls) to 42 (boys) minutes of MVPA per day (Konstabel et al., 2014).
- ICAD study: The physical activity level of the 3-4 year-old children included in the objective accelerometry data pooled from 11 countries in 2008-2010 were not clearly reported (Cooper et al., 2015).

- Physical Activity Factsheets: In 2015, only four of the 28 European Union countries reported physical activity prevalence data on children aged under 5 years. Their data were not able to estimate intercountry comparisons as the country studies used different methods (World Health Organization Regional Office for Europe, 2015).
- International standardized data on the physical activity of the children younger than 5 years are lacking. It is, however, encouraging that a new international physical activity surveillance system targeting specifically this population, and involving objective measurement of physical activity, the SUNRISE study, is currently under development.

Children and youth (5-17 years)

- HELENA study: In a 10-European country sample (n = 2,200; 1,184 girls), objectively measured data in 2006-2008 indicated that 41.0% of 12.5–17.5 year-old adolescents met the recommended 60 minutes of MVPA daily (Ruiz et al., 2011).
- SEYLE study: In a 10-European country sample (n = 11,072), self-reported physical activity data collected in 2009-2012 indicated that 13.6% of 14 and 16 year-olds were engaging in 60 min of physical activity everyday (McMahon et al., 2017).
- WHO GHO: Globally in 2010, more than 80% of school going adolescents aged 11-17 years were estimated to be insufficiently physically active (World Health Organization, 2018b).
- Global Matrix 3.0: In 2018, the average grade for the Overall Physical Activity indicator in 49 countries from 6 continents was a "D", which corresponds to an estimation of 27%–33% of children and youth meeting the physical activity guidelines.

The estimated prevalence of children and youth meeting the WHO physical activity guidelines (World Health Organization, 2019) varies depending on the source of data; however, the proportion of children and youth sufficiently active is consistently low across international data.

Sex/gender differences

- HBLPY surveys: Data collected in Pohnpei, Tonga, and Vanuatu in 2000-2001 indicated that among 13-year-old children, 50.5% (Vanuatu) to 71.7% (Tonga) of boys and 29.8% (Vanuatu) to 44.2% (Tonga) of girls declared exercising at least two times per week outside school hours; and 27.4% (Vanuatu) to 33.5% (Pohnpei) of boys and 16.4% (Vanuatu) to 20.3% (Tonga) of girls declared exercising at least two hours per week outside school hours (Phongsavan et al., 2005). Similarly, the same data indicated that among 15-year-old children, 58.2% (Vanuatu) to 69.2% (Tonga) of boys and 32.9% (Pohnpei) to 37.5% (Vanuatu) of girls declared exercising at least two times per week outside school hours; and 33.5% (Pohnpei) to 40.6% (Tonga) of boys and 17.3% (Pohnpei) to 23.6% of girls (Vanuatu) declared exercising at least two hours per week outside school hours (Phongsavan et al., 2005).
- HBSC: In physical activity data from 32 participating countries, 23.1% of boys and 14.0% of girls reported at least 60 min of MVPA daily (odds ratio/95% confidence interval: 0.546/0.537–0.554) (Kalman et al., 2015). Gender differences were significant in most countries across all age groups (Kalman et al., 2015).
- HELENA study: In Europe, objectively measured data in 2006-2008 indicated that 56.8% of boys vs 27.5% of girls met the recommended 60 minutes of MVPA daily ($p<0.001$) (Ruiz et al., 2011).
- ICAD study: Objective accelerometery data pooled from 11 countries in 2008-2010 indicated that among 5–17 year-olds, 9.0% of boys and 1.9% of girls achieved the WHO physical activity recommendations (Cooper et al., 2015).
- IDEFICS study: Objective data from eight European countries collected in 2007-2010 among 2 to 9 year-old children showed that 2.0% (Cyprus) to 14.7% (Sweden) of girls, and 9.5% (Italy) to 34.1% (Belgium) of boys were meeting the recommended 60 minutes of MVPA daily (Konstabel et al., 2014).

- ICAD study: Objective accelerometry data pooled from 11 countries in 2008-2010 indicated that on average, activity levels among boys were 0.45 standard deviations higher than in girls at age 9–10 years and 0.66 standard deviations higher at age 12–13 years. There was no country in which this difference was not significant (Cooper et al., 2015).
- SEYLE study: In a 10-European country sample (n = 11,072), self-reported physical activity data collected in 2009-2012 indicated that 17.9% (boys) and 10.7% (girls) of 14 and 16 year-olds reported engaging in 60 min of physical activity everyday (McMahon et al., 2017).
- WHO GHO: Globally, in 2010, among 11-17 year-old children and youth, it was estimated that the prevalence of adolescents meeting the minimum WHO recommended activity levels was higher for boys (ranging from 9.0% to 35.4%) than for girls (7.4% to 20.4%) (World Health Organization, 2014).

An alarming difference between girls and boys is consistently observed among 5-17 year-old children around the world.

Age differences

- ICAD study: Every year increase in age was associated with a relative reduction in mean vigorous-intensity physical activity of 6.9% (95% CI 6.2%, 7.5%) and in mean moderate-intensity physical activity of 6.0% (95% CI 5.6%, 6.4%) (Corder et al., 2016). The age-related difference in vigorous-intensity physical activity was substantially attenuated, but remained significant, when adjusted for moderate-intensity physical activity (Corder et al., 2016).
- EYHS: Objectively measured physical activity data from three European countries (Denmark, Estonia, Portugal) among 9 (n = 1,008) and 15 year-old (n = 738) children and youth show that 15 year-old adolescents spent a significantly lower amount of time engaging in low ($p < 0.001$) and moderate ($p < 0.001$) physical activity (the time engaging in vigorous physical activity was stable between the two age groups) (Ekelund et al., 2007).

- HBSC surveys: Self-reported physical activity data from 2013-2014 were analyzed from 15 countries (n = 61,329) and indicated that more 11 (25.2%; 95% confidence interval [24.5%, 25.8%]) and 13 year-olds (19.8%; 95% confidence interval [19.3%, 20.3%]) met the WHO's physical activity guidelines than 15 year-olds (14.8%; 95% confidence interval [14.3%, 15.3%]) (Ng et al., 2017).
- CHMS survey: Accelerometry data collected on a nationally representative sample of the Canadian population aged 6 to 19 years showed that the amount of MVPA and average steps per day were decreasing as age category increased (Colley et al., 2011).

Temporal trends

- HBSC: Overall, in countries and regions across Europe and North America, a small increase in the proportion of boys and girls aged 11–15 years who met the current physical activity recommendations was observed between 2002 and 2010 but these positive trends were not consistent in all countries (Kalman et al., 2015). Many countries reported increasing (n = 16) or stable levels (n = 7) of physical activity, however the proportion of adolescents achieving the WHO's physical activity guidelines decreased in nine countries (Kalman et al., 2015).
- According to objectively measured data from European countries, there is evidence of little or no significant change in overall physical activity among children and adolescents. Pedometer-derived data from Sweden comparing the number of steps per day between 2000 and 2008 did not find any changes over time. Similarly, a comparison of accelerometer data from Denmark (EYHS study) between 1997-1998 and 2003-2004, did not find apparent changes in the average counts per minute of boys and girls. A study from Czech Republic, comparing the proportion of adolescents achieving the recommended 11,000 steps per day in 1998 and 2010 found a decline among boys (68% to 55%), but no changes were observed among girls (75% to 74%) (Booth et al., 2015).

- Canadian Report Card: Temporal trend analysis of the Canadian Report Card's physical activity indicators over 12 years (2005-2016) indicated that most physical activity behaviors (overall physical activity, active transportation, sedentary behaviors) among children and youth have not improved since 2005 (Barnes & Tremblay, 2017).

Geographic variation

- HBSC: Self-reported data from 32 countries in Europe and North America indicate that 23.4% of children were active in 2010. However, there was some variability between countries indicating higher proportions of children meeting the guidelines in Ireland (34.4%), United States (32.6%), Austria (30.5%), Spain (29.9%) and Finland (29.7%), and the lowest proportions in Italy (10.7%), Denmark (14.3%), Sweden (15.6%), Russia (16.1%) and Estonia (16.6%) (Kalman et al., 2015).
- ICAD study: Results obtained with accelerometry indicate a low proportion of children meet physical activity guidelines in all the involved countries. However, the highest proportions of children meeting the guidelines were found in Norway and Estonia, and the lowest were from the United States and the East of England (Cooper et al., 2015).
- ISCOLE study: Objectively measured data of 10 year-old children from 12 countries found that the average MVPA per day varied from 45 minutes per day in China to 71 minutes per day in Kenya and Finland (Katzmarzyk et al., 2015).
- Global Matrix: In 2018, most of the working groups from Asia, Europe North and South America, and Oceania reported "D" or "F" grades (which corresponds to 0-39% of children and youth meeting the WHO's physical activity guidelines) for the Overall Physical Activity indicator, while the majority of the working groups from Africa assigned "C" grades (which corresponds to 40-59% of children and youth meeting the WHO's physical activity guidelines) (Aubert et al., 2018). These results, presented in *Figure 1*, are consistent with the previous Global Matrices published in 2014 and 2016 (Tremblay et al., 2016; Tremblay et al., 2014).

Different patterns are observed between studies and this could be attributed to the different approaches used to measure physical activity. Several international studies and initiatives including both objectively and subjectively measured physical activity data indicate that that children and youth are more active in countries from Africa and Northern/Eastern Europe, while they are less active in North America, the United Kingdom, China, and India; however the opposite was observed in the HBSC surveys.

Socioeconomic variation

- HBSC: Across all European and North American countries combined, children with higher Family Affluence Scale scores were more likely to meet the physical activity recommendations than children with low Family Affluence Scale scores (Kalman et al., 2015).
- Global Matrix 3.0: Distinct letter grade differences were observed for the Overall Physical Activity indicator between the low and medium Human Development Index (HDI) countries and the two other HDI groupings. The average grade for the low and medium HDI countries was "C-", whereas both the high and very high HDI countries obtained an average of "D-," which could represent a difference of 14% to 26% of children and youth meeting the physical activity guidelines.(Aubert et al., 2018) In addition, a significant low negative correlation was observed between the Overall Physical Activity indicator and several sociodemographic indicators including the HDI ($r = -.30$, $P < .05$) and the growth national income per capita ($r = -.33$, $P < .05$) (Aubert et al., 2018).
- ISCOLE study: Objectively measured physical activity data from 9–11 year-old children (n = 4,752) and self-reported parental education level data collected in 12 countries around the world indicated that relationships between maternal and paternal education and child physical activity appear to be related to the developmental stage of different countries. Significant negative associations between parental education and child physical activity were observed in lower economic status countries, and positive non-significant associations between parental

education and child physical activity were observed in high income countries (Muthuri et al., 2016).

The presented findings from these international physical activity data align with the recognized influence of the socioeconomic factors on the physical activity of children and youth. More research is needed to explore this relationship; however, available evidence shows that economic factors influence the physical activity of children and youth at two levels - national and individual. Overall, the observed children and youth physical activity levels are higher in low-income countries. Within LMICs, individual socio-economic indicators seem to be negatively associated with physical activity behaviors while the opposite is observed within high-income countries.

Special population data/issues

- TEENS study: In 2012-2013, 67% of 8-12-year-old children diagnosed with type 1 diabetes spent at least 30 min doing any physical activities or exercise3-7 times per week (against 33% who did 30 min of exercise 0-2 times per week) (Anderson et al., 2017). In 2012-2013, 62% of 13-18 year-old children diagnosed with type 1 diabetes spent at least 30 min doing any physical activities or exercise per week 3-7 times per week while 38% did 30 min of exercise 0-2 times per week (Anderson et al., 2017).
- YRBS: Self-reported data collected in 2011 among ≤12, 13, 14, 15, 16, 17, and ≥18 year-old students (n = 9,775) indicated that youth with a disability (n =1,986) were less likely to participate in 60 minutes of physical activity at least 5 out of 7 days/week (prevalence = 38% vs 52%, respectively; odds ratio = 0.5; 95% confidence interval: [0.4–0.6]) (Papas et al., 2016).
- HBSC surveys: Self-reported physical activity data were analyzed from 15 countries that included the same questions on long-term illnesses or disabilities (LTID) in their 2013/2014 surveys (n = 61,329). Overall, boys with LTID (23.4% meeting the physical activity guidelines) were significantly less likely (odds ratio = 0.89, 95% confidence interval = [0.81-0.98]) to meet the recommendations than boys without LTID (24.6% meeting the physical activity guidelines). The

difference among girls with LTID (16.6 % meeting the physical activity guidelines) and without LTID (15.4 % meeting the physical activity guidelines) were not significant (Ng et al., 2017).

- HBSC surveys: Self-reported physical activity data collected in Finland during 2002, 2006, 2010, and 2014 showed that among adolescents with LTID, the proportion of those physically active in 2014 was higher than in 2002 for girls (15.6% vs 8.7%) and boys (26.6% vs 13.0%) (Ng et al., 2016).
- Global Matrix: The Netherlands developed a 2017 Report Card focusing on physical activity indicators for children and youth with disabilities or chronic diseases. In 2017, only 26% of the Dutch youth with a chronic disease or disability met the current national physical activity guidelines (Burghard, de Jong, Vlieger, & Takken, 2018).

The evaluation of physical activity levels of specific populations, including children and youth with disabilities or chronic diseases, aboriginal children and youth, and immigrant children and youth is lacking globally.

Key/Emerging Issues for the Future

1. Lack of standardization and validation of measurement of physical activity

Despite the global attention on the need for the promotion of physical activity and systematic surveillance, levels of physical inactivity remain high (Guthold et al., 2018). While there is general consensus for making physical activity surveillance a global priority (World Health Organization, 2008), several challenges need to be addressed for current and future initiatives to be successful. Policies, action plans, proposals, and interventions must be anchored in the cultural and contextual realities of each region and acknowledge the complexities and the myriad of factors that may threaten progress. The lack of standardized and validated global surveillance tools for physical activity creates a predicament for accurate comparisons but also presents an opportunity for the development, trial and implementation of universal surveillance mechanisms. Without standardized surveillance systems, the existing and urgent

research gaps, including the lack of accurate global prevalence estimates of physical activity, will be difficult to fill. At present, although data for younger children may exist in some high-income countries (HICs) (Kalman et al., 2015), where country-specific surveys are used, most progress in the global surveillance of physical activity levels has been made for older children and adolescents (11-17 years old) because of data obtained from the GSHS and/or the HBSC surveys (Hallal et al., 2012). Without assessing their universal validity and reliability, the country-specific surveys that are used to obtain data for younger children cannot be adopted in other regions or countries where contexts and cultures may be different. Moreover, a systematic review published in 2010 that evaluated measurement properties of most available questionnaires for children found none that had both acceptable reliability and validity, and therefore proposed to improve and evaluate those with the most promise in multiple high-quality studies (Chinapaw et al., 2010).

Despite the reported increase in physical activity surveillance in middle- but not low-income countries (LIC), there still is lack of policy implementation and an absence of meaningful increases in the trends in global physical activity (Sallis et al., 2016). In many LMICs, the dearth of surveillance data can partly be attributable to the lack of validated surveillance tools, infrastructure, resources and technical capacity. Also, for some countries that have joined international surveillance systems, like the WHO GSHS, the samples studied are not nationally representative. The concern about inadequate physical activity surveillance and a lack of standardized surveillance systems that are adapted to national contexts was recently reiterated as an urgent global necessity (Aubert et al., 2018). Furthermore, there is significant heterogeneity in the definitions of key indicators that are relevant for the accurate surveillance of physical activity. For example, there is lack of consensus on how to assess key indicators of physical activity among children and youth such as active transportation, physical education attendance and active play (Aubert et al., 2018; Kohl III et al., 2012; M. S. Tremblay, Barnes, et al., 2016; Tremblay et al., 2014). Efforts for consensus and standardization in the approach to assess these indicators can lead to better comparisons and could increase the opportunities to learn from the experiences of countries that are succeeding in the promotion of physical activity in different domains. Currently, most of the physical

activity interventions involve different sectors, and actions at multiple levels. Consequently, global surveillance systems should incorporate a socioecological framework that monitors indicators at the individual, family/social, school, community and policy levels (Ding, 2018; Fulton & Carlson, 2012; Kohl III et al., 2012). The resulting data from this comprehensive approach could greatly contribute to the design and improvement of programs and interventions.

2. Research gaps

Trends data

Systematic surveillance of the physical activity of children and youth is still emerging or at very early stages in many countries. It is only recently that it has been prioritized, explaining the absence of continuous surveillance systems (Hallal et al., 2012; Kohl III et al., 2012) particularly in LMICs in sub-Saharan Africa and other resource-limited parts of Latin America and central Asia (Kohl III et al., 2012). The absence of continuous surveillance of physical activity levels for children and youth explains why there is such a lack of trend data to monitor the progress in physical activity promotion. In fact, the most recent estimates of global trends of physical activity in LICs, was based on data from only one country (Benin) (Guthold et al., 2018). In addition, existing surveillance initiatives designed for the assessment of trends in health behaviors, such as the GSHS, have not been regularly administered in some countries due to a combination of insufficient funds, staff turnover, or other in-country barriers (Centers for Disease Control and Prevention, 2016).

Physical activity in children under 10 years

Despite the importance of physical activity in the early years, surveillance of physical activity for younger children, particularly those in LICs is limited (Sallis et al., 2016; Tremblay et al., 2014). This absence could be due to a lack of valid and reliable questionnaires (Chinapaw et al., 2010). Additionally, it has been reported that less progress has been made in the population-level assessment of physical activity in young people because few countries have surveillance systems covering ages 5–18 years (Bull

et al., 2017). As part of the surveillance in the early years, future research should incorporate a 24-hour movement behaviors approach in order to better understand the health-related movement behaviors in this age group, and to guide the promotion of healthy development and growth (Tremblay et al., 2016).

Surveillance of physical activity in vulnerable groups

There is an absence of global surveillance data on the physical activity levels and opportunities for being active for children belonging to vulnerable groups, like children and youth with disabilities, immigrants and refugees, and children from rural communities and ethnic minorities. To the best of our knowledge, these particularly vulnerable groups have not been specifically included or prioritized in global surveillance initiatives (Aubert et al., 2018; Tremblay et al., 2016; Tremblay et al., 2014). Considering the benefits of physical activity for these populations, it is essential to include and accommodate them in the global surveillance agenda. A good example of the assessment of physical activity levels and opportunities for children with disabilities is the 2017 Dutch Report Card+ on Physical Activity, which is focused on the youth population living with a chronic disease or disability (Burghard et al., 2018). This initiative could guide efforts at the global level to provide a better understanding of the physical activity status of this population.

Characteristics of specific behavioral indicators

As recognized in the Global Matrix initiative and the Report Cards on Physical Activity (Aubert et al., 2018; Tremblay et al., 2016; Tremblay et al., 2014), organized sport and physical activity, active play and active transport are behaviors that contribute to the overall physical activity levels of children and youth. Certain progress on the assessment of these indicators has been made along the three versions of the Global Matrix initiative (Aubert et al., 2018; Tremblay et al., 2016; Tremblay et al., 2014). However, further research and standardization of the following elements is desirable to improve the comparability of data and provide a better perspective of the current situation of physical activity among children at the global level: 1) Details of the frequency, duration and intensity of physical activity associated with the practice of sports or organized physical activities (Aubert et al., 2018; Tremblay et al.,

2016); 2) Contextual information about the provision of sports and organized physical activity opportunities (i.e., equitable access, private clubs vs. public programs) (Aubert et al., 2018; Tremblay et al., 2016); 3) Definition development as well as valid and reliable measurements to assess active play (Aubert et al., 2018; Tremblay et al., 2016) 4); Dose and characteristics of the engagement in active transportation (Aubert et al., 2018); 5) Variation of the dose of active behaviors in and out of school, on school days versus non-school days, and over the four seasons of the year; 6) Variation of the dose of active behaviors in relation to individual characteristics (level of income, education level of parents, religion, ethnicity).

Standardized surveillance on multiple-level sources of influence

As suggested by the socioecological framework of active living, there are multiple levels of influence on physical activity (Sallis et al., 2006). While there is broad evidence that supports the importance of family and peers, school, community, built environment and policy environment on the physical activity of children and youth, there is a lack of standardization on practical and informative indicators to assess these influences (Aubert et al., 2018; Tremblay, Barnes, et al., 2016; Tremblay et al., 2014). There is also a lack of multi-sectoral approaches to surveillance, and limited national data on key macro-level indicators among the sources of influence, such as government support, infrastructure, impact evaluation and implementation monitoring of current policies and programs (Aubert et al., 2018; Ding, 2018; Tremblay et al., 2016).

Lack of data in LMICs

The lack of infrastructure and paucity of data in LMICs are research gaps that have been universally identified as urgent issues for accurate global estimates of physical activity and promotion, but progress to fulfil this need has been slow (Hallal et al., 2012; Sallis et al., 2016). As part of the Lancet series on physical activity, Sallis et al. reported an improvement from their 2012 data, noting an increase in the overall number of countries with data, a wider range in age groups of adolescents covered and a larger proportion of the adolescent population covered (Sallis et al., 2016). The fact that systematic

surveillance of physical activity has been steadily improving is encouraging. However, it is important to note that although the proportion of countries contributing surveillance data from adolescents increased in most world regions, this was not the case in Africa and Southeast Asia (Sallis et al., 2016). Therefore, despite the improvement in availability of data overall, LICs contributed the least (Sallis et al., 2016). Moreover, assessment methods in LMICs are reported to be weak, not tailored to local contexts, and most of the countries lack clear plans for resource mobilization to enable scaling up of interventions (Sallis et al., 2016). A synthesis of surveillance data for physical activity levels among children and youth from nine LMICs (Manyanga et al., 2018) revealed a glaring lack of data on most of the key indicators in these countries. The limited available data from these countries were mostly self-report, from small samples and often non-representative samples. The findings showing lack of data from the nine LMICs (Manyanga et al., 2018) are in line with the observation made by Sallis and associates in the Lancet series (Sallis et al., 2016). Without data, accurate estimates and comparisons across regions are difficult to make. In addition, lack of comparable data makes global intervention initiatives difficult to plan, implement and monitor.

Research devoted to surveillance improvement

There is need for research that can help improve global and national surveillance of physical activity across all ages, and abilities, including testing of new technologies and wearable devices, and methodologies for harmonization of data (World Health Organization, 2018a).

3. Reporting, knowledge translation, and accountability

There is need for globally accepted and standardized reporting and accountability protocols that countries can follow in order to have meaningful progress in the global surveillance and promotion of physical activity among children and youth. However, reaching consensus and standardizing these reporting and accountability protocols may be challenging. Potential points of contention could range from the common indicators to monitor and regularly report on, acceptable quality of data to be used, reporting schedules and methods of reporting. An additional challenge may be the availability of funding

for reporting and the capacity for effective knowledge translation. To facilitate accountability and regular reporting of progress, individual countries could develop and implement national surveillance systems and policy evaluation protocols that conform to established global frameworks and initiatives such as the WHO STEPwise approach (World Health Organization, 2017), the GAPPA (World Health Organization, 2018a), and the Global Matrix initiatives (Aubert et al., 2018; Tremblay et al., 2016; Tremblay et al., 2014). Individual countries could design and concurrently disseminate physical activity promotion plans such as those proposed by global agencies. For example, countries that have limited or no data to inform key indicators of physical activity among children and youth and participate in the Global Matrix Initiative, could develop and implement complete surveys to inform grades for their Report Cards as was done in Thailand (Amornsriwatanakul et al., 2016). These surveys could be adapted from already existing instruments.

National dissemination and promotion activities should be provided in simple and accessible language, deliberately designed to have a wide reach. For promotional activities, countries could adapt media tool kits from global initiatives such as the Global Matrix (Aubert et al., 2018), GAPPA (World Health Organization, 2018a), and other media campaign strategies covering print, audio-visual media, well as social media.

4. Issues of competing priorities

The combination of limited resources and lack of political will, as well as competing needs, are challenges that are omnipresent and often cited as reasons for lack of dedicated resource allocation to physical activity promotion in most LMICs. Due to lifestyle transitions that have been accelerated by rapid urbanization and industrialization, many LMICs face the dual burden of communicable and NCDs. LMICs, especially those in sub-Saharan Africa, still face a huge disease burden from infectious and other enteral diseases (Agyepong et al., 2018). In these countries, allocating the already limited resources to programs that promote physical activity in priority over communicable diseases or other needs will likely

attract criticism, which policy makers may not be willing to accept. Moreover, given that the mortality, morbidity and healthcare costs associated with physical inactivity do not manifest immediately, it makes for an even harder sell to prioritize. For example, despite evidence of huge direct and indirect healthcare costs of physical inactivity including loss of productivity and a decrease in life expectancy (Ding Ding et al., 2016), governments and policy makers in LMICs have not demonstrated a commitment to prioritizing systematic surveillance of physical activity and interventions. This is especially important given the evidence showing that although HICs bear the largest proportion of the economic burden caused by NCDs, LMICs have a larger proportion of the disease burden (Ding Ding et al., 2016). The disproportionate burden of disease caused by NCDs affecting LMICs, the lack of political will, and the seeming ambivalence by policy makers to urgently prioritize physical activity surveillance including resource allocation may alienate potential allies with whom reliable and enduring partnerships could be established. Furthermore, there is limited capacity development in some LMICs, thus, a lack expertise in physical activity research. Without experts who can develop robust surveillance systems and confidently argue for more resource allocation using empirical evidence, physical activity surveillance will continue to lag behind.

Recommendations for Research and Practice

1. Need for consensus in the surveillance methods

A possible way to address the lack of standardized instruments may involve an approach similar to the one used in the development of 24-hour movement behavior guidelines (Tremblay et al., 2016). Such an approach could involve combinations of a Delphi process and systematic reviews to gather evidence on all existing surveillance instruments. Once synthesized, common items from each of the instruments could be combined, adding some new items that are adapted to be context and culturally specific. The new instrument would then be pilot-tested, revised and implemented. Comprehensive global surveillance instruments must have items that assess all domains (e.g., occupational/school-based, leisure, household,

travel) and not just leisure-time physical activity. In addition, the following characteristics recommended in the Guidelines for Evaluating Surveillance Systems by the Centers for Disease Control and Prevention (Centers for Disease Control (CDC), 1988), should be taken into account, and consensus about the balance of these attributes should be reached (Fulton & Carlson, 2012).

- Simplicity: Surveillance systems should be as simple as possible in their structure and ease of operation.
- Flexibility: Ability to adapt to changes in the information needs, for example, changes in the definition of cut-points to define active populations. It is desirable that the surveillance instruments allow to re-calculate and adjust estimates as needed.
- Acceptability: Reflects the willingness of individuals to participate in the surveillance system.
- Sensitivity: Ability of the system to accurately measure the outcome of interest.
- Representativeness: Ability of the system to accurately reflect the characteristics of the outcome of interest over time and its distribution in the population.
- Timeliness: Reflects the desired time interval for the availability of the information under surveillance.
- Cost: Resources required to operate the surveillance system.

There is need to exploit the momentum and focused global attention created by the several and repeated global calls for action. To this end, it is critically important to develop partnerships and coalitions of willing entities such as those identified by Kohl and others (Kohl III et al., 2012). These partnerships can serve as the basis to establish cohesive leadership which can organize the various regional physical activity networks, and focus all surveillance research, policy and practices.

2. Suggestions for surveillance across a range of resource availability contexts

In order to advance in the goal of having comparable estimates of physical activity levels and determinants at a global level, the following recommendations can be useful to guide emerging surveillance initiatives in diverse contexts:

- Whenever possible, physical activity should be approached as a standalone priority in the surveillance agenda. A surveillance system specifically devoted to physical activity could contribute to assess behaviors and determinants in a more comprehensive way. In countries where physical activity is still not a priority for the surveillance agenda, a first step can be to include key indicators, like the proportion of children meeting physical activity guidelines, in other public health surveillance systems. Also, it is important to make visible the lack of data and the importance of its availability to make governments and surveillance-related stakeholders aware of the importance of having effective surveillance systems.
- In countries where physical activity surveillance is emerging and data are still limited, secondary data could help to inform environmental and policy indicators that can be relevant for the study of physical activity determinants. Examples of secondary data that could be used for global surveillance is the Worldwide Survey of School Physical Education conducted by UNESCO (United Nations Educational Scientific and Cultural Organization-UNESCO, 2014), the Multiple Indicator Cluster Survey from UNICEF (United Nations Children's Fund UNICEF, 2019), or environmental data collected with Geographic Information Systems at the global level (Fulton & Carlson, 2012).
- While new and standardized tools are developed, countries can adopt surveillance tools that are being used in similar contexts. Multi-country studies that assess physical activity with multiple measurements, like ISCOLE (Katzmarzyk et al., 2013) represent an opportunity for LMICs to conduct ancillary validity and reliability studies about the instruments used.

- To help fill the data gaps, it is imperative for LMICs to identify and support local researchers who can champion and advocate for the systematic surveillance of physical activity from within their countries. Networking with leaders from countries with more experience in surveillance, could lead to fruitful partnerships and opportunities to optimize resources (e.g., workshops for capacity building and agreements between institutions for accelerometer or other devices lending libraries).

Summary

The glaring physical inactivity crisis among children and youth and the global calls to action implore us to prioritize systematic surveillance of physical activity. Given the concerning levels of inactivity among children and youth, the importance of dependable and durable global surveillance systems cannot be over emphasized. Global surveillance systems should carefully balance feasibility and validity. This chapter presents some of the available global surveillance systems and highlights the needs for improvement of the physical activity surveillance systems which mostly focus on older children and adolescents, lack standardization and are not conducted regularly. Surveillance data are especially scarce for physical activity trends over time, vulnerable populations and in resource-limited LMICs.

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Tables

Table 1: International studies and surveillance systems of physical activity in children and youth.

Name	Location	Target population*	Frequency	Description
EuropeaN Energy balance Research to prevent excessive weight Gain among Youth (ENERGY) project	Seven European countries (Belgium, Greece, Hungary, the Netherlands, Norway, Slovenia, and Spain)	Pupils in the final years of primary education (aged 10–12 years)	No established frequency, data were collected once in 2010	The ENERGY project was a school-based cross-sectional survey aiming to provide prevalence of measured overweight, obesity, engagement in energy balance related behaviors, and blood-sample biomarkers of metabolic function; and to identify personal, family-environmental and school-environmental correlates of these energy balance related behaviors. Physical activity was assessed by self-report questionnaire measuring the dose (frequency and duration) of active transportation and organized sport, and accelerometers in a subsample (van Stralen et al., 2011).
European Youth Heart Study (EYHS)	Denmark (Odense), Estonia (Tartu), Norway (Oslo), and Portugal (Madeira)	9- and 15-year-old children and youth	No established frequency, data were collected once in 2010	The EYHS was an international multi-center cross-sectional survey focusing on the issue of cardiovascular disease risk factors in children. It investigated a wide range of factors that might influence the progression of CVD risk factors in children. Physical activity was measured objectively using accelerometers worn for four consecutive days, including two weekdays and two weekend days (Riddoch et al., 2005).

Global School-based Student Health Survey (GSHS)	Datasets currently available for 98 countries from Africa (17), Eastern Mediterranean Region (19), Europe (2), Latin America and the Caribbean (30), South East Asia (9), and Western Pacific Region (21)(World Health Organization, 2018d)	13–17-year-old students	No established frequency, participating countries are encouraged to collect data as often as resources allow them	The GSHS is a relatively low-cost school-based survey using a self-administered questionnaire to evaluate young people's health behavior and protective factors related to the leading causes of morbidity and mortality among children and adults worldwide. Physical activity is measured by three items evaluating the frequency of physical activity, active transportation, and physical education (World Health Organization, 2018c).
Health Behaviour in School-Aged Children (HBSC) Survey	48 countries and regions across Europe and North America(HBSC, 2018)	11-, 13-, and 15-year-old school students	Every four years since 1982	HBSC is a school-based survey existing for over 30 years, where data are collected through self-completion questionnaires administered in the classroom. Physical activity is measured using one item evaluating the frequency of moderate-to-vigorous physical activity and two items evaluating the frequency of vigorous physical activity (C. Roberts et al., 2009).
Health Behaviour and Lifestyle of Pacific Youth (HBLPY) surveys	Vanuatu, Tonga and Pohnpei (an island of the Federated States of Micronesia)	11-, 13-, and 15-year-old school students	No established frequency, data were collected in 2000-2001	The aim of the study was to collect population-based data on a range of health-related practices, lifestyles and physical and social environments among school-age students and out-of-school youth. Physical activity was measured using the 2000 version of the HBSC questionnaire (Phongsavan et al., 2005).

Healthy Lifestyle in Europe by Nutrition in Adolescence (HELENA)	10 European cities in Austria, Belgium, France, Germany, Greece, Hungary, Italy, Spain and Sweden	12.5–17.5-year-old adolescents	No established frequency, assessment occurred between 2006 and 2008	The HELENA study is a cross-sectional survey that aimed to evaluate the nutritional and health status in European adolescents. Physical activity was assessed by both objective (accelerometers worn for seven consecutive days) and self-reported methods (using the International Physical Activity Questionnaire for Adolescents) (Garaulet et al., 2011).
Identification and prevention of Dietary- and lifestyle-induced health EFfects In Children and infantS (IDEFICS)	Eight European countries (Sweden, Germany, Hungary, Italy, Cyprus, Spain, Belgium and Estonia)	2–9-year-old children	Baseline survey at T0 (between September 2007 and May 2008), follow-up survey 2 years later at T1 (September 2009 to May 2010); evaluation of the sustainability of the intervention at T2 (September 2010 to November 2010)	IDEFICS is a cohort study that started in 2006 and ended in 2012. It focused on exploring the risks for overweight and obesity in children as well as associated long-term consequences. Physical activity was objectively monitored over three days using accelerometers (Ahrens et al., 2011).
International Physical Activity and the Environment Network (IPEN)	In 2014, data collection was completed in eight countries, under completion in six countries, and under planning in two countries(International Physical activity and the Environment Network,	12–17-year-old secondary school students	No established frequency, participating countries are encouraged to collect data as often as resources allow them	The primary aim of IPEN is to estimate strengths of association between detailed measures of the neighborhood-built environment with leisure physical activity, active transportation, and Body Mass Index in all participants, based on self-report survey data collected according to a common protocol. Physical activity is measured by self-completed surveys using 17 items rated

	2015)			on a 4-point Likert scale and accelerometry monitoring over seven days, including two weekend days (Cerin et al., 2017; International Physical Activity and the Environment Network, 2017).
International Study of Asthma and Allergies in Childhood (ISAAC) study Phase Three	Complete physical activity data available from 73 centres in 32 countries across six continents and from 122 centres in 53 countries across six continents	6–7-year-old children and 13–14-year-old adolescents	No established frequency, data were collected in each study site between 2001 and 2003	The ISAAC study was a multinational multicentre study, established in 1991, and designed to measure time trends in the prevalence, severity and risk factors and the development of asthma and allergies. Data on heights, weights, and physical activity were collected among children and youth during its phase 3. Physical activity was evaluated using parent (for the 6–7-year-olds) and self (for the 13–14-year-olds) reported frequency of vigorous physical activity (Braithwaite et al., 2017). ISAAC datasets have now been deposited in an openly accessible data archive (Strachan et al., 2017).
International Study of Childhood Obesity, Lifestyle and the Environment (ISCOLE)	12 countries from five major geographic regions of the world (Europe, Africa, the Americas, South-East Asia, and the Western Pacific)	10-year-old children	No established frequency, data were collected in each study site between 2011 and 2013	ISCOLE aimed to determine the relationships between lifestyle behaviors and obesity, and to study the influence of additional characteristics such as behavioral settings, physical, social and policy environments, on the observed relationships. Physical activity of participants was measured using accelerometers worn for at least seven days and self-reported daily physical activity, outdoor time, physical education, active transport to school (Katzmarzyk et al., 2013).

Latin American Study of Nutrition and Health (ELANS)	Eight Latin American countries (Argentina, Brazil, Chile, Colombia, Costa Rica, Ecuador, Perú and Venezuela)	15-18-year-old adolescents	No established frequency, data were collected once in each study site between 2014 and 2015	The ELANS is a multicenter cross-sectional nutrition and health surveillance study evaluating the nutritional intakes, physical activity levels, and anthropometric measurements of nationally representative samples of 15 to 65 years-olds. Physical activity was measured using the Mexican (Spanish) version of the International Physical Activity Questionnaire (IPAQ)-long version, which was adapted for all countries of ELANS. Only the sections leisure-time and transport physical activity were included. In addition, physical activity was also objectively monitored using accelerometers for seven days in 40% of the of the samples (Fisberg et al., 2015).
Saving and Empowering Young Lives in Europe (SEYLE) study	10 European countries (Austria, Estonia, France, Germany, Hungary, Ireland, Italy, Romania, Slovenia and Spain)	14- and 16-year-old adolescents	No established frequency, data collection took place in 2009-2012	This study explored the prevalence of risk behaviors, and their association with psychopathology and self-destructive behaviors, in adolescents recruited in randomly selected schools across 10 European countries. Physical activity was assessed using a modified version of the PACE + (Patient-Centred Assessment and Counselling for Exercise Plus Nutrition) adolescent physical activity measure. This survey has three items measuring reported frequency of 60 min of physical activity over the past two weeks, and the regular participation in sport(s) over the past six

				months (McMahon et al., 2017).
SUNRISE International Surveillance Study of 24-hour movement behaviours in the Early Years	36 countries have expressed interest in participating in the SUNRISE Study: five of these are low-income, 11 lower-middle, 8 upper-middle, and 12 high-income countries	4-year-old children	No established frequency yet, pilot testing is underway in 21 countries	The SUNRISE study aims to estimate what proportion of 4-year-old children sampled in participating countries meet the WHO Global 24-hour movement guidelines for the early years and to determine if these proportions differ by sex, socioeconomic status, or urban/rural location between different levels of human and economic development. This study was still at its pilot stage in 2019. Physical activity will be monitored objectively using accelerometers thigh- or hip-worn over three days, as well as through parental report (University of Wollongong, 2019).
Global TEENS study	219 centers worldwide over 20 countries in five continents	School aged 8–12-year-old children; 13–18-year-old adolescents	No established frequency, data collection took place in 2012-2013	The TEENs study was a global, observational, cross-sectional study of youth and young adults with type 1 diabetes launched across 5 continents in 20 countries in 2012. The primary aim of this study was to characterize diabetes-specific quality of life and glycemic control of a global sample of patients in predetermined age groups. Physical activity was assessed with self-reported number of days per week spent doing at least 30 min of any physical activities or exercise (Anderson et al., 2017).

Note: Even if some of the surveys have various sample age groups, the characteristics presented here only focus on the pediatric part (0-18 years) of their study population.

Table 2: Global initiatives compiling evidence on physical activity of children and youth.

Name	Location	Target population*	Frequency	Description
Determinants of Diet and Physical Activity Knowledge Hub - DEDIPAC study	Every country with objective or subjective physical activity data	3-12-year-old children and 13-18-year-old adolescents	No established frequency, the DEDIPAC Knowledge Hub occurred from 2013 to 2016	The DEDIPAC Knowledge Hub was a multidisciplinary consortium of scientists from 46 research centers working on three thematic areas: Assessment and harmonization of methods for future research, surveillance and monitoring, and evaluation of interventions and policies; Determinants of dietary, physical activity and sedentary behaviors across the life course and in vulnerable groups; Evaluation and benchmarking of public health and policy interventions aimed at improving dietary, physical activity and sedentary behaviors. This project is now complete, it ended in 2016 (DEDIPAC Determinants of diet & physical activity, 2016b). One of the outputs of this international collaboration was the creation of a Compendium of Datasets on Physical Activity openly available online (DEDIPAC Determinants of diet & physical activity, 2016a).
Global Matrix on physical activity of children and youth	49 countries from 6 continents in 2018	5-17-year-old children and youth	Every 2/3 years since 2014	The Global Matrix initiative, led by the Active Healthy Kids Global Alliance (Active Healthy Kids Global Alliance, 2018), brings together working groups

				for countries across the world who follow harmonized procedures to develop their Report Cards on Physical Activity for Children and Youth by grading 10 common indicators using the best available data (Aubert et al., 2018).
International Children's Accelerometry Database (ICAD)	Australia, Brazil, Belgium, Denmark, England, Estonia, Norway, Portugal, Switzerland, United States	3-18-year-old children and youth	No established frequency, this initiative only occurred once in 2008-2010	The ICAD was established to pool data on objectively measured physical activity from studies using the same type of accelerometer (Actigraph) worldwide. Investigators from 20 studies with a sample size >400 agreed to participate and shared their raw accelerometry files, and standardized analysis were performed on the pooled datasets (Sherar et al., 2011).
Physical Activity Factsheets	28 European Union Member States of the WHO European Region	0-18-year-old children and youth	First published in 2015, renewed in 2018	The country physical activity factsheets were developed by a partnership between the European Union and WHO. They summarize physical activity monitoring and surveillance related indicators (including the proportion of children and adolescents reaching the minimum levels of physical activity for health recommended by WHO or another cut-off), as well as policies and action in the area of health-enhancing physical activity promotion, for the European Union Member States of the WHO European Region. National physical

				activity experts from the noted countries were responsible to report the aforementioned information.(World Health Organization, 2018f)
World Health Organization (WHO) Global Health Observatory (GHO)	194 WHO member states	11-17-years-old adolescents	This first round was performed in 2015 updates over the next 15 years are expected	The GHO is a WHO initiative compiling health related statistics for more than 1,000 indicators. Concerning physical activity, the WHO GHO compiled surveys that presented sex- and age-specific prevalence with sample sizes (minimum: n=50), using the definition of not meeting the WHO recommendations on physical activity for health, or a similar definition (less than 60 minutes of activity on less than 5 days per week). Data had to come from a random sample of the adolescent population, with clearly indicated survey methods (World Health Organization, 2018b).

Note: Even though some of the initiatives cover various sample age groups, the characteristics presented here only focus on the pediatric part (0-18 years) of their study population.

Figures

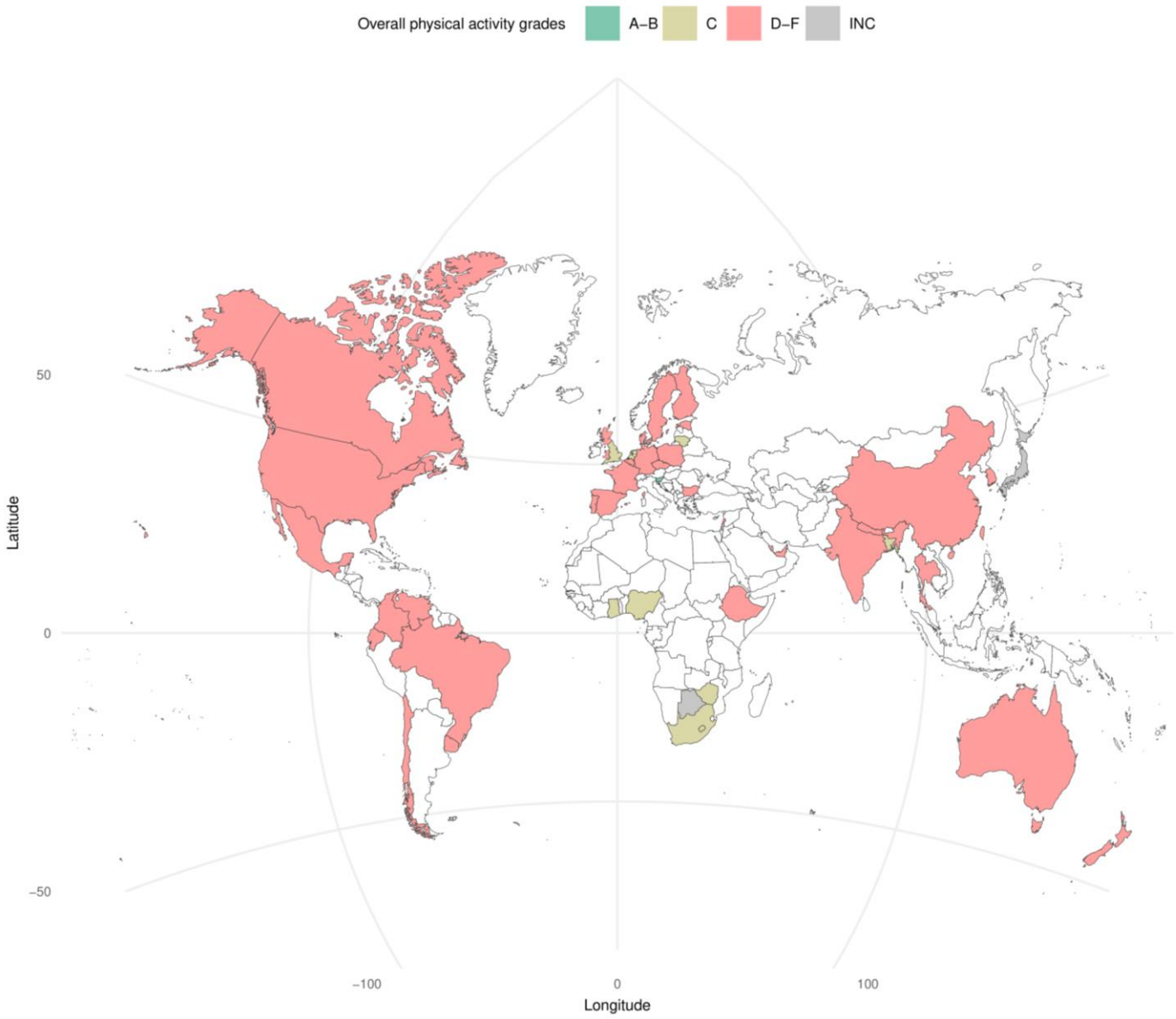

Figure 1: Distribution of the grades (“A-B”, “C”, “D-F”, or “INC” grades) for the Overall Physical Activity indicator in the 49 countries that participated in the Global Matrix 3.0 initiative of the Active Healthy Kids Global Alliance.

Chapter 3: Evolution of the Global Matrix methods

The first Report Card on Physical Activity for Children and Youth was created in Canada in 2005 by Active Healthy Kids Canada (AHKC). AHKC (www.activehealthykids.ca) was a Canadian not-for-profit organization who was, at the time, aiming to inspire the engagement of all children and youth in physical activity through the development of expert advice addressed to policy makers and the public.[1] The Report Card is a public facing document, reporting letter grades, updated scientific information, research gaps, and recommendations for improvement on physical activity indicators for children and youth aged 0-17 years. An AHKC Report Card was produced annually and the number of physical activity indicators included evolved over time. AHKC Report Card meetings occurred semi-annually where a group of experts from across Canada reviewed the evidence and assigned letter grades to the pre-determined indicators.[1]

Over 10 years, the Report Card successfully attracted media attention and was heavily used to facilitate and inform the development of physical activity programs nationally and locally.[2] An increasing number of countries approached AHKC asking for its mentorship to develop similar Report Cards. In 2012, AHKC decided that these demands were becoming burdensome and decided to make it a group effort, aiming to involve Canada and 14 additional countries concurrently. In addition, to celebrate the 10 year anniversary of the Report Card, and the 20th anniversary of AHKC, the AHKC decided to organize a Global Summit on Physical Activity for Children where all the 15 countries would release their national Report Cards together, prepared following a harmonized process and timelines, constituting the "Global Matrix 1.0".

1. Global Matrix 1.0

AHKC facilitated the development of the Global Matrix 1.0. Three of the additional countries (Kenya, Mexico, South Africa) produced a national Report Card for the second or third time. Researchers from 11 other countries were recruited to participate in this project by direct contacts, word of mouth, the *International Study of Childhood Obesity, Lifestyle, and the Environment* principal investigators, and Internet notices.[3] The general AHKC Report Card development process[1] was followed concurrently by 15 countries: Australia, Canada, Colombia, England, Finland, Ghana, Ireland, Kenya, Mexico, Mozambique, New Zealand, Nigeria, Scotland, South Africa, United States. A Report Card working group consisting of childhood physical activity researchers, practitioners, and leaders was constituted in each country. AHKC and the Report Card leaders took the collective decision to select 9 physical activity indicators for the purpose of the global matrix comparisons: 5 behaviors (Overall Physical Activity, Organized Sport Participation, Active Play, Active Transportation, Sedentary Behaviour) and 4 key sources of influence (Family and Peers, School, Community and Built Environment, and Government Strategies and Investments). Report Card working groups compiled all the best available published and unpublished evidence and information for each of the 9 physical activity indicators among children and youth (0-17 years). The assignment of a consensus grade to each indicator by the Report Card working groups was guided by a standardized grading framework presented in Chapter 6 Table 1, and standardized benchmarks presented in Table 1. Several benchmarks were considered to be applicable to the variety of data available across the 15 participating countries. AHKC offered standardized guidance to all the Report Card working groups and participated in most grade assignment processes to enhance comparability across countries. A Report Card document combining physical activity grades and their rationales, formulated in general population language, was produced by each participating country. The Report Card working groups had full creativity freedom to create their Report Card document in terms of length (short form and/or long form) and format. All the assigned grades for each indicator and participating country were compiled in a table, constituting the Global Matrix 1.0.

A peer-reviewed publication, co-authored by all Report Card leaders, integrating and comparing the findings from each Report Card, was published in a special supplement in the Journal of Physical Activity and Health (JPAH). This special JPAH document also included a peer-reviewed article summarizing the findings of the Report Card of each participating country. AHKC mentored the Report Card working groups for the writing of their article and paid for the open access publication of the special JPAH supplement on the same day of the launch of the Global Matrix 1.0 at the Global Summit on Physical Activity for Children in Toronto in May 2014. Each Report Card leader had the opportunity to do an oral presentation summarizing the main findings of their Report Card.

Table 1: Benchmarks used to guide the grade assignment for each indicator. Reproduced with permission from Tremblay et al.[3]

Indicator	Benchmark
Overall Physical Activity	% of children and youth who meet physical activity guidelines
Organized Sport Participation	% of children and youth who participate in organized sport and/or physical activity programs
Active Play	% of children and youth who engage in unstructured/unorganized active play for several hours a day
Active Transportation	% of children and youth who use active transportation to get to and from places (school, park, mall, friend's place)
Sedentary Behaviour	% of children and youth who meet sedentary behavior or screen-time guidelines
Family and Peers	% of parents who facilitate physical activity and sport opportunities for their children (e.g., volunteering, coaching, driving, paying for membership fees and equipment) % of parents who meet the physical activity guidelines for adults % of parents who are physically active with their kids % of children and youth with friends and peers who encourage and support them to be physically active % of children and youth who encourage and support their friends and peers to be physically active
School	% of schools with active school policies (e.g., Daily Physical Activity, recess, "everyone plays" approach, bike racks at school, traffic calming on school property, outdoor time) % of schools where the majority (≥ 80%) of students are taught by a

	physical education specialist % of schools where the majority (≥ 80%) of students are offered at least 150 minutes of physical education per week % of schools that offer physical activity opportunities (excluding physical education) to the majority (≥ 80%) of their students % of parents with children and youth who have access to physical activity opportunities at school in addition to physical education % of schools with students who have regular access to facilities and equipment that support physical activity (e.g., gymnasium, outdoor playgrounds, sporting fields, equipment in good condition)
Community and the Built Environment	% of children or parents who perceive their community/municipality is doing a good job at promoting physical activity (e.g., variety, location, cost, quality) % of communities/municipalities that report they have policies promoting physical activity % of communities/municipalities that report infrastructure (e.g., sidewalks, trails, paths, bike lanes) specifically geared toward promoting physical activity % of children or parents with facilities, programs, parks, and playgrounds available to them in their community % of children or parents living in a safe neighborhood where they can be physically active % of children or parents reporting well-maintained facilities, parks/playgrounds in their community that are safe % of children and youth who report being outdoors for several hours a day
Government Strategies and Investments	Evidence of leadership and commitment in providing physical activity opportunities for all children and youth Allocated funds and resources for the implementation of physical activity promotion strategies and initiatives for all children and youth Demonstrated progress through the key stages of public policy making (i.e., policy agenda, policy formation, policy implementation, policy evaluation, and decisions about the future)

Following the release of the Global Matrix 1.0, all Report Card leaders met to debrief on its success and voted unanimously to repeat and further develop the Global Matrix initiative. This led to the formation of the AHKGA and the initiation of the planning for the Global Matrix 2.0.

2. Global Matrix 2.0

The AHKGA distributed an open call through established networks in July of 2014 to recruit more countries for the Global Matrix 2.0. Based on the previous Global Matrix 1.0 experience and the

associated cost of its development, the AHKGA took the decision to ask all participating countries to pay a US $500 registration fee. A total of 40 countries from 6 continents responded and 38 fully participated to the Global Matrix 2.0.[4] The methods in terms of harmonized Report Card development process was the same concerning the formation of a Report Card working group and the identification of a Report Card leader, the nine common physical activity indicators selected, the gathering of the best available evidence, and the transparent grade assignment process, and using the same grading framework and physical activity indicator benchmarks as the Global Matrix 1.0.

The AHKGA came up with several innovations to overcome the burden of guiding 38 Report Card working groups with various level of experience in research and knowledge synthesis and translation, and different national economic and social contexts, including:

- An "e-blast", including instructions, resource documents, tips, and deadlines for the harmonized and concurrent development of the Report Cards, was circulated by email by the AHKGA to Report Card leaders monthly.
- An experienced Report Card leader who participated in the Global Matrix 1.0 from each continent was designated as a "Mentor". Each mentor had the responsibility to guide the Report Card working groups from their world area, to ensure adherence to the harmonized processes, and make sure that the deadlines for the Global Matrix 2.0 development process were met.
- Report Card working groups were asked to develop a cover story highlighting important themes and findings from their Report Card to facilitate the promotion of their Report Card in the media and to the public.
- The AHKGA developed an official website (www.activehealthykids.org) promoting the Global Matrix initiative and presenting digital versions of the Report Cards.
- The AHKGA paid the open access publication fees for a special issue of the JPAH, including an introductory article,[5] a peer-reviewed article for each country Report Card, and a peer-reviewed article integrating the findings of the 38 Report Cards.[6] The AHKGA provided a template to

guide the writing of the Report Card articles and offered writing support in the form of proof-review to several Report Card working groups.

- In addition to the descriptive presentation and comparisons of the results within and between countries, the number of participating countries in the Global Matrix 2.0 allowed for correlational analyses to determine the extent to which Report Card grades were related to several global descriptors and demographic indices.

The Global Matrix 2.0 was released at the International Congress on Physical Activity and Public Health in Bangkok, Thailand in November 2016. Each Report Card working group had the opportunity to develop and present a poster summarizing the findings of their Report Card at this event. The AHKGA led a special workshop immediately preceding the International Congress on Physical Activity and Public Health to prepare country leaders for the release of the Global Matrix 2.0 and brief the Report Card leaders attending on how to facilitate the promotion of their Report Card to the medias. At the end of the International Congress on Physical Activity and Public Health, the AHKGA led a special debriefing workshop where the Report Card leaders attending expressed their interest in pursuing the extension of the Global Matrix initiative and in participating in the Global Matrix 3.0 and had the opportunity to provide feedback and suggestions for the methods of the Global Matrix initiative.

3. Global Matrix 3.0

The AHKGA opened the registration to the Global Matrix 3.0 from April 2017 to January 2018 and circulated an open call to any country interested via established networks. A total of 49 countries from 6 continents registered and fully participated to the Global Matrix 3.0.[7] The AHKGA decided to propose registrations fees based on the Human Development Index (HDI)[8,9] classification of the participating countries to cover costs associated with the Global Matrix 3.0 initiative ($500 USD for the low HDI countries, $750 USD for the medium HDI countries, $1000 USD for the high HDI countries, and $1500 USD for the very high HDI countries). In May 2018, the AHKGA became an incorporated not-for-profit

organization and formed an AHKGA Board of Directors including representatives from each continent. Again, the methods in terms of the harmonized Report Card development process was similar to the Global Matrix 1.0 and 2.0. Multidisciplinary Report Card working groups of national physical activity experts and stakeholders were formed, and up to three Report Card leaders/coleaders per country were designated to manage their Report Card development, and to ensure effective communication between the AHKGA Board of Directors and the Report Card working groups. Report Card working groups gathered the best available evidence and followed the harmonized and transparent grade assignment process.

However, based on feedback received through the Global Matrix 2.0 process, the AHKGA Board of Directors proposed several changes to the Global Matrix 3.0 development process, including:[7]

- A more sophisticated mentoring system was developed: Report Card working groups from new participating countries were paired with an experienced Report Card leader who participated in the Global Matrix 2.0. In addition, 6 regional mentors (one for each continent) were designated to provide help and guidance to the countries when needed and report their progress to the AHKGA Board of Directors.
- The AHKGA Board of Directors coordinated the Global Matrix development through monthly e-blasts by sharing milestones and upcoming deadlines, and providing relevant information including background papers and documents, fundraising suggestions, and a theoretical framework to support the preparation of funding applications.
- The list of physical activity indicators and corresponding benchmarks was updated, including a new indicator, Physical Fitness, based on the previous Global Matrix methods, and on the feedback received from the Report Card working group members. The content of several benchmarks was modified to address several issues reported by Report Card leaders. The final version of the benchmarks for the 10 indicators is presented in Chapter 6 Table 1.

- A more detailed grading framework was also developed by the AHKGA Board of Directors, using positive (+) and negative (-) mathematical symbols. The final version of the Global Matrix 3.0 grading rubric is presented in Chapter 6 Table 2.
- The AHKGA Board of Directors decided that the 10 indicator grades should only be informed by data from school-aged children and youth (~5–17 years) to circumvent the issue of the lack of data concerning physical activity among children in the early years (0–4 year-olds) and to ensure consistency across countries.
- Report Card leaders had to submit a draft of their Report Card grades with their rationale to be audited by several designated AHKGA members to ensure that the grades were consistent with the harmonized benchmarks and grading scheme.
- Again, in addition to descriptive statistics (average grades and variations), correlational analyses between the 10 common physical activity indicators and sociodemographic indicators were performed using Spearman's rank correlation coefficients.
- The AHKGA Board of Directors paid for the open access publication of a special JPAH supplement including four peer-reviewed articles: one presenting, comparing, and discussing analyses of the results from the 49 countries participating in the Global Matrix 3.0.; and one presenting and comparing the Report Card results for the participating countries from each category of HDI (low and medium HDI countries, high HDI countries, and very high HDI countries). This supplement also included 49 non-peer-reviewed short Report Card articles – one for each participating country. The AHKGA provided a template to support the writing of the short Report Card articles and designated several AHKGA members to be responsible for the audit of these articles before going through JPAH editorial process.
- The AHKGA Board of Directors developed a new version of the AHKGA website (www.activehealthykids.org), presenting and promoting the integrated findings of the Global Matrix 3.0 as well as the previous editions of the Global Matrices (1.0 and 2.0), and including a specific webpage for each country that had ever participated to the Global Matrix initiative.

- To support the dissemination and promotion of the launch of the Global Matrix 3.0 and each country's Report Card, the AHKGA Board of Directors developed and circulated to all the Report Card working groups a detailed dissemination package including infographics, social media material, press release documents, a sample article that could be used to promote the release of the Global Matrix 3.0 via websites or newsletters, and a questions and answers sheet to assist with media interviews.

The Global Matrix 3.0 was released at the Movement to Move event, in Adelaide, Australia, in November 2018. All the Report Cards were presented in a poster format at this event. The event was preceded by a special workshop led by the AHKGA Board of Directors to do a rehearsal of the release of the Global Matrix 3.0 and brief the attending Report Card leaders on how to optimize the impact of the release of their Report Card. The Movement to Move event was closed by a final workshop addressed to the Report Card leaders and led by the AHKGA Board of Directors to debrief on the release of the Global Matrix 3.0 and open the discussion concerning the future of the Global Matrix initiative. The Report Card leaders showed interest in pursuing the expansion of the Global Matrix initiative but it was collectively decided to delay the future release of the Global Matrix 4.0 to 2021 to give more time to Report Card working groups to access or collect new physical activity data, and to the AHKGA Board of Directors to explore new possibilities of funding and to make further improvements to the Global Matrix methods.

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Chapter 4: Manuscript 1

This manuscript has been written and formatted following the publication standards of the *Journal of Physical Activity and Health*. It appears in its published format. This article was not peer-reviewed but went through an audit process led by AHKGA physical activity experts.

Title:

Results from France's 2018 Report Card on Physical Activity for Children and Youth

Citation:

Aubert S, Aucouturier J, Ganière C, et al. Results from France's 2018 Report Card on Physical Activity for Children and Youth. *Journal of Physical Activity and Health*. 2018;15(S2):S360-S362. doi:10.1123/jpah.2018-0511

This article presents briefly the main findings of the France's 2018 Report Card on physical activity for children and youth. I am the primary (first) author on this article. All the co-authors contributed to the compilation of data informing the grades presented in this article. I wrote a draft and the co-authors edited the manuscript and approved the final version of the manuscript before it was submitted for audit review. All co-authors contributed significantly and met the International Committee of Medical Journal Editors guidelines for authorship. I handled the revisions suggested by the auditor, and this article is now published in open access.

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BRIEF REPORT

Results from France's 2018 Report Card on Physical Activity for Children and Youth

Salomé Aubert, Julien Aucouturier, Caroline Ganière, Alicia Fillon, Pauline Genin, Julien Schipman, Benjamin Larras, Corinne Praznoczy, Martine Duclos, and David Thivel

Introduction

The French Government officially recognises the health benefits of physical activity for children and youth and has supported the development and promotion of national physical activity guidelines since 2002, and their recent renewal in 2016.[1] France's first Report Card of grades on Physical Activity for Children and Adolescents was developed in 2016 with an incomplete grade for the Overall Physical Activity indicator given a lack of recent nationally representative data.[2] The purpose of this paper is to summarize the results of the 2018 France Report Card that includes new data from two national surveys.

Methods

The 2018 France Report Card synthesized available evidence for 10 indicators of physical activity: Overall Physical Activity Levels, Organized Sport Participation, Active Transportation, Active Play, Sedentary Behaviours, Physical Fitness, Family and Peers, School, Community and Environment and Government. Two French national surveys were used to inform the Overall Physical Activity, the Active transportation and the Sedentary Behavior indicators: the National Study of Individual Nutritional Consuption 3 (INCA 3 2014-2015) and the Health Study of the Environment, Biosurveillance, Physical Activity, and Nutrition (ESTEBAN 2014-2016). To measure child and youth physical activity and its characteristics, both of these surveys used a modified version of the French Surveillance and Nutritional Epidemiology Unit (USEN) questionnaire for the 6-10 year-olds (reported by a parent); and a modified version of the Youth Risk Behaviour Surveillance System questionaire for the 11-17 year-olds (self-reported). The other indicators were informed by national statistics, reports and scientific studies. The French Report Card Group, composed of national experts discussed and assigned the grades to each indicator, using standardized benchmarks and the same grading scheme (from A+ = excellent, to F = failing), taking into account the nature and origin of the data sources, the sample size, the age range of participants, the year of publication, and the quality of the available data.

Results and Discussion

The cover of the 2018 France Report Card is presented in Figure 1, and the grades and rationales for each indicator are presented in Table 1. There is still a lack of large, good quality, national surveys

Figure 1 — France's 2018 Report Card cover.

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Table 1 Grades and rationales for France's 2018 Report Card

Indicator	Grade	Rationale
Overall Physical Activity	D	In the two national surveys, a "high level of physical activity" corresponded to five or more days a week of physical activity and the regular use of active transportation (reported by the parents) for the 6-10 years old; and to practicing a moderate to vigorous physical activity at least 5 days a week (self-reported for the 11-17 years old). Only 24% of the 7-10 years old were reported to have a high level of physical activity; 38% of the 11-14 years old reported a high level of physical activity; 24% of the 15-17 years old reported a high level of physical activity.[3] And only 23% of the 6-17 years old were estimated to have a high level of physical activity in ESTEBAN 2015.[4]
Organized Sport Participation	C-	The proportion of children and youth enrolled in sport federations in 2016 (not including the school sport federations) was 33% for the 0-9 year-olds, 60% for the 10-14 year-olds, and 34% for the 15-19 year-olds.[5]
Active Play	INC	Among the 6-10 year-olds, 38% of the boys and 39% of the girls reported playing outside every school day of the week; and 32% of the boys and 33% of the girls reported playing outside every day on day with reduced or no school time.[4]
Active Transportation	C-	It was estimated in INCA3 2014-2015 that 44% of the 3-10 year-olds and 43% of the 11-14 year-olds use active transportation to go to school.[3] And 41% of the 6-10 year-olds report using active transportation to go to school in ESTEBAN 2015.[4]
Sedentary Behaviours	D-	On average, children and youth spend 3 to 4 hours daily in front of a screen. This estimate varies depending on the data source, the age, and the sex.[3,4] Only 35% of 6-10 year-olds, 17% of 11-14 year-olds, and 8% of 15-17 year-olds spend less than 2 hours in front of a screen daily.[4] Screen time may be overestimated because parents or children were asked to report the time for each type of screen (ie,TV, phone, etc.) and then these times were added. It is a possible that some of these screen times occurred simultaneously.
Physical Fitness	B-	On average, 10-14.9 year-old French adolescents (n=10,631) are at the 68th percentile for cardiorespiratory fitness ($V0_2$max estimated from the 20m-shuttle-run test)[6] based on age- and sex-specific international normative data from 24 countries.[7] On average, 10-14.9 year-old French adolescents (n=10,776) are at the 58th percentile for flexibility (measured with the test sit-and-reach)[6] based on age- and sex-specific international normative data from 27 countries.[7]
Family and Peers	INC	A cross sectional study that surveyed 1713 boys and 1724 girls (all 12 years old) in Bas-Rhin found that 46% of fathers and 42% of the mothers "engaged regularly in physical activities".[8] 46% of 2385 adolescents (11-18 years old) reported that at least one of their parents "is regularly active" in a cross-sectional survey realised in Aquitaine in 2005.[9]
School	B	In primary school (6-10 years old), 3 hours are dedicated to physical education (PE) but only 2 hours and 15 minutes on average were reported,[10] and these classes do not have to be taught by a physical education specialist. In middle school (11-14 years old) and high school (15-17 years old), PE is mandatory for all the students (except proved medical condition), and PE time is fixed and mandatory for 100% of the public educational institutions. Middle school must provide 4 hours of PE weekly the first year, and then 3 hours weekly for the next 3 years. As for high school, 2 hours of physical education weekly is mandatory. Those classes must be taught by a PE teacher (an expert trained for 5 years). Any institution caught not respecting these rules could face disciplinary procedures. In 2016, 22% of all students in middle school or high school were enrolled with the scholar sport federations (National Statistics),[11] which means that they were potentially practicing 1 to 3 additional hours of sport per week but we do not have data to confirm the actual attendance of those enrolled.
Community and Environment	INC	In 2016, 60 territorial communities were enrolled in the "Cycling Cities and Territories Club" (9 with <50,000 inhabitants, 11 between 50,000 and 100,000 inhabitants, 26 between 100,000 and 250,000 inhabitants, and 14 with >250,000 inhabitants). Among these communities, 26% of the roadway is equipped with cycling path.[12] In addition, 63% of the territorial communities have a budget dedicated to cycling promotion, and the average annual budget is 7.7 euros/year/ inhabitant (vs 5.8 euros/year/ inhabitant in 2013).[12]
Government	C	We decided to assign a grade of C to this indicator because the importance of physical activity is officially acknowledged by the government in official texts, but this acknowledgement is more translated into promotional campaigns (i.e. physical activity and sedentary behaviours guidelines) and local action such as the intervention based on the ICAPS randomized control trial[13] in small population. However, several forms of financial help exist to support the registration of children and adolescent from medium- and low-income families to sport federations. In addition, financial support is also provided to sport clubs annually. This help increases if the clubs are hosting activities after school time, if there are many children or youths or girls or women enrolled, if they are welcoming people with disabilities, and/ or if they are situated in poor, rural or critical areas. This help does not exceed 1,500 euros in 65% of the cases, but 100% of the clubs receive it annually.

assessing physical activity and sedentary behavior characteristics in France. The two national surveys presented here have a relatively small sample size (ie, 3,117 6-17 years children in total), and they are not using commonly used, validated questionnaires. In addition, the way the data were treated potentially led to an underestimation of the physical activity in the 6-10 years age category, and to a potential overestimation of the screen time. Moreover, there is a lack of data to inform grades for the Active Play, Family and Peers, and the Community and Environment indicators.

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Conclusion

While findings from two national surveys show that French children and youth are spending too much time in front of a screen, and that only a small part of the pediatric population is meeting the physical activity guidelines, these negative outcomes might be exaggerated because of the method used in these surveys. In contrast, French pre-adolescents (10-14 years old) show a good level of physical fitness that can potentially be explained by the good level of organized sport participation in this age group and the mandatory time devoted to PE.

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Chapter 5: Manuscript 2

This manuscript has been written and formatted following the submission standards of the *Journal of Physical Activity and Health*. It appears in its submitted format.

Title:

France's 2018 Report Card on Physical Activity for Children and Youth: results and international comparisons

Citation:

Aubert S, Aucouturier J, Vanhelst J, et al. Results from France's 2018 Report Card on Physical Activity for Children and Youth. Accepted in: *Journal of Physical Activity and Health*. 2019

This article presents and discusses the findings of the France's 2018 Report Card on physical activity for children and youth, compares the French Report Card grades with the other Global Matrix 3.0 counties' grades, highlights research and surveillance gaps, and proposes recommendations to improve the physical activity grades in France. I am the primary (first) author on this article. All the co-authors contributed to the compilation of data informing the grades presented in this article. After a first draft was proposed by Julien Aucouturier and David Thivel, I rewrote an entire manuscript keeping the same outline and circulated it to the co-authors. The co-authors edited the manuscript and approved the final version of the manuscript before it was submitted for peer-review. All co-authors contributed significantly and met the International Committee of Medical Journal Editors guidelines for authorship. I handled the revisions suggested by the reviewer and resubmitted this article. It was accepted for publication on December 2019. The title page, the blinded manuscript, and the Supplement Material 1 are presented in this chapter.

France's 2018 Report Card on Physical Activity for Children and Youth: results and international comparisons.

Manuscript Type: Original Research

Key words: Adolescents, Sedentary Behaviors, Health, Active Transportation, Physical Activity Promotion

Abstract words count: 200

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Salomé Aubert, Julien Aucouturier, Jeremy Vanhelst, Alicia Fillon, Pauline Genin, Caroline Ganière, Corinne Praznoczy, Benjamin Larras, Julien Schipman, Martine Duclos, and David Thivel

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France's 2018 Report Card on Physical Activity for Children and Youth: results and international comparisons.

Manuscript Type: Original Research

Key words: Adolescents, Sedentary Behaviors, Health, Active Transportation, Physical Activity Promotion

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Abstract:

Background: Insufficient levels of physical activity and increasing sedentary time among children and youth are being observed internationally. The purpose of this paper is to summarize findings from France's 2018 Report Card on physical activity for children and youth, and to make comparisons with its 2016 predecessor and with the Report Cards of other countries engaged in the Global Matrix 3.0.

Methods: The France's 2018 Report Card was developed following the standardized methodology established for the Global Matrix 3.0 by grading 10 common physical activity indicators using best available data. Grades were informed by national surveys, peer-reviewed literature, government and non-government reports, and online information.

Results: The expert panel awarded the following grades: Overall Physical Activity: D; Organized Sport Participation and Physical Activity: C-; Active Play: INC; Active Transportation: C-; Sedentary Behaviors: D-; Family and Peers: INC; School: B; Community and the Built Environment: INC; Government: C**.**

Conclusions: Very concerning levels of physical activity and sedentary behaviors among French children and youth were observed, highlighting the urgent need for well-designed national actions addressing the presented physical inactivity crisis. The top three strategies that should be implemented in priority to improve the lifestyle of French children and youth are provided.

Introduction

Despite concerted efforts to promote physical activity and the development of strategies to reduce sedentary time, scientific data continues to reveal insufficient levels of physical activity[1–5] and increasing time devoted to sedentary behaviors[1,4,6–8] among children and youth internationally. This decline in healthy active lifestyles among children and youth is particularly worrying since physical, psychological, social, and cognitive health have been found to be associated with physical activity levels in school aged children,[9,10] with physical inactivity (defined as not meeting physical activity recommendations) favoring adverse health effects[9–12]. The World Health Organization (WHO) recommends that 5-17 year-old children and youth accumulate at least 60 minutes of moderate-to-vigorous intensity physical activity per day with no more than 2 hours of recreational screen time.[13] These guidelines have been broadcasted and promoted by national agencies throughout the world.

In 2005, Canada launched the first Report Card initiative, which gathered and synthesized the best available national data on the physical activity and sedentary behaviors of Canadian children and youth.[14] This annual report was recognized as a highly useful and informative tool, and it quickly influenced national policy, practice, and research orientations.[15] In 2014, based on this Canadian approach and in order to develop a better understanding of childhood physical activity and inactivity across nations, 15 countries replicated the Report Card process, which constituted the Global Matrix 1.0.[16] The Global Matrix 1.0 aimed to use a harmonized process for data gathering, assessing, and assigning grades for 9 physical activity indicators.[16] Taking advantage of the creation of the National French Observatory for Physical Activity and Sedentary Behaviors (ONAPS), the first French Report Card for Physical Activity and Sedentary Behaviors in children and adolescents was launched in 2016,[17] independently of the Global Matrix 2.0 that involved the participation of 38 countries.[18] This French 2016 Report Card adopted and adapted the Global Matrix 2.0 harmonized process to provide the first national grades for each of the common physical activity indicators: Overall Physical Activity; Organized Sport Participation; Active Transportation; Sedentary Behaviors; Family and Peers; School Implications; Community and Built Environment; Government Strategies and

Investments; Active Play (Grades detailed in Table 1). This 2016 Report Card concluded by emphasizing the need to implement national physical activity promotion programs and the need for larger scale studies to fill knowledge gaps regarding the physical activity levels and habits of French children and adolescents.[17]

As part of the 2018 Global Matrix 3.0 initiative,[19] our national expert panel carried out an updated evaluation of these physical activity indicators, that is briefly summarized in a recently published condensed article.[20] The purpose of this paper is to present the detailed findings from the France's 2018 Report Card on physical activity for children and youth, to highlight its evolution compared with its 2016 edition, and to discuss these results in comparison with the 48 other countries that participated in the Global Matrix 3.0.[19]

Methods

Following the standardized methodology established for the Global Matrix 3.0 on physical activity for children and youth previously detailed,[19] the France's 2018 Report Card was prepared and redacted with the collective work of an expert panel composed of members of the French National Observatory for Physical Activity and Sedentary Behaviors (ONAPS, www.onaps.fr) and external and academic experts, and with the guidance of the Active Healthy Kids Global Alliance (AHKGA, www.activehealthykids.org). The expert panel leader was responsible for integrating each expert's contribution and for writing the Report Card main document. All members reviewed the whole document and contributed to the grade assignment process for each indicator. All of the authors contributed to identifying key data sources and synthesized the evidence from a range of national surveys. The Report Card was realized thanks to a close collaboration with the ONAPS whose main role was to gather and synthesize national database results and surveys.

The expert panel evaluated 10 physical activity indicators: Overall Physical Activity Levels, Organized Sport and Physical Activity, Active Play, Active Transportation, Sedentary Behaviors, Physical Fitness, Family and Peers, School, Community and Environment, and Government. These indicators are consistent with the common indicators assessed by all countries participating in the Global Matrix 3.0. Overall

Physical Activity, Active transportation, and Sedentary Behavior indicators were informed by two national surveys: National Study of Individual Nutritional Consumption 3 (INCA 3 2014-2015)[21] and the Health Study of the Environment, Biosurveillance, Physical Activity, and Nutrition (ESTEBAN 2014-2016).[22] The remaining indicators were informed by national statistics, official reports, and scientific studies.

The expert panel first connected in December 2017 and indicators were assigned to specific members of the panel according to their area of interest and expertise. Experts were asked to compile the best available evidence for 5-17 year-olds and to write a brief chapter for each indicator they were assigned. Based on this compiled information, final grades were collectively discussed and assigned in May 2018 using the standardized benchmarks and grading scheme provided by the AHKGA[19] presented in Supplement Material 1. Nature and origin of the data sources, sample size, age range of participants, and year of publication were considered to establish the quality of the available data. An incomplete grade (INC) was assigned where insufficient data were available or due to the absence of a suitable benchmark.

The data from the Global Matrix 3.0 were used to perform comparisons between France and the 48 other participating countries. Letter grades were converted into interval values using the standardized corresponding numbers presented in the Global Matrix 3.0 grading scheme[19] to calculate averages which were floored before being converted back to letter grades. Finally, in order to create Table 2, the Global Matrix 3.0 grades were regrouped in cluster grades as follows: “A” including “A-”, “A”, and “A+”; “B” including “B-”, “B”, and “B+”; “C” including “C-”, “C”, and “C+”; “D” including “D-”, “D”, and “D+”; and “F” and INC remained unchanged.

Results & Discussion

France’s 2018 Report Card findings and comparison with the 2016 Report Card

The grades assigned for each indicator composing the 2018 and 2016 French Report Cards are presented in Table 1. Insufficient evidence was available for Active Play, Family and Peers, and Community and

Environment, therefore these indicators were graded INC. In comparison with the 2016 France's Report Card, three more indicators were attributed a letter grade in the France's 2018 Report Card: Overall Physical Activity, Physical Fitness, and Government. On average, the physical activity indicators were graded "C-" in 2018, which was slightly higher than in 2016 ("D"). The available evidence synthesized for the France's 2018 Report Card is presented and discussed by indicators in this part.

Overall Physical Activity: D

The two national surveys informing this indicator (INCA 3 and ESTEBAN 2014-2016) used the same modified version of the French Surveillance and Nutritional Epidemiology Unit (USEN) questionnaire for 6-10 year-olds (ESTEBAN 2014-2016) and for 3-10 year-olds (INCA 3) that was reported by a parent or legal guardian; and a modified French version of the Youth Risk Behavior Surveillance System (YRBSS) questionnaire for 11-17 year-olds that was self-reported. For the analysis of these two surveys, three categories of physical activity level were created (low, medium, and high), where a high level of physical activity was estimated to meet the WHO's physical activity guidelines.[13] For children aged below10 years-old, a high level of physical activity corresponded to practicing physical activity (including physical education, outdoor active play, and sport participation outside of school) five or more days a week and regularly using active transportation; while for 11-17 year-olds, a high level of physical activity corresponded only to practicing moderate to vigorous physical activity at least five days a week.[21,22]

Data from INCA 3 indicated that 20.9% of girls and 27.7% of boys 7-10 years-old, 30.1% of girls and 45.6% of boys 11-14 years-old, and 20.0% of girls and 28.3% of boys 15-17 years-old are meeting the WHO's physical activity guidelines.[21] Based on the ESTEBAN 2014-2016 survey, it was estimated that 17.8% of 6-10 year-olds (same proportion for boys and girls), 20.2% of girls and 33.7% of boys 11-14 years-old, and 15.4% of girls and 40.1% of boys 15-17 years-old are meeting the WHO's physical activity guidelines.[22] For both surveys, the differences observed between sexes were not significant for children 10

years-old and below, but these differences were statistically significant for 11-14 year-olds and 15-17 year-olds.[21,22]

In the 2016 France's Report Card, the Overall Physical Activity indicator was graded INC as the only national data available was nearly 10 years old. Therefore, the availability of data from these two surveys (INCA 3 and ESTEBAN 2014-2016) is a positive outcome, in particular because both surveys used similar measurement methods, which allowed for their comparison. However, there are still methodological issues that must be highlighted. The main issue is that there have been no studies on the validity of the two questionnaires used in these two surveys. As such, we cannot anticipate if the obtained proportions are being over or underestimated. The rationale behind the creation of low, medium, and high categories of physical activity level was not provided. In addition, we can expect that the physical activity levels for the 6-10 year-olds is underestimated as all children not using active transportation, regardless of their frequency of physical activity, could not be classified in the high level of physical activity category. Objective measurement methods and validated questionnaires that are utilized internationally are required to improve the quality of physical activity surveillance in France.

Beyond the aforementioned methodological issues, based on these data, it is estimated that overall only 20 to 30% of the children and youth in France are meeting the physical activity guidelines. This situation is very alarming, especially with regards to girls who had a significantly lower level of physical activity than their male counterparts. These findings suggest that the support and development of effective physical activity promotion programs and actions targeting children and youth is urgently needed in France.

Organized Sport and Physical Activity: C-

Participation in organized sports was assessed based on the number of sports licenses delivered by French sports federations after registration in sports clubs for children and youth. Licenses delivered for school-based organized sports were excluded from this inventory. In 2017, the proportion of children and youth enrolled in sports federations in 2016 was 32.6% of 0-9 year-olds, 59.6% of 10-14 year-olds, and 34.3% of

15-19 year-olds.[23] In both boys and girls, a decrease of more than one third of memberships is observed between 10 and 14 year-olds, most poignantly among girls.

In the 2016 France's Report Card, a grade of "D" was attributed to this indicator based on the prevalence of people 0-24 years-old engaged in a sports club.[17] Having access to data that is more specific in terms of targeting different age groups of children and youth is an encouraging progression with regards to the surveillance of organized sport participation. In addition, the lower proportion of girls enrolled in sports federations is consistent with the findings for the Overall Physical activity indicator. However, these data do not provide any information concerning the dose of physical activity associated with the practice of sport among these children and youth enrolled with sports federations. This represents a research gap in the French surveillance system that should be addressed in the future. Additional research is also needed to identify what the potential barriers to the access to organized sport and physical activity for French children and youth are, and if there is equal opportunity for participation in affordable and appealing activities in terms of territory (rural versus urban), gender, socio-economic level, and sporting ability.

Active Play: INC

The Active Play indicator was not evaluated in the 2016 France's Report Card. Active Play corresponds to a form of gross motor or total body movement in which young children exert energy in a freely chosen, fun, and unstructured manner.[24] The standardized benchmarks proposed by the AHKGA for Active Play included "% of children and youth who engage in unstructured/unorganized active play at any physical activity intensity for more than 2 h a day" and "% of children and youth who report being outdoors for more than 2 h a day".[19] According to the ESTEBAN 2014-2016 study, among 6-10 year-olds, 38% of boys and 39.3% of girls reported engaging in outdoor active play every school day, and 32.2% of boys and 33.2% of girls also reported playing outdoors on non-school days.[22]

There is still a need for an international consensus on the definition of active play, and this is an obstacle for the development of tools measuring this behavior. The available evidence remains insufficient to grade

this indicator in the France's 2018 Report Card, as there is no indication of duration of the engagement in outdoor activities; however it does suggest that not enough French children spend time outside on a regular basis. Access to active play in the outdoors and in nature, with its risks, is considered essential for healthy child development,[25] therefore our expert panel calls for the better consideration of active outdoor time for public health messages. Families and schools, in particular, are encouraged to facilitate and create opportunities for children to freely engage in active play outside.

Active Transportation: C-

According to the INCA3 survey, 44% of 3-10 year-olds and 43% of 11-14 year-olds report travelling to school using a mode of active transportation.[21] Similarly, according to the ESTEBAN 2014-2016 survey, 41% of 6-10 year-olds use active transportation to go to school.[22] Moreover, among all transportation modes, 6-9 year-olds use walking for 37.2% and biking for 4.3% of their trips.[21] For 10-14 year-olds, it is 36.6% and 6.7% respectively, and for 15-18 year-olds, it is 26.7% and 5.6% respectively.[21] The difference of engagement in active transportation by sex among the 6-10 year-olds was reported in the ESTBAN 2014-2016 report: 35.6% of the boys and 44.9% of the girls report using active transportation.[22]

In comparison with the results from the 2016 Report Card, based on data from 2006-2008, a small increase in the proportion of children and youth who report using active transportation is observed (40% of the 3-10 year-olds and 30% of the 11-14 year-olds were using active transportation to go to school).[17] Overall, the use of active transportation by children and youth is unsatisfactory and the France's 2018 Report Card highlights the need for the better promotion of cycling and walking to and from school. More research and surveillance are needed to identify the characteristics of the active transportation of children and youth (frequency, mode, distance covered) and to identify the potential barriers to this in order to develop effective promotion program.

Sedentary Behaviors: D-

On average, French children and youth are estimated to spend three to four hours per day in front of screens.[21,22] This estimation varies depending on the age, sex, and data source. Custom analysis from ESTEBAN 2014-2016 indicates that only 34.6% of 6-10 year-olds spend less than two hours per day in front of a screen; 17% of 11-14 year-olds, and 8.4% of15-17 years-olds.[22] In comparison with data from 2006 that were reported in the 2016 France's Report Card, a significant increase in screen time was observed on average in boys (+1h17 ; p<0,001) and girls (+50min ; p<0,001) among 6-17 year-olds.[22] According to ESTEBAN 2014-2016, this increase is more likely associated with greater time spent in front of computer, smartphone, and tablet, and not linked to increased TV time.

The increased time that children and youth spend in front of screens is a potential barrier to active behaviors such as active play. In addition, screen time in children and youth is negatively associated with numerous health indicators including adiposity, aerobic fitness, quality of life, self-esteem, pro-social behavior, academic achievement, depression, and anxiety.[26] These findings highlight a clear need for the development of policies that are aimed at decreasing recreational screen time among children and youth to prevent the hazardous health consequences associated with this behavior.[27]

Physical Fitness: B-

Physical Fitness is a new indicator that was recently added in the Global Matrix process and was not evaluated in the 2016 France's Report Card. Good quality data were available for the cardiorespiratory fitness (n=10,631), muscular endurance (n = 10.293), speed (n = 10.308), and the flexibility (n=10,776) of French 10-14.9 year-olds.[28] These data were collected between 2009 and 2013, in 101 schools from 16 regions of France. On average, French youths were in the 68th percentile for cardiorespiratory fitness (using V02max estimated with by performance on the 20m-shuttle-run test) and in the 58th percentile for flexibility (measured with the sit-and-reach test) based on age- and sex-specific international normative data from 27 countries.[29] In addition, boys performed an average of 34.4 repetitions and girls an average of

27.7 repetitions on the curl-up test (indicator of muscular endurance); and boys ran the 50 meter sprint test (an indicator of speed) in an average of 9.0 seconds and girls in an average of 9.5 seconds.

These findings indicate that French youths had a moderately good physical fitness level. Cardiorespiratory fitness is recognized as an important indicator of current and future health among school-aged children and youth, and it is critical to develop the continuous surveillance of this indicator,[30] in combination with the surveillance of the other physical fitness health-related components using standardized measurements methods. This surveillance system needs to be implemented at the regional and national level, and cover all 5-17 year-old children and youth.

Family and Peers: INC

A regional cross sectional study that surveyed French 12 year-old boys (n = 1713) and girls (n = 1,724) in 2004 found that 46% of the fathers and 42% of the mothers were regularly engaged in physical activity.[31] In addition, in another regional cross sectional survey, 46% of 11-18 year-olds (n = 2,385) reported that at least one of their parents "is regularly active".[32] Similarly to the 2016 France's Report Card, the available evidence is not complete enough to attribute a letter grade to the Family and Peers indicator. More research is needed to develop validated tools to assess the support from family and friends for children and youth's physical activity. It may also be insightful to pair parents with their children in future national surveys assessing physical activity levels of the French population.

School: B

As previously detailed in the 2016 France's Report Card, three hours per week of physical education are recommended nationally for children attending primary schools (6-10 years-old); however an official report from the Ministry of Education revealed that only two hours and 15 minutes were actually being implemented on average in 2002-2003.[33] In secondary schools (11-14 years-old), physical education covers three to four hours per week, depending on the school grade, and two hours per week in high school (15-18 years-old). Gender differences were also observed concerning the physical activity of children and youth

in school settings. Among the 21.9% of school children and youth involved in school-based extracurricular physical activity, girls represented 40.9% of the enrolled students (compared with 59.2% of boys).[34] The grade attributed to this indicator is stable compared with the 2016 Report Card ("B").

Even though a relatively good grade was obtained for this indicator, our expert panel wants to highlight the potential of the school environment to promote physical activity. In fact, allocating more time to physical activity by decreasing the time dedicated to other subjects can improve the time children spend engaging in moderate to vigorous physical activity without altering academic achievement.[35] This is why developing new school policies that would increase the physical activity opportunities to at least one hour daily would ensure that a greater proportion of children and youth, ideally all of those attending public schools, would meet the WHO's physical activity guidelines. Regarding the difference of participation to school-based extracurricular physical activity by sex, the National Plan for the Development of French School Sport 2016-2020 specifically targets an official strategic objective to increase the proportion of girls to obtain a 50%/50% ratio between boys and girl by 2020.[36]

Community and Environment: INC

According to the French Active Mobility Observatory, the number of walking and cycling pathways has increased between 2013 and 2016 (+26% of cycling and +18% of walking pathways),[37] data are however missing for 2016 onwards. In addition, in 2016, 63% of French territorial communities had a budget dedicated to cycling promotion, which totaled an average of 7.7 euros/year/inhabitant (compared with 5.8 euros/year/inhabitant in 2013).[37] Similarly to the 2016 France's Report Card, there remains not enough evidence available to assign a letter grade to the Community and Environment indicator for the France's 2018 Report Card. This finding underlines the need for more research and surveillance regarding the availability and quality of active facilities, in addition to the perceived quality, safety, and attractiveness of these infrastructures to French parents and children and youth.

Government: C

French Ministries responsible for health, sports, and transport have officially acknowledged the promotion of physical activity and the reduction of sedentary behaviors, although this has yet to translate into concrete actions at the national level. This indicator was graded INC in the 2016 France's Report Card. Despite the absence of data allowing us to quantify the level of leadership and commitment in providing physical activity opportunities for all children and youth from the French government, we decided to grade this indicator "C" to acknowledge the various forms of funding available to support the physical activity of children and youth from French public institutions. Indeed, sports clubs and leagues can apply for grants funding the building and repair of sports infrastructure and equipment,[38] or for grants financing specific projects that target, amongst others, girls, people with disabilities, and low income areas.[39] In addition, low and middle income families can also access several financial aids for the payment of the registration of children and youth to sports clubs or federations, and for the purchase of their sports equipment.[40,41] It is hoped that the nomination of Paris as the future host of the 2024 Summer Olympic Games, will create a real dynamic to facilitate the promotion of physical activity and sports participation for French people, especially children and youths.

Overall, the evidence compiled in the 2018 France's Report Card shows that French children and youth are not active enough and too sedentary. Girls are particularly more affected, as a smaller proportion of girls are meeting the WHO's physical activity guidelines, and similar findings were observed for the Organized Sport and Physical Activity and School indicators. The small increase in the average grade from "D" to "C-" within the two years since the 2016 Report Card cannot be interpreted accurately since four indicators not previously graded obtained a letter grade in 2018, and because the standardized grading scheme and benchmarks provided by the AHKGA were modified between 2016 and 2018.

International comparisons

France's participation in the Global Matrix 3.0 has opened the door to international comparisons with the other participating countries to gain perspective on how France is doing and what can be learnt from it. The present section gives an overview of the main findings and discussions generated by this comparison.

The distribution of the percentages of the 49 countries participating in the Global Matrix 3.0 by clustered grade for each indicator is detailed in **Table 2** where the cells with the proportion of countries including France are shaded. Overall, a total of 121 INC grades were obtained by the 49 countries participating in the Global Matrix 3.0, for an average of 2.5 INC per country;[19] and a total of 67 INC grades were obtained by the 30 participating very high human development index countries, for an average of 2.2 INC grades per country.[42] With three INC grades, France is slightly above the two mentioned averages, however its INC grades concerned three of the four indicators that had the highest number of INC across the 49 countries: Active Play (n = 29), Family and Peers (n = 22), and Community and Environment (n = 13).[19] This finding shows that the lack of good quality data and the lack of approved standardized methods of measurements for these three indicators is not just a national but a global research issue. International collaborations are needed for the development of clear consensus definitions and standardized measurement methods for these indicators.[43]

Concerning France's letter grades, the only indicator that stands-out in comparison with the 48 other countries participating in Global Matrix 3.0 were Physical Fitness and School. A "B-" was assigned to France for Physical Fitness, which places France among the top 10% of the most successful countries for this indicator. Another study that compared the physical fitness of children and youth by means of the 20 m shuttle run across 50 countries ranked France 11th using less recent data.[44] More research is necessary to confirm if French children and youth have a higher level of physical fitness and to identify the factors explaining this success. Concerning the School indicator, obtaining a "B" put France among the top 35% of the 49 Global Matrix 3.0 countries, which is consistent with other data showing that France remains one of the European countries offering the highest number of physical education lessons per week in secondary

school.[45] All of the other letter grades that were assigned fell in the cluster categories with the highest proportions of countries.

While the physical activity profile of French children and youth was following the average pattern of the 49 Global Matrix 3.0 countries, performing comparisons focusing only on the 20 European countries showed a different story. **Table 3** presents the country letter grades organized by descending order and the average letter grades for each indicator among Global Matrix 3.0 European countries. Overall, France was less successful than the majority of the other countries. Among the seven indicators with a letter grade, France's grades were below the average for five of the indicators (Organized Sport and Physical Activity, Active Transportation, Sedentary Behaviors, and Government), equal to the average for Physical Activity, and above the average for two indicators (Physical Fitness and School). The average grades for France and the Global Matrix 3.0 European countries were the same ("C-"), however, this ranks France in the bottom half of these 20 countries.

The findings presented in this paper suggest that Organized Sport and Physical Activity and Active Transportation are two indicators that could potentially be targeted to increase the overall level of physical activity among children and youth in France. In Denmark, 83% of 7-15 year-olds participate in organized sports;[46] and 75% of 11-15 year-olds participate in organized sport two times per week in Sweden.[47] Similarly, high rates of children and youth using active transportation were observed in Denmark and Finland. These data show that increasing participation in organized sports and the use of active transportation among children and youth in France should be conceivable with well-planned strategies. The successful policies and strategies implemented in Denmark, Finland, and Sweden to promote participation in organized sports and/or active transportation among children and youth should be studied to facilitate their adaptation to a French context.

Based on the presented findings for France and their comparison to the rest of the world, the France's 2018 Report Card expert panel has identified the top three priorities to improve grades and promote an active healthy lifestyle among children and youth:

1. Development and implementation of a consistent national surveillance system of physical activity and related indicators (Organized Sport and Physical activity, Active Play, Active Transportation, Sedentary behavior, Physical Fitness, Family and Peers, and Community and Environment) among children and youth, including children and youth with disability. The collection of objective physical activity and sedentary behavior data at the population level is recommended as well.

2. Development and implementation of specific interventions targeting the reduction of screen time among all children and youth.

3. Identify the barriers to the engagement in active behaviors, in particular among girls and other specific populations to increase the offer of attractive and accessible organized sport opportunities, physical play structures, and active transportation structures for children of all ages, cultures, and abilities.

Conclusion

The France's 2018 Report Card expert panel proposes here an update to the first 2016 Report Card, officially joining the 48 other countries composing the Global Matrix 3.0.[43] While insufficient data were available to grade three indicators (Active Play, Family and Peers, Community and Environment), the results show very concerning levels of physical activity and sedentary behaviors among French children and youth, and gender differences were observed. French national survey analysis issues and research gaps were identified in this article. When compared to the other 48 countries from six continents that participated in the Global Matrix 3.0, it was observed that overall, France was performing similarly to the majority of the countries for each indicator, except for the Physical Fitness and School indicators where France was among the top 10% and 35%, respectively. But when compared uniquely to the 20 European countries that

participated in the Global Matrix 3.0 (all classified in the very high human development index category except Bulgaria),[42] France is behind the majority of these countries, especially in terms of the Organized Sport and Physical Activity, Active Transportation, and Sedentary Behavior indicators. These findings highlight the urgent need for well-designed actions at the national level to address the presented physical inactivity crisis, and the France's Report Card expert panel has identified the top three strategies that should be implemented in priority to improve the lifestyles of French children and youth. In light of the 2024 Olympic Games in Paris, Ministries in charge of education, sports and agriculture launched a call for tenders to encourage the development of educative projects promoting physical activity of children and youths, including children and youth with disabilities.[48] It is hoped that this will generate a real national momentum in terms of financial and political support for the promotion of physical activity and the reduction of screen time for French people, especially in children and youth.

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Tables

Table 1: Evolution of the French Report Card grades from 2016 to 2018 for each physical activity indicator.

Indicator	**2016**	**2018**
Overall Physical Activity	INC	D
Organized Sport and Physical Activity	D	C-
Active Play	NA	INC
Active Transportation	D	C-
Sedentary Behaviors	D	D-
Physical Fitness	NA	B-
Family and Peers	INC	INC
School	B	B
Community and Environment	INC	INC
Government	INC	C
Average	**D**	**C-**

Note: NA = not assigned; INC = incomplete grade.

Table 2: Number and proportion (%) of countries involved in the Global Matrix 3.0 per clustered grade for each indicator. The proportion that includes France is shadowed for each indicator.

Indicator	A	B	C	D	F	INC	NA	2018 France's letter grade
Overall Physical Activity	1 (2.0)	0 (0.0)	9 (18.4)	31 (63.3)	6 (12.2)	2 (4.1)	0 (0.0)	D
Organized Sport and Physical Activity	1 (2.0)	13 (26.5)	18 (36.7)	8 (16.3)	2 (4.1)	7 (14.3)	0 (0.0)	C-
Active Play	0 (0.0)	3 (6.1)	7 (14.3)	8 (16.3)	2 (4.1)	29 (59.2)	0 (0.0)	INC
Active Transportation	3 (6.1)	11 (22.4)	24 (49.0)	8 (16.3)	1 (2.0)	1 (2.0)	1 (2.0)	C-
Sedentary Behaviors	1 (2.0)	6 (12.2)	16 (32.7)	18 (36.7)	5 (10.2)	3 (6.1)	0 (0.0)	D-
Physical Fitness	2 (4.1)	2 (4.1)	8 (16.3)	9 (18.4)	1 (2.0)	27 (55.1)	0 (0.0)	B-
Family and Peers	1 (2.0)	4 (8.2)	11 (22.4)	7 (14.3)	4 (8.2)	22 (44.9)	0 (0.0)	INC
School	4 (8.2)	13 (26.5)	13 (26.5)	11 (22.4)	0 (0.0)	8 (16.3)	0 (0.0)	B
Community and Environment	2 (4.1)	17 (34.7)	9 (18.4)	6 (12.2)	2 (4.1)	13 (26.5)	0 (0.0)	INC
Government	3 (6.1)	13 (26.5)	14 (28.6)	9 (18.4)	2 (4.1)	8 (16.3)	0 (0.0)	C

Note: NA = not assigned; INC = incomplete grade.

Table 3: Country letter grades organized by descending order and average letter grades for each indicator among the 20 Global Matrix 3.0 European countries.

PA		SP		AP		AT		SB		PF	
Average	**D**	**Average**	**C+**	**Average**	**D+**	**Average**	**C**	**Average**	**D+**	**Average**	**C**
Slovenia	A-	Denmark	A-	Netherlands	B	Denmark	B+	Slovenia	B+	Slovenia	A-
Netherlands	C	Sweden	B+	Bulgaria	C+	Finland	B+	Spain	B+	France	B-
England	C-	Flanders	B	Finland	C	Bulgaria	B-	Sweden	C+	Czech Republic	C+
Lithuania	C-	Germany	B	Spain	C-	Netherlands	B-	Flanders	C	Lithuania	C+
Bulgaria	D+	Netherlands	B	Wales	C-	Spain	B-	Guernsey	C	Finland	C
Sweden	D+	Scotland	B	Slovenia	D	Flanders	C+	Jersey	C	Portugal	C
Wales	D+	Spain	B	Czech Republic	D-	Czech Republic	C+	Lithuania	C-	England	C-
Czech Republic	D	Czech Republic	B-	Germany	D-	Poland	C	Netherlands	C-	Poland	C-
Finland	D	Portugal	B-	Estonia	F	Scotland	C	Portugal	C-	Jersey	D
France	D	Bulgaria	C+	Flanders	INC	Slovenia	C	Denmark	D+	Flanders	INC
Guernsey	D	Finland	C+	Denmark	INC	Sweden	C	England	D+	Bulgaria	INC
Portugal	D	Guernsey	C+	England	INC	England	C-	Bulgaria	D	Denmark	INC
Spain	D	Slovenia	C+	France	INC	France	C-	Poland	D	Estonia	INC
Denmark	D-	Wales	C+	Guernsey	INC	Germany	C-	Czech Republic	D-	Germany	INC
Estonia	D-	Estonia	C	Jersey	INC	Lithuania	C-	Finland	D-	Guernsey	INC
Germany	D-	Lithuania	C	Lithuania	INC	Portugal	C-	France	D-	Netherlands	INC
Jersey	D-	France	C-	Poland	INC	Jersey	D+	Germany	D-	Scotland	INC
Poland	D-	England	D+	Portugal	INC	Wales	D+	Estonia	F	Spain	INC
Flanders	F	Poland	D	Scotland	INC	Estonia	D	Scotland	F	Sweden	INC
Scotland	F	Jersey	INC	Sweden	INC	Guernsey	D	Wales	F	Wales	INC

FAM		SCH		COM		GOV		AVG	
Average	**C-**	**Average**	**B-**	**Average**	**B-**	**Average**	**C+**	**Average**	**C-**
Slovenia	B+	Finland	A	Sweden	A	Slovenia	A	Slovenia	B
Finland	B-	Portugal	A	Denmark	B+	Denmark	A-	Denmark	B-
Germany	B-	Slovenia	A	Finland	B+	Finland	A-	Finland	C+
Flanders	C+	Denmark	A-	Germany	B+	Flanders	B	Netherlands	C+
Czech Republic	C+	France	B	Flanders	B	Estonia	B	Portugal	C+
Jersey	C	Poland	B	Czech Republic	B	Portugal	B	Spain	C+
Portugal	C	Czech Republic	B+	Estonia	B	Sweden	B	Sweden	C+
Poland	C-	England	B+	Portugal	B	Czech Republic	C+	Flanders	C
Bulgaria	D	Germany	B+	Slovenia	B	Poland	C+	Czech Republic	C
Estonia	D	Flanders	B-	Scotland	B-	Wales	C+	Germany	C
Lithuania	D	Jersey	B-	Bulgaria	C	France	C	Bulgaria	C-
Wales	D	Estonia	C+	England	C	Lithuania	C	England	C-
Denmark	INC	Lithuania	C+	Jersey	C	Scotland	C	France	C-
England	INC	Spain	C+	Lithuania	C	Guernsey	D	Lithuania	C-
France	INC	Sweden	C+	Poland	C	Jersey	D	Poland	C-
Guernsey	INC	Bulgaria	C	France	INC	Bulgaria	INC	Estonia	D+
Netherlands	INC	Netherlands	C	Guernsey	INC	England	INC	Guernsey	D+
Scotland	INC	Guernsey	INC	Netherlands	INC	Germany	INC	Jersey	D+
Spain	INC	Scotland	INC	Spain	INC	Netherlands	INC	Scotland	D+
Sweden	INC	Wales	INC	Wales	INC	Spain	INC	Wales	D+

Abbreviations: PA, Physical Activity; SP, Organized Sport and Physical Activity; AP, Active Play; AT, Active Transportation; SB, Sedentary Behaviors; PF, Physical Fitness; FAM, Family and Peers; SCH,

School; COM, Community and Environment; GOV, Government; AVG, Average; INC, incomplete grade; N/A, not applicable.

Supplement Material 1: Global Matrix 3.0 indicator benchmarks and grading rubric provided by the Active Healthy Kids Global Alliance

Global Matrix 3.0 indicators and benchmarks used to guide the grade assignment process

Indicator	Benchmark
Overall Physical Activity	% of children and youth who meet the Global Recommendations on Physical Activity for Health, which recommend that children and youth accumulate at least 60 minutes of moderate- to vigorous-intensity physical activity per day on average. Or % of children and youth meeting the guidelines on at least 4 days a week (when an average cannot be estimated).
Organized Sport and Physical Activity	% of children and youth who participate in organized sport and/or physical activity programs.
Active Play	% of children and youth who engage in unstructured/unorganized active play at any intensity for more than 2 hours a day. % of children and youth who report being outdoors for more than 2 hours a day.
Active Transportation	% of children and youth who use active transportation to get to and from places (e.g., school, park, mall, friend's house).
Sedentary Behaviors	% of children and youth who meet the Canadian Sedentary Behaviour Guidelines (5- to 17-year-olds: no more than 2 hours of recreational screen time per day). Note: the Guidelines currently provide a time limit recommendation for screen-related pursuits, but not for non-screen-related pursuits.
Physical Fitness	Average percentile achieved on certain physical fitness indicators based on the normative values published by Tomkinson et al.[76]
Family and Peers	% of family members (e.g., parents, guardians) who facilitate physical activity and sport opportunities for their children (e.g., volunteering, coaching, driving, paying for membership fees and equipment). % of parents who meet the Global Recommendations on Physical Activity for Health, which recommend that adults accumulate at least 150 minutes of moderate-intensity aerobic physical activity throughout the week or do at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week or an equivalent combination of moderate- and vigorous-intensity physical activity. % of family members (e.g., parents, guardians) who are physically active with their kids. % of children and youth with friends and peers who encourage and support them to be physically active. % of children and youth who encourage and support their friends and peers to be physically active.

School	% of schools with active school policies (e.g., daily PE, daily physical activity, recess, "everyone plays" approach, bike racks at school, traffic calming on school property, outdoor time). % of schools where the majority (≥ 80%) of students are taught by a PE specialist. % of schools where the majority (≥ 80%) of students are offered the mandated amount of PE (for the given state/territory/region/country). % of schools that offer physical activity opportunities (excluding PE) to the majority (> 80%) of their students. % of parents who report their children and youth have access to physical activity opportunities at school in addition to PE classes. % of schools with students who have regular access to facilities and equipment that support physical activity (e.g., gymnasium, outdoor playgrounds, sporting fields, multi-purpose space for physical activity, equipment in good condition).
Community and Environment	% of children or parents who perceive their community/municipality is doing a good job at promoting physical activity (e.g., variety, location, cost, quality). % of communities/municipalities that report they have policies promoting physical activity. % of communities/municipalities that report they have infrastructure (e.g., sidewalks, trails, paths, bike lanes) specifically geared toward promoting physical activity. % of children or parents who report having facilities, programs, parks and playgrounds available to them in their community. % of children or parents who report living in a safe neighbourhood where they can be physically active. % of children or parents who report having well-maintained facilities, parks and playgrounds in their community that are safe to use.
Government	Evidence of leadership and commitment in providing physical activity opportunities for all children and youth. Allocated funds and resources for the implementation of physical activity promotion strategies and initiatives for all children and youth. Demonstrated progress through the key stages of public policy making (i.e., policy agenda, policy formation, policy implementation, policy evaluation and decisions about the future).

Global Matrix 3.0 grading rubric

Grade	Interpretation	Corresponding number for analysis
A+	94% - 100%	15
A	We are succeeding with a large majority of children and youth (87% - 93%)	14
A-	80% - 86%	13
B+	74% - 79%	12
B	We are succeeding with well over half of children and youth (67% - 73%)	11
B-	60% - 66%	10
C+	54% - 59%	9
C	We are succeeding with about half of children and youth (47% - 53%)	8
C-	40% - 46%	7
D+	34% - 39%	6
D	We are succeeding with less than half but some children and youth (27% - 33%)	5
D-	20% - 26%	4
F	We are succeeding with very few children and youth (<20%)	2
INC	Incomplete - insufficient or inadequate information to assign a grade	No Grade

Chapter 6: Manuscript 3

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Global Matrix 3.0 Physical Activity Report Card Grades for Children and Youth: Results and Analysis from 49 Countries

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This article summarizes the findings from the 49 Report Cards of physical activity grades that were developed for the Global Matrix 3.0. I am the primary (first) author on this article. Joel Barnes performed the statistical analysis and I wrote a draft manuscript. The co-authors edited the manuscript and approved the final version of the manuscript before it was submitted for peer-review. All co-authors contributed significantly and met the International Committee of Medical Journal Editors guidelines for authorship. This article is now published in open access. The published manuscript and two online supplementary files are presented in this chapter.

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ORIGINAL RESEARCH

Global Matrix 3.0 Physical Activity Report Card Grades for Children and Youth: Results and Analysis From 49 Countries

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Background: Accumulating sufficient moderate to vigorous physical activity is recognized as a key determinant of physical, physiological, developmental, mental, cognitive, and social health among children and youth (aged 5–17 y). The Global Matrix 3.0 of Report Card grades on physical activity was developed to achieve a better understanding of the global variation in child and youth physical activity and associated supports. **Methods**: Work groups from 49 countries followed harmonized procedures to develop their Report Cards by grading 10 common indicators using the best available data. The participating countries were divided into 3 categories using the United Nations' human development index (HDI) classification (low or medium, high, and very high HDI). **Results**: A total of 490 grades, including 369 letter grades and 121 incomplete grades, were assigned by the 49 work groups. Overall, an average grade of "C–," "D+," and "C–" was obtained for the low and medium HDI countries, high HDI countries, and very high HDI countries, respectively. **Conclusions**: The present study provides rich new evidence showing that the situation regarding the physical activity of children and youth is a concern worldwide. Strategic public investments to implement effective interventions to increase physical activity opportunities are needed.

Keywords: global comparison, sedentary behavior, health promotion, international, sport, active transportation

Physical inactivity, defined as engaging in insufficient levels of physical activity and not meeting the current physical activity recommendations,[1] has been identified as the fourth leading risk factor of premature mortality in adulthood.[2] In contrast, accumulating sufficient moderate- to vigorous-intensity physical activity (MVPA) is recognized as a key determinant of physical, mental,

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social, and environmental health.[3,4] Among children and youth (aged 5–17 y), several systematic reviews have reported physical activity benefits on physical, physiological, developmental, mental, cognitive, and social health, as well as academic achievement.[5–10] Despite these benefits, it has been estimated that 80% of youth (11–17 y old) worldwide do not reach the minimum recommendation of 60 minutes of MVPA per day.[11] This is alarming given that physical inactivity among school-aged children and youth has been found to be associated with adverse physical, mental, social, and cognitive health outcomes,[5,8,12,13] lower physical fitness,[14] and lower physical activity levels in later life.[15]

To achieve a better understanding of the global variation in child and youth physical activity and its correlates, the Global Matrix of Report Card grades on physical activity was launched for the first time in 2014.[16] Physical activity Report Cards were developed based on the Canadian Report Card model,[17] using a harmonized process for data gathering, assessing, and assigning grades to indicators. For over a decade, the Canadian Report Card has been successful in raising awareness and influencing policies for childhood physical activity promotion. However, these efforts have not yet translated into improving the physical activity levels of Canadian children and youth.[18] Fifteen countries in 2014 (Global Matrix 1.0) and 38 countries in 2016 (Global Matrix 2.0) developed and launched Report Cards presenting grades for 9 physical activity indicators, allowing for international comparisons and offering insights from global data.[16,19] The first 2 Global Matrices enabled the identification of several gaps in surveillance and research practice. Also, a paradox of higher physical activity and lower sedentary behavior in countries reporting poorer infrastructure, and lower physical activity and higher sedentary behavior in countries reporting better infrastructure was highlighted.[16,19] Although participation in the Global Matrices 1.0 and 2.0 facilitated capacity building, professional networking, research collaborations, and international comparisons, the Global Matrix framework still needs to be continuously expanded, improved, replicated, and widely disseminated.[19]

The Global Matrix initiative is led by the Active Healthy Kids Global Alliance (AHKGA), which is an incorporated not-for-profit organization consisting of researchers, health professionals, and stakeholders who collaborate to advance physical activity in children and youth from around the world.[20] In 2017, the AHKGA invited previous participating countries and called for new countries to register for the Global Matrix 3.0. As a result, work groups from 49 countries completed the full registration process and followed the harmonized procedures to develop their Report Cards by grading 10 common indicators (Overall Physical Activity, Organized Sport and Physical Activity, Active Play, Active Transportation, Sedentary Behaviors, Physical Fitness, Family and Peers, School, Community and Environment, and Government) using the best available data.

Countries in different development stages may have different challenges and priorities to inform strategies to improve physical activity among children and youth. Countries involved in the Global Matrix 3.0 were classified within 3 categories using the human development index (HDI): low and medium HDI (<0.70), high HDI (≥0.70 to <0.80), and very high HDI (≥0.80). The HDI, ranging from 0 to 1, is a composite index calculated using data on education, life expectancy, and income per capita,[21] and was created by the United Nations Development Programme to rank countries on a scale of human development conceptualized in terms of capabilities of humans within the countries to function.[22] Nine of the participating countries were classified as low or medium HDI (Bangladesh, Botswana, Ethiopia, Ghana, India, Nepal, Nigeria, South Africa, and Zimbabwe), 10 as high HDI (Brazil, Bulgaria, China, Colombia, Ecuador, Lebanon, Mexico, Thailand, Uruguay, and Venezuela), and 30 countries and territories as very high HDI

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(Australia, Belgium [Flanders], Canada, Chile, Chinese Taipei [Taiwan], Czech Republic, Denmark, England, Estonia, Finland, France, Germany, Guernsey, Hong Kong, Japan, Jersey, Lithuania, The Netherlands, New Zealand, Poland, Portugal, Qatar, Scotland, Slovenia, South Korea, Spain, Sweden, United Arab Emirates, United States, and Wales).

This special issue of the *Journal of Physical Activity and Health* includes 49 extended abstracts documenting the main Report Card findings from each participating country. In addition to this current paper, 3 papers were developed to present and discuss results from the Report Cards by predetermined HDI categories as follows:

- "The Indicators of Physical Activity among Children and Youth in Nine Countries with Low and Medium Human Development Indices: A Global Matrix 3.0 Paper"[23];
- "Report Card Grades on the Physical Activity of Children and Youth from 10 Countries with High Human Development Index—Global Matrix 3.0"[24];
- "Report Card Grades on the Physical Activity of Children and Youth Comparing 30 Very High Human Development Index Countries."[25]

The aim of this integrated article is to combine and compare the findings from each of the HDI (low and medium, high, and very high) papers and present, compare, and discuss further analyses of the results from the 49 countries participating in the Global Matrix 3.0.

Methods

Creating the Global Matrix 3.0

In April 2017, the AHKGA invited interested countries to participate in and register for the Global Matrix 3.0 through an open call that was distributed via established networks. Between April 2017 and January 2018, 49 countries from 6 different continents (Africa, Asia, Europe, North America, Oceania, and South America) registered and paid a registration fee based on their HDI classification to cover costs associated with the Global Matrix 3.0 initiative. Three different tiers of registration fees ($500 USD for the low HDI countries, $750 USD for the medium HDI countries, $1000 USD for the high HDI countries, and $1500 USD for the very high HDI countries) were offered to encourage equitable participation from around the world. Individuals who registered on behalf of their country were responsible for leading the effort to form a multidisciplinary Report Card work group of national physical activity experts and stakeholders. Furthermore, 1 to 3 Report Card leaders/coleaders per country were designated officially to manage the national Report Card development, and to ensure effective communication between the AHKGA Executive Committee and the Report Card work group.

A mentoring system was developed for the Global Matrix 3.0. New Report Card leaders and teams were paired with an experienced Report Card leader from a country who participated in the Global Matrix 2.0. In addition, 6 members of the Executive Committee of AHKGA were assigned to be regional mentors for each involved continent to provide help and guidance to the countries when needed and report their progress to the AHKGA Executive Committee. Finally, the AHKGA Executive Committee served as the coordinating center of the Global Matrix development and provided information including background papers, previous Report Cards and Report Card papers, fundraising suggestions, and a theoretical framework to support the preparation of grant proposals, scholarship, and funding applications. The AHKGA Executive Committee also provided guidance through monthly e-blasts by sharing milestones and upcoming deadlines.

Harmonized Report Card Development

An updated list of indicators (to which grades would be assigned) and corresponding benchmarks were created based on the previous Global Matrix methods,[19] and feedback received during a workshop after the Global Matrix 2.0 launch in Bangkok, Thailand (November, 2016). A new indicator, Physical Fitness, and its corresponding benchmarks were added to the list. The benchmark for Overall Physical Activity was modified in accordance with the new Canadian 24-Hour Movement Guidelines for Children and Youth,[26] where "at least 60 minutes of MVPA per day" was changed to "at least 60 minutes of MVPA per day *on average*." Further modifications to the benchmarks were made during the development of the Global Matrix 3.0 to address several issues that were reported by Report Card leaders to the AHKGA Executive Committee. The final version of the benchmarks for the 10 indicators is presented in Table 1. A more detailed grading scheme using positive (+) and negative (−) mathematical symbols was also developed (Table 2). In some countries, because of the modifications of the benchmarks from previous Global Matrices, grades for some indicators have changed while in fact, the situation was relatively the same. Consequently, while the Report Card work groups reported grades based on the revised benchmarks for the Global Matrix 3.0, some countries reported different grades in their national Report Grades (ie, to be consistent with their previous methods). For example, in Colombia, with the new benchmark, a "D+" was assigned to Overall Physical Activity for the Global Matrix 3.0, whereas a "D−" is reported in the Colombian country Report Card, based on the previous benchmark.[28]

Each country work group identified and complemented the list of indicators to be graded (ie, the 10 common indicators and potentially additional ones that would be included in their national Report Card but not in the Global Matrix 3.0) and gathered the highest quality of published and unpublished evidence, or in some cases, collected data prospectively. Due to the lack of data concerning physical activity among children in the early years (0–4 y) observed in the previous Global Matrices, consensus was reached among the AHKGA Executive Committee that the 10 indicator grades should only be informed by data from school-aged children and youth (~5–17 y old) for the Global Matrix 3.0 to ensure consistency across countries. Where possible, countries were also advised to consider and synthesize the best available evidence from approximately the past 5 years for each indicator. Through a harmonized and transparent Report Card development process, each country's work group collected and collated the best available evidence from local, national, or international studies, national surveys, official reports, and normative documents, and then synthesized findings and reached consensus for the grading of each indicator. A draft of each country Report Card grades were submitted along with their rationale by Report Card leaders and were audited by members of the AHKGA Executive Committee to ensure that the grades were consistent with the harmonized benchmarks and grading scheme. This audit process led to minor changes of the grades or rationale for most of the countries.

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Table 1 Global Matrix 3.0 Indicators and Benchmarks Used to Guide the Grade Assignment Process

Indicator	Benchmark
Overall Physical Activity	% of children and youth who meet the Global Recommendations on Physical Activity for Health, which recommend that children and youth accumulate at least 60 min of moderate- to vigorous-intensity physical activity per day on average. Or % of children and youth meeting the guidelines on at least 4 d a week (when an average cannot be estimated).
Organized Sport and Physical Activity	% of children and youth who participate in organized sport and/or physical activity programs.
Active Play	% of children and youth who engage in unstructured/unorganized active play at any intensity for more than 2 h a day. % of children and youth who report being outdoors for more than 2 h a day.
Active Transportation	% of children and youth who use active transportation to get to and from places (eg, school, park, mall, friend's house).
Sedentary Behaviors	% of children and youth who meet the Canadian Sedentary Behaviour Guidelines (5- to 17-y-olds: no more than 2 h of recreational screen time per day). Note: the Guidelines currently provide a time limit recommendation for screen-related pursuits, but not for nonscreen-related pursuits.
Physical Fitness	Average percentile achieved on certain physical fitness indicators based on the normative values published by Tomkinson et al.[27]
Family and Peers	% of family members (eg, parents, guardians) who facilitate physical activity and sport opportunities for their children (eg, volunteering, coaching, driving, paying for membership fees and equipment). % of parents who meet the Global Recommendations on Physical Activity for Health, which recommend that adults accumulate at least 150 min of moderate-intensity aerobic physical activity throughout the week or do at least 75 min of vigorous-intensity aerobic physical activity throughout the week or an equivalent combination of moderate- and vigorous-intensity physical activity. % of family members (eg, parents, guardians) who are physically active with their kids. % of children and youth with friends and peers who encourage and support them to be physically active. % of children and youth who encourage and support their friends and peers to be physically active.
School	% of schools with active school policies (eg, daily physical education (PE), daily physical activity, recess, "everyone plays" approach, bike racks at school, traffic calming on school property, outdoor time). % of schools where the majority (≥80%) of students are taught by a PE specialist. % of schools where the majority (≥80%) of students are offered the mandated amount of PE (for the given state/territory/region/country). % of schools that offer physical activity opportunities (excluding PE) to the majority (>80%) of their students. % of parents who report their children and youth have access to physical activity opportunities at school in addition to PE classes. % of schools with students who have regular access to facilities and equipment that support physical activity (eg, gymnasium, outdoor playgrounds, sporting fields, multipurpose space for physical activity, equipment in good condition).
Community and Environment	% of children or parents who perceive their community/municipality is doing a good job at promoting physical activity (eg, variety, location, cost, quality). % of communities/municipalities that report they have policies promoting physical activity. % of communities/municipalities that report they have infrastructure (eg, sidewalks, trails, paths, bike lanes) specifically geared toward promoting physical activity. % of children or parents who report having facilities, programs, parks, and playgrounds available to them in their community. % of children or parents who report living in a safe neighborhood where they can be physically active. % of children or parents who report having well-maintained facilities, parks, and playgrounds in their community that are safe to use.
Government	Evidence of leadership and commitment in providing physical activity opportunities for all children and youth. Allocated funds and resources for the implementation of physical activity promotion strategies and initiatives for all children and youth. Demonstrated progress through the key stages of public policy making (ie, policy agenda, policy formation, policy implementation, policy evaluation and decisions about the future).

Data Analysis

For analysis purposes, the 49 participating countries and regions were divided into 3 categories using the United Nations' HDI classification (low or medium, high, and very high HDI) described above. Sociodemographic data that are available online were compiled to identify the characteristics of the participating countries. Descriptive statistics (average grade and standard deviation) were calculated after converting categorical variables (letter grades) to interval variables (see corresponding numbers in Table 2), and the incomplete (INC) grades were converted into null values, which were treated as missing values. Averages were calculated by country, indicator, and category of HDI from the interval values, and the floor (the number rounded down) was converted back to a letter grade. Three scores were generated for the analysis: (1) overall score computed as the sum of interval values for all indicators, (2) behavioral score (the sum of Overall Physical Activity, Organized Sport and Physical Activity, Active Play, Active Transportation, and Sedentary Behaviors interval values), and (3) sources of influence score (the sum of Family and Peers, School, Community and Environment, and Government interval values). "INC" grades were removed, and the scores were reweighted accordingly (ie, the missing grade was replaced by the sum of the interval values divided by the number of letter grades included in the score). Categorical variables (letter grades) were grouped into 4 ("A–B," "C," "D–F," and "No Grade") based on the

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Table 2 Global Matrix 3.0 Grading Rubric

Grade	Interpretation	Corresponding number for analysis
A+	94%–100%	15
A	We are succeeding with a large majority of children and youth (87%–93%)	14
A–	80%–86%	13
B+	74%–79%	12
B	We are succeeding with well over half of children and youth (67%–73%)	11
B–	60%–66%	10
C+	54%–59%	9
C	We are succeeding with about half of children and youth (47%–53%)	8
C–	40%–46%	7
D+	34%–39%	6
D	We are succeeding with less than half but some children and youth (27%–33%)	5
D–	20%–26%	4
F	We are succeeding with very few children and youth (<20%)	2
INC	Incomplete—insufficient or inadequate information to assign a grade	No grade

overall score. These categories were then used to rank countries by the letter grade/score and category level in scatter plots. Correlational analyses between the 10 common indicators and sociodemographic indicators were performed using Spearman's rank correlation coefficients. Only significant moderate to strong correlations were considered for the discussion in this analysis ($r \geq .30$ or $r \leq -.30$, $P < .05$).[29] Pairwise deletion was used to treat missing data (INC grades) in order to minimize the number of cases excluded from the analysis. All statistical analyses were performed, and maps were created in R version 3.4.1 (The R Foundation for Statistical Computing, Vienna, Austria). Several packages were loaded to extend base R including corrplot,[30] ggplot2,[31] UpSetR,[32] and VIM.[33]

Results

A total of 52 countries responded to the AHKGA and showed interest in participation in the Global Matrix 3.0, but only 51 fully registered on time, and later on 2 countries withdrew. Sociodemographic characteristics of the 49 countries participating in the Global Matrix 3.0 are presented in Table 3. The HDI scores ranged from 0.448 (Ethiopia) to 0.985 (Jersey). Ethiopia also scored the lowest for the following: growth national income per capita ($1523 USD), mean years of schooling (2.6 y), global food security index (33.3), urban population percentage (17.2%), and prevalence of people using improved drinking water sources (44%). Qatar scored highest in the growth national income per capita ($129,916 USD) and the gender inequality index (0.542). Public health expenditure in percentage of Gross Domestic Product was the highest in Sweden (10.0%) and the lowest in Venezuela (1.5%). Life expectancy at birth ranged from 53.1 years in Nigeria to 84.2 years in Hong Kong. Hong Kong also had the highest urban population percentage (100%) and the highest population density (6987 people/km^2 of land area). The lowest Gini index (least income inequality) was observed in Slovenia (25.4) and the highest (greatest income inequality) in Botswana (60.5).

The physical activity grades for the 10 common indicators are organized by country in alphabetical order (Table 4). A total of 490 grades, including 369 letter grades and 121 "INC" grades, were assigned by the 49 Report Card work groups. A "not applicable" grade was assigned to Active Transportation by Qatar's Report Card work group because of unsafe road conditions and a hot climate during most of the year.[45] The grade count, number of "INC" grades, mean number grade, SD, and mean letter grade by indicator and group of indicators are presented in Table 5. The indicators with the lowest number of "INC" grades were Overall Physical Activity and Active Transportation (n = 2), whereas the indicator with the highest number of "INC" grades was Active Play (n = 29), followed by Physical Fitness (n = 27), and Family and Peers (n = 22). The mean letter grades ranged from "D" for Overall Physical Activity to "C" for Organized Sport and Physical Activity, Active Transportation, School, Community and Environment, and Government. An average grade of "C–" was obtained for the behavioral indicators, "C" for the sources of influence indicators, and "C–" was the overall average grade for the 369 letter grades. The average letter grades by indicator and group of indicators for the low or medium, high, and very high HDI countries are presented in Table 6. For the low or medium HDI countries, an average of "C" was obtained for the behavioral indicators and "D+" for the source of influence indicators, whereas for the very high HDI countries, an average of "D+" was obtained for the behavioral indicators and "C+" for the sources of influence indicators. For the high HDI countries, an average of "D+" was obtained for the behavioral indicators and for the sources of influence indicators. Overall, an average grade of "C–," "D+," and "C–" was obtained for the low and medium HDI countries, high HDI countries, and very high HDI countries, respectively.

A plot for the estimated overall score of each country from the 10 indicators is presented in Figure 1, and the behavioral and sources of influence scores are shown in Figures 2 and 3, respectively. Slovenia ranked first, whereas China ranked 49th for the overall score (full rankings are shown in Figure 1); Nepal ranked first, and Estonia ranked last for the behavioral score (complete rankings are shown in Figure 2); and Slovenia ranked first, whereas Venezuela ranked last for the source of influence score (see all country rankings in Figure 3). The Supplementary Material 1 (available online) presents the correlation coefficients and their associated P values between and within the 10 core physical activity indicators and the sociodemographic indicators. It showed that there were no statistically significant relationships between the

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Table 3 Sociodemographic Information of the 49 Countries in the Global Matrix 3.0

Country (in alphabetical order)	HDI[a]	GNI per capita,[a] USD	Public health expenditure (% of GDP)[a]	GII[a]	Life expectancy at birth,[a] y	Mean years of schooling,[a] y	Gini index[b]	Global food security index[c]	Urban population percentage[d]	Improved drinking water coverage,[d] %	Population density (people/km^2 of land area)[e]	Summer Olympic medal count[f]	Distance to the equator,[g] km
Australia	0.939	42,822	6.3	0.12	82.5	13.2	34.7	83.3	89.4	100	3	497	2796
Bangladesh	0.579	3341	3.7	0.52	72	5.2	32.4	39.7	28.9	81	1252	0	2620
Belgium (Flanders)	0.896	41,243	8.3	0.073	81	11.4	27.7	79.8	97.5	100	374	148	5597
Botswana	0.698	14,663	5.1	0.435	71.7	11.9	60.5	59.4	62.3	96	4	1	2470
Brazil	0.754	14,145	3.8	0.414	74.7	7.8	51.3	67.7	84.9	98	25	128	1574
Bulgaria	0.794	16,261	4.6	0.223	74.3	10.8	37.4	62.9	73.7	100	66	218	4733
Canada	0.92	42,582	7.4	0.098	82.2	13.1	34	82.2	80.8	100	4	302	6223
Chile	0.847	21,665	3.9	0.322	82	9.9	47.7	74.7	89.4	96	24	13	3949
China	0.738	13,345	3.1	0.164	76	7.6	42.2	63.7	51.9	91	147	546	3970
Colombia	0.727	12,762	5.4	0.393	74.2	7.6	50.8	60.1	75.6	92	44	28	505
Czech Republic	0.878	28,144	6.3	0.129	78.8	12.3	25.9	75.8	73.4	100	137	56	5521
Denmark	0.925	44,519	9.2	0.041	80.4	12.7	28.2	80.3	87.1	100	136	194	6238
Ecuador	0.739	10,536	4.5	0.391	76.1	8.3	45	55.2	68	94	66	2	202
England	0.909	37,931	7.6	0.131	80.8	13.3	33.2	84.2	79.7	100	271	NA	5803
Estonia	0.865	26,362	5	0.131	77	12.5	32.7	NA	69.5	98	31	34	6498
Ethiopia	0.448	1523	4.7	0.499	64.6	2.6	39.1	33.3	17.2	44	102	53	1011
Finland	0.895	38,868	7.3	0.056	81	11.2	27.1	81	83.8	100	18	303	6868
France	0.897	38,085	9	0.102	82.4	11.6	32.7	82.3	86.4	100	122	716	5121
Germany	0.926	45,000	8.7	0.066	81.1	13.2	31.7	82.5	74.1	100	236	1346	5671
Ghana	0.579	3839	4.8	0.547	61.5	6.9	42.4	47.9	52.6	86	124	4	879
Guernsey Channel Islands*	0.975	NA	NA	NA	82.6	NA	40	NA	31.7	NA	850	NA	5481
Hong Kong	0.917	54,265	NA	NA	84.2	11.6	NA	NA	100	NA	6987	3	2478
India	0.624	5663	3.9	0.53	68.3	6.3	35.1	48.9	31.6	92	445	28	2278
Japan	0.903	37,268	8.6	0.116	83.7	12.5	32.1	79.5	91.9	100	348	439	4008
Jersey**	0.985	NA	NA	NA	81.9	NA	41	NA	31.7	NA	845	NA	5453
Lebanon	0.763	13,312	3	0.381	79.5	8.6	31.8	NA	87.4	100	587	4	3748
Lithuania	0.848	26,006	4.4	0.121	73.5	12.7	37.4	NA	67.2	92	46	25	6116
Mexico	0.762	16,383	3.3	0.345	77	8.6	43.4	65.8	78.4	96	66	69	2615
Nepal	0.558	2337	5.4	0.497	70	4.1	32.8	44.5	17.3	89	202	0	3142
The Netherlands	0.924	46,326	9.5	0.044	81.7	11.9	29.3	82.8	83.6	100	506	285	5778
New Zealand	0.915	32,870	9.1	0.158	82	12.5	NA	81	86.3	100	18	117	4530
Nigeria	0.527	5443	5.3	NA	53.1	6	43	38.4	50.3	58	204	25	1004

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Table 3 *(continued)*

Country (in alphabetical order)	HDI[a]	GNI per capita,[a] USD	Public health expenditure (% of GDP)[a]	GII[a]	Life expectancy at birth,[a] y	Mean years of schooling,[a] y	Gini index[b]	Global food security index[c]	Urban population percentage[d]	Improved drinking water coverage,[d] %	Population density (people/km^2 of land area)[e]	Summer Olympic medal count[f]	Distance to the equator,[g] km
Poland	0.855	24,117	4.5	0.137	77.6	11.9	31.8	74.1	60.8	NA	124	284	5754
Portugal	0.843	26,104	6.2	0.091	81.2	8.9	35.5	79	61.6	99	113	24	4363
Qatar	0.856	129,916	1.9	0.542	78.3	9.8	NA	73.3	98.9	100	221	5	2805
Scotland	0.909	37,931	7.6	0.131	80.8	13.3	33.2	84.2	79.7	100	271	NA	6263
Slovenia	0.89	28,664	6.6	0.053	80.6	12.1	25.4	NA	49.8	99	103	23	5113
South Africa	0.666	12,087	8.5	0.394	57.7	10.3	63	64	62.4	91	46	86	3382
South Korea	0.901	34,541	4	0.067	82.1	12.2	31.6	NA	83.5	98	526	267	3975
Spain	0.884	32,779	6.4	0.081	82.8	9.8	36.2	78.1	77.6	100	93	150	4481
Sweden	0.913	46,251	10	0.048	82.3	12.3	29.2	81.7	85.4	100	24	494	6668
Taiwan***	0.885	45,582	NA	NA	80.2	NA	33.6	NA	NA	NA	NA	24	2622
Thailand	0.74	14,519	5.6	0.366	74.6	7.9	37.8	58.3	34.4	96	135	33	1755
United Arab Emirates	0.84	66,203	2.6	0.232	77.1	9.5	NA	70.9	84.7	100	111	2	2592
United States	0.92	53,245	8.3	0.203	79.2	13.2	41.5	84.6	82.6	99	35	2522	4107
Uruguay	0.795	19,148	6.1	0.284	77.4	8.6	39.7	69.7	92.6	100	20	10	3600
Venezuela	0.767	15,129	1.5	0.461	74.4	9.4	46.9	50.2	93.7	93	36	15	710
Wales	0.909	37,931	7.6	0.131	80.8	13.3	33.2	84.2	79.7	100	271	NA	5778
Zimbabwe	0.516	1588	NA	0.54	59.2	7.7	43.2	NA	39.1	80	42	8	2103

Abbreviations: GDP, Gross Domestic Product; GII, gender inequality index; GNI, gross national income; HDI, human development index; NA, not available. Note: For England, Scotland, and Wales, the official data for UK were reported.

Sources of information: [a]United Nations Developement Programme[21]; [b and c]the World Bank[34,35]; [c]the Economist Intelligence Unit[36]; [d]United Nations, Department of Economic and Social Affairs[37]; [f]the Wikimedia Foundation[38]; and [g]the distance to the Equator was calculated from the latitude and longitude from *LatLong.net*.[39]

*For Guernsey, the HDI sourced from the United Nations Economic and Social Commission for Asia and the Pacific[40]; the life expectancy at birth, population size, and the population density sourced from the United States Central Intelligence Agency[41]; and the Gini index sourced from the State of Guernsey.[42] **For Jersey, the HDI sourced from the United Nations Economic and Social Commission for Asia and the Pacific[40]; the life expectancy at birth, population size, and the population density sourced from the United States Central Intelligence Agency[41]; and the Gini index sourced from the State of Jersey.[43] ***For Taiwan, the HDI, the GNI per capita, the life expectancy at birth, and the Gini index come from the National Statistics, Republic of China (Taiwan).[44]

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Table 4 Grades Assigned to the 10 Core Physical Activity Indicators for the 49 Countries of the Global Matrix 3.0

	PA	SP	AP	AT	SB	PF	FAM	SCH	COM	GOV	AVG
Australia	D–	B–	INC	D+	D–	D+	C+	B+	A–	D	C–
Bangladesh	C–	INC	INC	C–	A–	INC	INC	INC	INC	C–	C
Belgium (Flanders)	F	B	INC	C+	C	INC	C+	B–	B	B	C
Botswana	INC	INC	D–	C	B–	INC	INC	C–	INC	C	C–
Brazil	D	C+	D+	C	D–	D	C–	C	C–	D+	D+
Bulgaria	D+	C+	C+	B–	D	INC	D	C	C	INC	C–
Canada	D+	B+	D	D–	D+	D	C+	B–	B+	C+	C–
Chile	D–	D–	INC	F	C–	D	F	D	B	B–	D
China	F	D–	D+	C+	F	D	D+	D+	F	F	D–
Colombia	D+	C	INC	B	D+	D–	INC	D	B–	B	C–
Czech Republic	D	B–	D–	C+	D–	C+	C+	B+	B	C+	C
Denmark	D–	A–	INC	B+	D+	INC	INC	A–	B+	A–	B–
Ecuador	D	INC	INC	C–	C	INC	F	INC	D+	INC	D
England	C–	D+	INC	C–	D+	C–	INC	B+	C	INC	C–
Estonia	D–	C	F	D	F	INC	D	C+	B	B	D+
Ethiopia	D	C	B	C	F	INC	F	D	F	D	D
Finland	D	C+	C	B+	D–	C	B–	A	B+	A–	C+
France	D	C–	INC	C–	D–	B–	INC	B	INC	C	C–
Germany	D–	B	D–	C–	D–	INC	B–	B+	B+	INC	C
Ghana	C	C+	B–	C+	INC	INC	F	D	D+	D	D+
Guernsey	D	C+	INC	D	C	INC	INC	INC	INC	D	D+
Hong Kong	C–	C	INC	B+	C–	D	D–	C	B	C	C–
India	D	INC	C–	B–	C–	F	D	INC	D	D	D
Japan	INC	B–	INC	A–	C–	A	C–	B+	B–	B	B–
Jersey	D–	INC	INC	D+	C	D	C	B–	C	D	D+
Lebanon	D	F	INC	D	C–	INC	INC	D	INC	C+	D
Lithuania	C–	C	INC	C–	C–	C+	D	C+	C	C	C–
Mexico	D+	C	INC	C+	D–	INC	INC	D+	D+	C	D+
Nepal	D+	INC	INC	A–	B+	INC	A	INC	C–	INC	B–
The Netherlands	C	B	B	B–	C–	INC	INC	C	INC	INC	C+
New Zealand	D–	B	C+	C–	D	INC	C–	B–	B	B+	C
Nigeria	C	C–	C	B	B–	INC	INC	C–	INC	B	C
Poland	D–	D	INC	C	D	C–	C–	B	C	C+	C–
Portugal	D	B–	INC	C–	C–	C	C	A	B	B	C+
Qatar	D	D+	INC	N/A	D+	INC	INC	C	INC	B+	C–
Scotland	F	B	INC	C	F	INC	INC	INC	B–	C	D+
Slovenia	A–	C+	D	C	B+	A–	B+	A	B	A	B
South Africa	C	D	INC	C	INC	INC	C–	D–	C–	C	D+

(continued)

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Table 4 *(continued)*

	PA	SP	AP	AT	SB	PF	FAM	SCH	COM	GOV	AVG
South Korea	F	C	INC	B+	D	D+	INC	D+	INC	D	D+
Spain	D	B	C–	B–	B+	INC	INC	C+	INC	INC	C+
Sweden	D+	B+	INC	C	C+	INC	INC	C+	A	B	C+
Taiwan	F	D–	INC	C–	C–	B–	INC	B+	B+	B+	C
Thailand	D–	C–	F	C	D–	INC	B	B	B–	B+	C–
United Arab Emirates	F	INC	INC	INC	C–	INC	INC	D–	INC	B+	D+
United States	D–	C	INC	D–	D	C–	INC	D–	C	INC	D
Uruguay	D	F	INC	C	C–	C–	INC	C–	INC	D	D
Venezuela	D	D	INC	B–	INC	INC	INC	INC	D–	F	D
Wales	D+	C+	C–	D+	F	INC	D	INC	INC	C+	D+
Zimbabwe	C+	B	D+	A–	B	INC	INC	C	D	C–	C

Abbreviations: AP, Active Play; AT, Active Transportation; AVG, Average; COM, Community and Environment; FAM, Family and Peers; GOV, Government; INC, incomplete grade; N/A, not applicable; PA, Physical Activity; PF, Physical Fitness; SB, Sedentary Behaviors; SCH, School; SP, Organized Sport and Physical Activity.

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Table 5 Descriptive Statistics of the Grades by Indicator and Groups of Indicators for the 49 Countries of the Global Matrix 3.0

	Grade count	Incomplete grades	Mean number grade	SD	Mean letter grade
Overall Physical Activity	47	2	5.2	2.1	D
Organized Sport and Physical Activity	42	7	8.2	2.7	C
Active Play	20	29	6.5	2.7	D+
Active Transportation	47	2	8.3	2.5	C
Sedentary Behaviors	46	3	6.4	2.8	D+
Physical Fitness	22	27	7.1	2.9	C–
Family and Peers	27	22	7.0	3.1	D+
School	41	8	8.8	3.0	C
Community and Environment	36	13	8.9	3.0	C
Government	41	8	8.6	3.1	C
Behavioral indicators	**49**	**0**	**7.0**	**1.6**	**C–**
Sources of influence indicators	**49**	**0**	**8.3**	**2.5**	**C**
All indicators	**49**	**0**	**7.5**	**1.6**	**C–**

Note: Behavioral indicators = average of Overall Physical Activity, Organized Sport and Physical Activity, Active Play, Active Transportation, and Sedentary Behavior indicator grades; sources of influence indicators = average of Family and Peers, School, Community and Environment, and Government indicator grades. Physical Fitness was not included in the behavioral indicators cluster. There are no missing grades for the bottom 3 rows (bolded) because these scores are adjusted for missing grades.

Table 6 Average Grades by Indicator and Group of Indicators for the 3 HDI Categories (Low or Medium, High, and Very High)

	Low and medium HDI	High HDI	Very high HDI
Overall Physical Activity	C–	D–	D–
Organized Sport and Physical Activity	C	D+	C+
Active Play	C–	D	D+
Active Transportation	C+	C	C–
Sedentary Behaviors	C+	D	D+
Physical Fitness	F	D	C–
Family and Peers	D+	D+	C–
School	D+	C–	C+
Community and Environment	D	D+	B–
Government	C–	D+	C+
Behavioral indicators	**C**	**D+**	**D+**
Sources of influence indicators	**D+**	**D+**	**C+**
All indicators	**C–**	**D+**	**C–**

Abbreviation: HDI, human development index. Note: Behavioral indicators = average of Overall Physical Activity, Organized Sport and Physical Activity, Active Play, Active Transportation, and Sedentary Behavior indicator grades; sources of influence indicators = average of Family and Peers, School, Community and Environment, and Government indicator grades. Physical Fitness was not included in the behavioral indicators cluster. There are no missing grades for the bottom 3 rows (bolded) because these scores are adjusted for missing grades.

Overall Physical Activity grade and the other core indicator grades with the exception of Sedentary Behaviors for which a statistically significant positive moderate correlation was observed ($r = .39$, $P < .05$). Finally, presented in the Supplementary Material 2 (available online) is the distribution of the grades ("A–B," "C," "D–F," or "INC" grades) for the 10 common indicators and the average grades per country. Slovenia was the only country out of 49 with a very high grade for Overall Physical Activity ("A–"), whereas most of the other countries had "D–F" (n = 38). A greater variability in grades was observed for Sedentary Behaviors, but poor grades ("D–F") were observed in most of the very high HDI countries.

Discussion

As a result of the efforts of the Report Card work groups, the Global Matrix 3.0 allowed us to present physical activity-related indicators for children and youth assembled across 49 countries with varying levels of human development (9 low or medium HDI, 10 high HDI, and 30 very high HDI countries). While the average grades calculated for the indicators were all between "D" and "C" (Table 5), a great variety of grades was observed within and across the countries (Table 4), showing that every country is facing unique challenges and can learn from the successes or difficulties experienced by

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Figure 1 — Plot of the overall score estimated for the 10 core indicators for the 49 countries of the Global Matrix 3.0. Note: The overall score was adjusted for missing and incomplete grades. The number in parenthesis shows the number of grades available for the calculation of the score.

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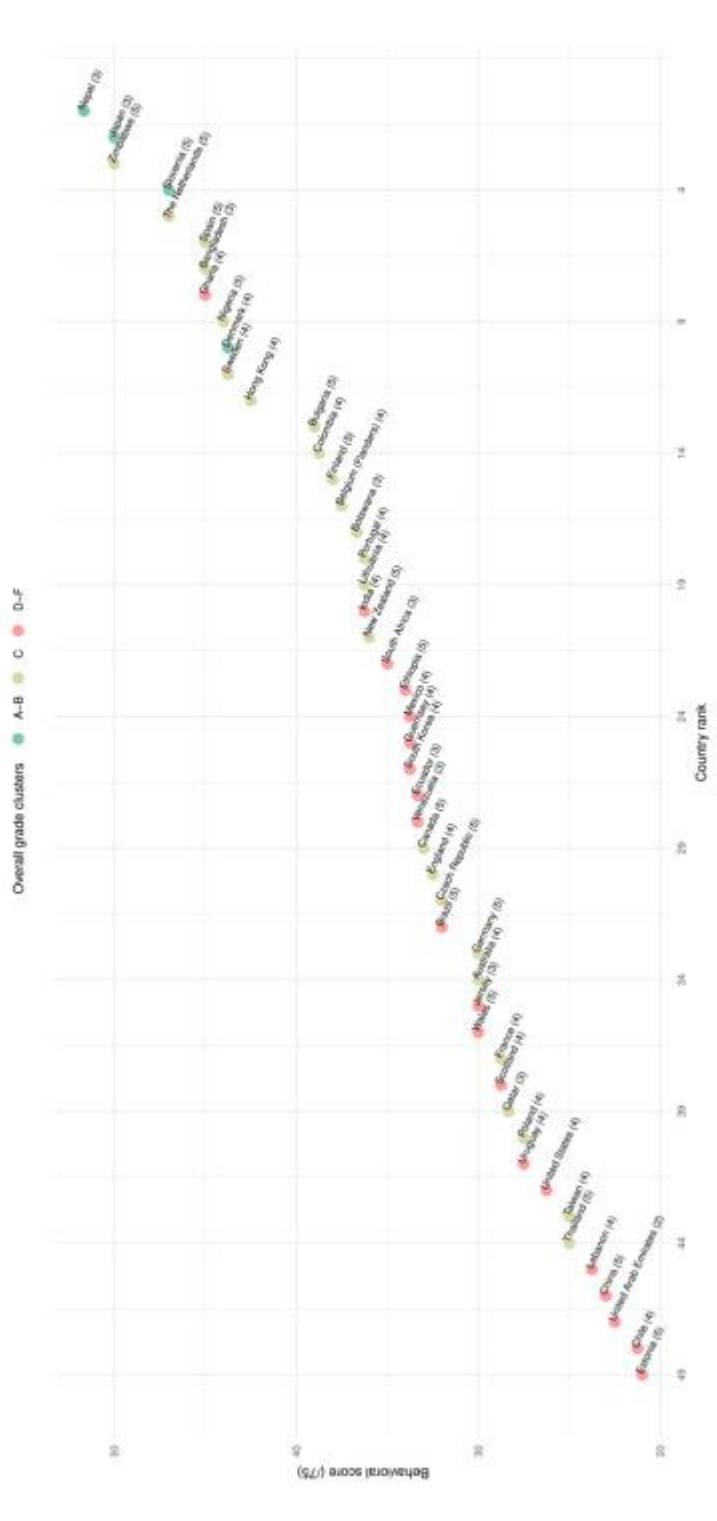

Figure 2 — Plot of the behavioral score estimated for the 49 countries of the Global Matrix 3.0. Note: The behavioral score was adjusted for missing and incomplete grades. The number in parenthesis shows the number of grades available for the calculation of the score.

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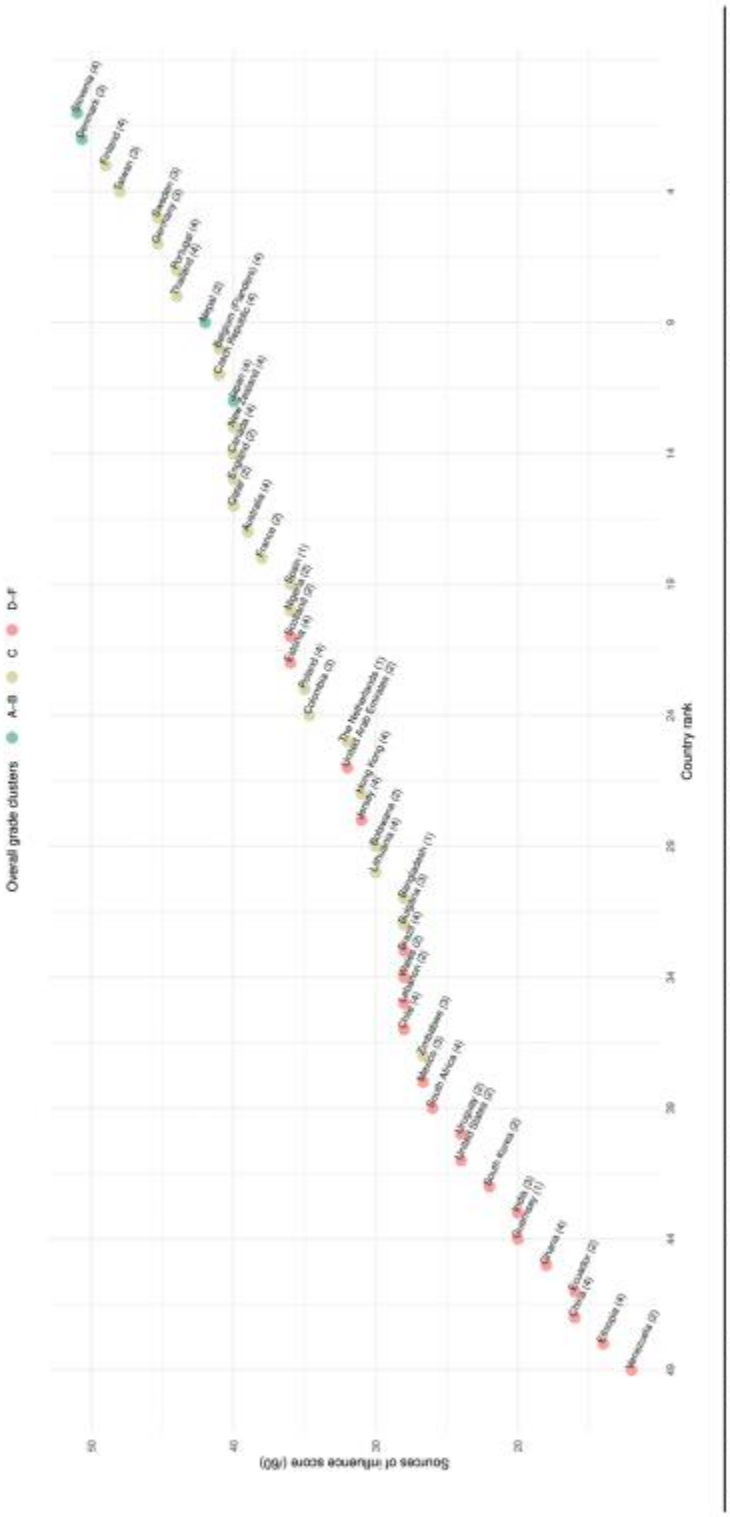

Figure 3 — Plot of the source of influence indicators score for the 49 countries of the Global Matrix 3.0. Note: The source of influence score was adjusted for missing and incomplete grades. The number in parenthesis shows the number of grades available for the calculation of the score. These estimates of sources of influence score are interpreted with a high degree of caution as they are likely imprecise estimates of sources of influence due to the level of missing data used to determine this score.

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others. However, trends and comparable challenges identified across the physical activity indicators were identified within countries in the same HDI grouping despite their diverse sociodemographic, cultural, and geographical contexts. A discussion of the most and the least successful countries, followed by the interpretation of the findings from each indicator is presented in the following section, integrating the comparison of each HDI grouping.

Most Successful Countries

On the overall score, the very high HDI countries ranked generally higher than the low and medium, and high HDI countries (Figure 1), but this is not corroborated with results presented in Table 6 where the overall averages were the same for the low and medium HDI countries and the very high HDI countries. Slovenia obtained the best grade on average ("B"), followed by 2 other very high HDI countries (Japan and Denmark) that both obtained an average grade of "B–." The specifics of childhood physical activity in these 3 countries have already been discussed in the paper presenting the findings from the very high HDI countries.[25] These 3 countries were also leading the ranking based on the sources of influence score (Figure 3). The ranking of the behavioral score was dominated by 2 low HDI countries (Nepal and Zimbabwe) and Japan (Figure 2). These rankings should be interpreted with caution given the large number of "INC" grades in their country Report Cards (2 in Japan, 3 in Denmark, 5 in Nepal, and 2 in Zimbabwe).

Nepal lacked data to inform 5 of the 10 indicators that were assigned an "INC" grade (Organized Sport and Physical Activity, Active Play, Physical Fitness, School, and Government). A "D+" was assigned to Overall Physical Activity based on a study that found that only 39.8% of children and youth accumulated at least 60 minutes of MVPA per day. Nevertheless, Nepal shared the best grade for Active Transportation with Japan and Zimbabwe ("A–"), obtained a high grade for Sedentary Behaviors ("B+") and also scored highest for the Family and Peers indicator ("A"). These grades were all informed by local studies focusing on adolescents.[46] Nepal's good grades in many of the indicators including Active Transportation and Sedentary Behavior may be associated with low automobile dependency (eg, 7.12 vehicles for 1000 people in 2011)[47] and minimal opportunities and access to screen-based recreational sedentary pursuits such as television and computer time and time spent using the Internet. Nepal had 5.30 televisions per 1000 people (as of 2003), 4.37 computer (as of 2004), and 4.51 Internet subscribers (as of 2012) for 1000 people.[48] Due to the concurrent economic development in recent years in Nepal, the number of motorized vehicles is increasing rapidly with the expansion of road networks in rural areas,[49] and potentially more people have access to screen devices. These findings should be interpreted with caution, but they do suggest that the situation can potentially be positive in Nepal in terms of child and youth's active transportation and sedentary behaviors at present. Yet, these favorable behaviors might be threatened by the economic growth and development, and these physical activity behaviors may be more a function of poor economic development than a freely chosen physical activity. Nonetheless, more good quality research with nationally representative data is needed to obtain more reliable estimates of the physical activity of children and youth and to inform the grades with "INC" grades.

Zimbabwe had the second-best grade for Overall Physical Activity ("C+") after Slovenia, with high grades for most of the behavioral indicators ("B" for Organized Sport and Physical Activity, "A–" for Active Transportation, and "B" for Sedentary Behaviors); however, its sources of influence indicators were assigned grades between "D" and "C." In comparison with the previous Report Card in Zimbabwe, the grades for School, Community and Environment, and Government, have improved due to recent policy implementations and commitments made by the government to promote physical activity and nutritional status among Zimbabwean children and youth.[50] However, there is need for caution in interpreting these grades as they were informed by limited and mostly unpublished data and expert opinion. Thus, more research is needed to obtain a reliable picture of the context of the physical activity level of children and youth in Zimbabwe.

Least Successful Countries

One low HDI country, Ethiopia, and 2 high HDI countries, Venezuela and China, were the least successful countries based on the overall and the source of influence score rankings (Figures 1 and 3). An average grade of "D–" was assigned to China, and an average grade of "D" was assigned to Ethiopia and Venezuela. China's Report Card work group developed a national surveillance protocol to collect nationally representative data for China's 2018 Report Card.[51] An "F" was assigned to 4 indicators (Overall Physical Activity, Sedentary Behaviors, Community and Environment, and Government) and the remaining indicators were assigned grades between "D–" and "C+." The small proportions of 9- to 17-year-old children in China meeting the physical activity guidelines (13.1%) or the sedentary behavior guidelines (7.1%) are alarming.[51] With an estimated population of 1.4 billion,[52] China is the most populated country in the world, and the low prevalence estimates observed here suggest that the majority of a large number of children and youth (approximately 160 million of 10- to 19-y-olds in 2015)[52] are not engaging in sufficient amounts of MVPA to benefit their health. However, the high level of air pollution in China represents a major threat to the promotion of physical activity[53] and is a potential barrier stopping the Chinese children and youth from exercising. The recent support from the Chinese Ministry of Education in conducting national surveillance of children physical activity is however encouraging, and hopefully this support will be expanded to future investments in the development of interventions and policies designed to increase physical activity opportunities at community and environment levels in China.

In Ethiopia, an "F" was assigned to Sedentary Behaviors, Family and Peers, and Community and Environment, and the grades for the remaining indicators ranged between "D" and "C," with the exception of Active Play that was graded "B." These findings should be interpreted with caution as the grades were informed by estimates based on experts' opinion when data for an indicator were unavailable.[54] This method, nevertheless, did allow the Report Card work group to present an initial broad picture of childhood physical activity in Ethiopia.

Venezuela is currently facing a humanitarian crisis related to its economic and sociopolitical situation. Between 2016 and 2017, marked increases in maternal mortality (65%), infant mortality (30%), and cases of malaria (76%) were observed, and the estimated prevalence of severe malnutrition among children under 5 years of age increased from 10.2% in February 2017 to 14.5% in September 2017.[55] Nevertheless, a Report Card was developed, using published and unpublished national survey data, peer-reviewed literature, government and nongovernment reports and online content, and meetings with experts working for governmental (municipal) and nongovernmental organizations.[56] The Venezuelan Report Card work group assigned an "INC" grade to

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5 indicators: Active Play, Sedentary Behaviors, Physical Fitness, Family and Peers, and School. An "F" grade was assigned to the Government indicator while the remaining indicators were graded "D" or "D–," with the exception of Active Transportation which was graded "B–." Although there were no physical activity data available for those under 15 years of age, the work group found that the majority of adolescents older than 15 years do not engage in physical activity regularly. In addition, the high rates of crime were identified as a barrier to physical activity. Currently, no governmental efforts to ensure safety and promote an active lifestyle in Venezuela are being implemented.[56]

Overall Physical Activity

Only 2 countries assigned "INC" grades to the Overall Physical Activity indicator: Japan and Botswana. Slovenia, where more than 80% of children and youth aged between 6 and 19 years (according to subjective self-reported data), 88% of the 11-year-olds, and 66% of the 14-year-olds (according to objective data) were meeting the physical activity guidelines, was the only country reporting a high grade for this indicator ("A–").[57] For this indicator, the grades for the remaining countries ranged from "F" (Belgium, China, Scotland, South Korea, and Taiwan) to "C+" (Zimbabwe).

The Overall Physical Activity grade was informed by various types of data across countries: objective measurement with accelerometers or pedometers, self-report or proxy-report questionnaire, and expert opinion. Even among both the subjective and objective data, the methods varied substantially in terms of instruments, analysis, age range, sample size, and representativeness of samples.[23,24,58] In addition, the available data in each country did not necessarily allow the Report Card work groups to use either of the recommended benchmarks (see Table 1) strictly when estimating the prevalence of physically active children and youth in their sample.[23,24,58] For such reasons, the comparability of these results among the countries should be interpreted with caution.

Overall Physical Activity was the indicator with the lowest average grade: "D." A distinction was observed between the low and medium HDI countries and the 2 other HDI groupings. The average grade for the low and medium HDI countries was "C–," whereas both the high and very high HDI countries obtained an average of "D–," which could represent a difference of 14% to 26% in physical activity guidelines adherence ("D–" = 20%–26% vs "C–" 40%–46%). In accordance with this difference of grades, a significant low negative correlation was observed between the Overall Physical Activity indicator and several sociodemographic indicators including the HDI ($r = -.30$, $P < .05$) and the growth national income per capita ($r = -.33$, $P < .05$) (see Supplementary Material 1 [available online]). The present study provides new evidence showing that the situation regarding the physical activity of children and youth is a universal concern worldwide. This finding is consistent with the results from the previous Global Matrices[16,19] and recent global estimates.[11] Efforts should be made globally and collectively to develop standardized physical activity surveillance systems adapted to the national context of each country. Furthermore, developing effective strategies to increase physical activity opportunities for all should be a national public health priority in all countries regardless of the HDI background.

Organized Sport and Physical Activity

An "INC" grade was assigned for this indicator in 7 countries: Bangladesh, Botswana, Ecuador, India, Jersey, Nepal, and United Arab Emirates. The Organized Sport and Physical Activity grades ranged from "F" (Lebanon and Uruguay) to "A–" (Denmark), with an average of "C." The benchmark recommended for this indicator was the "percentage of children and youth who participate in organized sport and/or physical activity programs" (Table 1), meaning that this indicator did not provide any information on the dose (ie, duration, frequency, intensity) of physical activity while participating in sport and organized physical activities, because few countries have such data. The grade for this indicator depends on the availability of organized sport opportunities and the availability of data reporting the prevalence of children and youth who have taken advantage of these opportunities. This grade was mostly informed by official reports from governmental and/or public institutions as well as self-reported surveys.

Organized Sport and Physical Activity was graded "C," "D+," and "C+" on average for the low and medium HDI countries, the high HDI countries, and the very high HDI countries, respectively. Among the 9 low and medium HDI countries, 5 assigned a letter grade to this indicator, which ranged from "D" to "B," with an average of "C." In these countries, the organized sport opportunities corresponded mostly to school-based sports or sport teams and recreational sports organized by nongovernmental organizations and communities. Among the high HDI countries, the grades ranged from "F" to "C+" with an average of "D+." However, it is not possible to discern from the available data if these low grades correspond to the limited availability of organized sport opportunities (ie, distal correlates) or if there are barriers (eg, proximal correlates such as motivation, interest, time, or parental support) hindering children from participating while organized physical activities are readily available to them. In the very high HDI countries, with an average grade of "C+," Organized Sport and Physical Activity was the highest graded behavioral indicator. In these countries, organized sport opportunities are available to children and youth in various settings: sport club and federations, school-based sport teams and organized sport sessions, municipal sport programs, and sport programs offered by private businesses. In addition, significant low to moderate positive associations were observed between Organized Sport and Physical Activity and several sociodemographic indicators including HDI, life expectancy at birth, mean years of schooling, growth national income per capita, public health expenditure (% of GDP), global food security index, improved drinking water coverage, and summer Olympic medal count, whereas significant low negative associations between this indicator and the 2 inequality indices (Gini index and gender inequality index) (see Supplementary Material 1 [available online]) were observed.

More research is needed to examine if affordable and appealing organized physical activity and sport opportunities are offered to all children and youth equally and equitably—across different age, gender, socioeconomic, ethnic, and special population groups—and to isolate the missing components of organized sports opportunities in each country. In addition, it would be interesting to add the measurement of the dose of physical activity associated with organized sports and physical activities in national physical activity surveillance systems. Filling these research and surveillance gaps is a necessary step toward the development of effective strategies to promote physical activity by increasing organized sport opportunities at the national level.

Active Play

Among the 20 countries that graded Active Play, this behavior was mostly measured by self- or proxy-report surveys, assessing the frequency or the time of active play/being active while

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playing,[57,59–62] unstructured/unorganized active play,[51,63–69] playing outdoors/outdoors activities/being outdoors,[50,59,67,70–72] and/or was based on expert opinion.[50,54,73,74] A definition for active play was proposed in a recent systematic review: "a form of gross motor or total body movement in which young children exert energy in a freely chosen, fun, and unstructured manner."[75] A consensus definition, however, still needs to be internationally agreed upon and acknowledged to allow the development of standardized measurement tools for this indicator in varying age groups.

Active Play was the indicator with the most "INC" grades where 29 of 49 countries were unable to find available data to grade this indicator. The grades ranged from "F" (Estonia and Thailand) to "B" (Ethiopia and The Netherlands) with an average of "D+." The average grades for the low and medium HDI countries, high HDI countries, and very high HDI countries were "C–," "D," and "D+," respectively. Given the amount of "INC" grades and the variability of the data used to inform the grades for the Active Play indicator, a valid comparison between the 3 HDI groupings was difficult. The low grades that were reported for this indicator aligned with the previous Global Matrices findings.[16,19] Such low level of engagement in active play can potentially be explained by the low detection capacity of instruments utilized for its measurement. Active play during free time may be slowly disappearing in favor of screen time in developed countries or is replaced with chores or work in developing countries. Perception of the environment as unsafe can also be a potential barrier to this behavior. However, no relation was found between Active Play and the Community and Environment indicators (Supplementary Material 1 [available online]). Further research is needed for the development of a consensus definition, measurement instruments, surveillance systems, and to identify the barriers and facilitators of active play.

Active Transportation

Only 2 countries did not assign a letter grade to Active Transportation: Qatar (not applicable) and United Arab Emirates ("INC"). The average grade for this indicator was D+ and ranged from "F" (Chile) to "A–" (Japan, Nepal, and Zimbabwe). The recommended benchmark for this indicator was "the percentage of children and youth who use active transportation to get to and from places" (Table 1). For most of the countries, the grades were informed by data reporting the prevalence of children and/or youth actively commuting between home and school without information on different doses (ie, frequency, duration, intensity).

Active Transportation was the indicator with the highest average grade for the low and medium HDI countries ("C+") and for the high HDI countries ("C"). The average grade for the very high HDI countries was "C–" for this indicator. In 3 of the 4 very high HDI countries from Eastern Asia, very high grades were assigned to this indicator: Japan ("A–"), Hong Kong ("B+"), and South Korea ("B+"). These 3 countries share similar characteristics historically, culturally, and developmentally,[76] and have shown a high percentage of urban population (83.3%–100%, Table 3). A specific policy in Japan (limiting the distance between the children and youth homes and the public elementary and junior high schools)[77] and the high density of Hong Kong, Japanese, and South Korean cities, allow children and youth to live a short trip away from their school, which can minimize the use of cars or other forms of motorized vehicles, and promote active travel.[25,78,79]

High to very high grades for this indicator were also reported in several developing countries: Colombia ("B"), Nepal ("A–"), Nigeria ("B"), Venezuela ("B–"), and Zimbabwe ("A–"), whereas poor grades were reported for 16 of the 30 very high HDI countries (with grades between "F" and "C–"). However, no statistically significant relation was found between Active Transportation and Community and Environment indicators or the HDI in the correlational analysis. These findings suggest that, for developing countries, active transportation may be driven by a necessity (ie, no access to public or family/personal motorized transportation) instead of a choice,[80] notwithstanding the safety of the environment or the long distance to commute. The measurement of the dose and the characteristics of children's and youth's active transportation internationally are necessary to identify the contribution of active transport to overall physical activity levels, as well as the facilitators and obstacles for this behavior in order to develop contextually adapted, effective ways to promote it. Strategies to improve safety conditions and to promote active transportation as a desirable mode of transport are required in order to maintain the high grades in the country's leading this indicator and to improve those that are lagging.

Sedentary Behaviors

Sedentary Behaviors is defined as "any waking behavior characterized by an energy expenditure ≤1.5 metabolic equivalents, while in a sitting, reclining, or lying posture."[1] Screen time, referring to time spent in screen-based behaviors,[1] is often used as a proxy for sedentary behavior in research. Screen time can be performed while being sedentary or physically active[1]; however, this behavior has been shown to be associated with a variety of negative health outcomes among children and youth.[81] This is why guidelines recommending limiting screen time to 2 hours daily for 5- to 17-year-olds were developed for the first time in Canada.[82] Furthermore, it was also the reason why the benchmark for Sedentary Behaviors focused on screen time: "percentage of children and youth who meet the *Canadian Sedentary Behaviour Guidelines* (5- to 17-year-olds: no more than 2 hours of recreational screen time per day)" (Table 1). However, the comparisons between the countries should be interpreted with caution because of the variability of the data that were used to inform the grades for this indicator. Several Sedentary Behaviors grades were partially or totally informed by data reporting time spent sitting or doing other sedentary activities that did not involve screens, and screen time cutoff points differing from the one in the benchmark (ie, ≤1 h/d, <2 used hours/day, ≤3 h/d) were also used by some countries because of available data.

Three countries assigned an "INC" grade to Sedentary Behaviors: Ghana, South Africa, and Venezuela. The grades for this indicator ranged from "F" (China, Estonia, Ethiopia, Scotland, and Wales) to "A–" (Bangladesh), with an average of "D+." These findings are consistent with international estimates reporting that at least two-thirds of the children exceed 2 hours of recreational screen time per day,[83] although comparison may be limited by the heterogeneity in Sedentary Behaviors across countries. The low and medium HDI countries obtained an average of "C+" for this indicator, and only 2 of the 8 countries had a low grade: Ethiopia "F" and India "C–." The grades for the 6 remaining low and medium HDI countries ranged from "B" to "A–." The high and the very high HDI countries obtained an average grade of "D" and "D+," respectively, for Sedentary Behaviors. In 36 out of the 39 high and very high HDI countries that graded this indicator, a low or very low grade (between "F" and "C–") was assigned. Regardless, the Sedentary Behaviors grades were not significantly related to HDI or to the other sociodemographic indicators except the mean

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years of schooling ($r = .31$, $P < .05$) and the summer Olympic medal count ($r = -.57$, $P < .05$) in the correlational analysis presented in the Supplementary Material 1 (available online).

The results presented here suggest that the situation concerning the childhood screen time is particularly concerning in high and very high HDI countries. The moderately good grades for Sedentary Behavior in the low and medium HDI countries are potentially threatened to decrease with their continuing economic growth and development, which may lead to increased access to electronic devices. Several interventions to reduce screen time have been developed and tested, and results from systematic reviews and meta-analyses reported that interventions to reduce children's screen time can have a small but significant effect.[84] More research is necessary to accumulate more evidence on the effectiveness of specific interventions across different contexts and settings, but investment from public health institutions in high and very high HDI countries to support the implementation of these interventions in the child and youth population should become a priority.

Physical Fitness

Physical fitness represents the ability to perform daily activities with vigor, and the demonstration of traits and capacities that are associated with a lower risk of the premature development of diseases associated with physical inactivity.[85] Cardiorespiratory endurance, muscular endurance, muscular strength, body composition, and flexibility are the health-related components of physical fitness.[86] The Global Matrix 3.0 evaluated the Physical Fitness indicator for the first time, and 27 countries were unable to find available data to inform the grade for this indicator. In the remaining countries, the grade for Physical Fitness ranged from "F" (India) to "A" (Japan), with an average of "C–." India was the only country from the low and medium HDI countries with a letter grade for this indicator. Among the 10 high HDI countries, only 4 had a letter grade reported for this indicator: Brazil ("D"), China ("D"), Colombia ("D–"), and Uruguay ("C–"), with an average of "D." A letter grade was assigned to 17 of the 30 very high HDI countries, ranging from "D" (Canada, Chile, Hong Kong, and Jersey) to "A" (Japan).

The benchmark for this indicator corresponded to the average percentile achieved on certain health-related physical fitness components based on the normative values published by Tomkinson et al (Table 1).[27] However, many differences in the data informing the grades for this indicator were observed across countries in terms of number fitness indicators reported, normative value used, age range, and sample size. Given the amount of "INC" grades and variability in the data informing the grades for this indicator, the comparison between HDI groupings is difficult. Cardiorespiratory fitness (measured with the 20-m shuttle run test) was found to be associated with favorable indicators of adiposity and some indicators of cardiometabolic, cognitive, and psychosocial health in boys and girls from 32 countries in a recent systematic review.[87] Therefore, cardiorespiratory fitness is an important indicator of current and future health among school-aged children and youth and can be used as a holistic indicator of population health in this age group.[88] These findings highlight that global surveillance of physical fitness, which represents a simple and cost-effective assessment[89] that could be integrated in physical education classes, should be a priority in all countries.

Family and Peers

The average grade for Family and Peers was the same among the 3 HDI groupings: "D+." An "INC" grade was assigned in 22 countries: 4 from the low and medium HDI group, 6 from the high HDI group, and 12 from the very high HDI group. The grades ranged from "F" (Chile, Ecuador, Ethiopia, and Ghana) to "A" (Nepal). This amount of "INC" grades and the letter grades reported are consistent with the previous Global Matrices.[16,19]

Support from parents and peers is recognized as a correlate of physical activity in children and youth[90]; however, the nature of this relationship is complex and no valid and internationally recognized instrument exists to measure the influence of family and friends on children and youth's physical activity at present. This is why several benchmarks were proposed to capture a picture of the influence of Family and Peers (Table 1), and variability in the data used to inform the letter grades for this indicator was observed. The number of "INC" grades and the measurement variation for this indicator limit the comparison and the interpretation of the letter grades reported. However, these findings highlight the need for the development of standardized methods for the surveillance of this indicator in various settings and contexts.

School

Given the potentially significant amount of time that children and youth spend at school, this environment is a strategically important setting for the promotion of physical activity. Physical activity opportunities can be provided to children and youth in the school environment through physical education, lunch and recess breaks, in-class physical activities, and in intramural competitive and noncompetitive activities before or after school.[91] However, school physical activity policies, if they exist at all, differ from one country to another and are not always mandatory.

The average grade for the School indicator was "C," and Report Card work groups in 8 countries could not assign a letter grade to this indicator (Bangladesh, Ecuador, Guernsey, India, Nepal, Scotland, Venezuela, and Wales). This indicator ranged from "D–" (South Africa, United Arab Emirates, and United States) to "A" (Finland, Portugal, and Slovenia). The average grade for this indicator was "D+" for the low and medium HDI countries. For the high HDI countries, School was the source of influence indicator that obtained the highest average grade ("C–"). The very high HDI countries obtained an average grade of "B–," and it is worth noting that only medium to favorable grades ("C" to "A") were assigned to European countries (high and very high HDI counties included). The correlational analysis found a significant moderate association between the School indicator and 6 of the sociodemographic indicators: the HDI ($r = .53$, $P < .001$), the mean years of schooling ($r = .51$, $P < .001$), the Gini Index ($r = -.66$, $P < .001$), the gender inequality index ($r = -.65$, $P < .001$), the global food security index ($r = .52$, $P < .05$), and the distance to equator ($r = .55$, $P < .001$). In other words, the grades for School indicator increased as the HDI, the mean years of schooling, the food security, and the distance to the equator increased, and as the gender inequality index and the Gini index decreased. These findings align with the results of the Global Matrix 2.0.[19]

These findings further suggest that the quality and/or quantity of physical activity opportunities offered by the school are associated with the economic and development status of a given country. Cultural values attributed to sport and or physical activity can also be potential barriers or facilitators for this indicator. Quality school policies and programs related to physical activity for the 3 European countries leading this indicator (Finland, Portugal, and Slovenia) have already been highlighted elsewhere.[19,25] While mandatory physical education classes are part of the school

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curriculum in most European countries for all school grades, it is only optional in some other countries from other parts of the world. For example, in the United States, the percentage of schools delivering mandatory physical education classes, in each grade, decrease from 97% in sixth grade to 42% in 12th grade.[92] In the United Arab Emirates, only 26% of adolescents aged 13–17 years reported participating in physical education class on 3 or more days each week.[93] In South Africa, 32% of children do not participate in school physical education classes, and no evidence of progress in the prioritization of physical education in the schools was found by the Report Card work group.[94] Similarly, 2 consecutive Report Cards from South Korea highlighted that the emphasis on important subjects (eg, math, science) for university admission overrides the importance of physical activity in the Korean education system.[95,96] Although the new 2018 Korean national curriculum requires schools to provide mandatory physical education, it is regarded as a minor subject and, with progressing school grades, it is devalued and neglected.[97]

Evidence showed that adding more time to academic or curricular subjects by taking time away from physical education programs was found not to enhance academic achievement in the corresponding academic subjects and to be potentially detrimental to health.[98] Conversely, allocating more time to physical activity from other subjects can improve the time children spend engaging in MVPA without the risk of "hindering students' academic achievement."[98] The measure of the dose of physical activity occurring in school should also be added to the national surveillance systems globally to identify the needs in terms of policies and interventions aimed at promoting physical activity at school. In addition, the Global Matrix 3.0 findings suggest that developing interventions or programs targeting schools in low and medium HDI countries should be a priority on the international public health agenda.

Community and Environment

The Community and Environment indicator obtained an average grade of "C" and had 13 "INC" grades. The grades ranged from "D–" (Venezuela) to "A" (Sweden). The low and medium HDI countries obtained an average of "D," and the high HDI countries obtained a "D+." Among the very high HDI countries, the Community and Environment indicator was the indicator with the highest average grade ("B–"). The correlational analysis (see Supplementary Material 1 [available online]) found a positive significant moderate to strong association between the Community and Environment indicator and the HDI ($r = .73$, $P < .001$), the life expectancy at birth ($r = .74$, $P < .001$), mean years of schooling ($r = .64$, $P < .001$), growth national income per capita ($r = .80$, $P < .001$), public health expenditure ($r = .67$, $P < .001$), global food security index ($r = .71$, $P < .001$), urban population percentage ($r = .51$, $P < .001$), improved drinking water coverage ($r = .77$, $P < .001$), and distance to equator ($r = .58$, $P < .001$); and a negative significant moderate to strong association was found with the Gini Index ($r = -.62$, $P < .001$) and gender inequality index ($r = -.83$, $P < .001$). These findings aligned with the results of the previous Global Matrices[16,19] and reinforce the importance of income and gender equity for the physical activity and overall population health.

Characteristics of the built environment are recognized as a potential source of influence on the physical activity levels of children and youth.[99–101] Given that a great number of characteristics could potentially influence the physical activity of children and youth, numerous benchmarks were proposed to evaluate this indicator. A great variability of data was used to inform the grades for this indicator, limiting direct comparisons between countries. Yet, the significant correlations suggest that despite the variability of data available that was used to inform the grade for this indicator, the Report Card work groups assigned a grade that was coherent with the characteristics of the environment. The available evidence from this indicator suggests that the characteristics of the built environment potentially influencing the physical activity of children and youth are already favorable in the very high HDI countries, and that an increase of the grades for this indicator is expected with the further development of low, medium, and high HDI countries.

Government

The average grade for the Government grade was "C," and an "INC" grade was assigned in 8 countries. With an average of "C–," Government was the source of influence indicator with the highest average in low and medium HDI countries. The high HDI countries obtained an average of "D+," and the very high HDI countries a "C+." The highest grades for this indicator were reported in high and very high HDI countries. The correlation analysis found significant moderate associations between the Government indicator and the growth national income per capita ($r = .48$, $P < .01$), public health expenditure ($r = .48$, $P < .01$), Gini index ($r = -.45$, $P < .01$), gender inequality index ($r = -.45$, $P < .01$), improved water coverage ($r = .44$, $P < .01$), and distance to the equator ($r = .31$, $P < .01$).

Similar to the Community and Environment indicator, a government can potentially influence the physical activity level of children and youth in multiple ways. As there is no official standardized method to evaluate this influence, the recommended benchmark for this indicator focused on evidence of leadership and commitment, allocated funds and resources, and demonstrated progress for the promotion of physical activity opportunities for all children and youth (Table 1). As a result, the grades were informed by very different types of data across countries, and the Report Card work groups did not always have access to relevant quantitative data and, therefore, graded this indicator mostly based on expert opinion when required.

The low behavioral grades that were reported broadly in the Global Matrix 3.0 suggest that the government's efforts and physical activity policies are not reflected in an increase in the prevalence of MVPA among children and youth, and/or that there is an implementation gap between the strategy level (source of influence indicators) and individual level (behavioral indicators). More research is needed globally to identify the potential barriers for the engagement of children at the country and community level, in different contexts and settings.

Integrated Discussion

Overall, the average grades obtained for each indicator were low, and a small variation was observed within the 10 indicators ("D" to "C"). More diversity was observed between the 3 HDI groupings, between the countries, and within each country. Higher behavioral grades and lower source of influence grades were generally observed in the low and medium HDI countries, whereas the opposite was observed for the very high HDI countries, and generally low average grades were reported for each indicator in the high HDI countries. It is important to highlight that the overall concerning levels of physical activity and sedentary behavior

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among children and youth may be indicative of a global crisis. Moreover, this phenomenon may get worse with the economic growth and development of low, medium, and high HDI countries, and very high rates of noncommunicable diseases can be anticipated when the current generation of children and youth reaches adulthood unless a major shift to a more active lifestyle happens soon. Strategies to mitigate the projected reduction in habitual physical activity in developing countries should learn from countries who have already navigated the physical activity transition.[102]

Strengths and Limitations

A major limitation of this study was the amount of missing data to inform the grades, resulting in a total of 121 "INC" grades of the 490 grades in total. In addition, the great variability of the data (eg, in terms of benchmark, measurement instrument, age range, sample size, quality, quantity) that were used to inform the grades was observed between the countries for each indicator, and in many cases, the available data did not permit the Report Card work groups to align strictly with the recommended benchmarks. Furthermore, a loss of information potentially occurred when translating original prevalence data to a letter grade, as letter grades provide less information than continuous variables. Consequently, all the comparisons, correlations, and interpretations involving the grades are limited and should be interpreted with caution, as 2 identical grades for the same indicator can capture 2 very different contexts from one country to another. Excluding the countries with insufficient data and imposing to assign "INC" grades every time the data did not fit exactly with the benchmarks for each indicator could have been an alternative strategy. But this approach would have significantly reduced the number of countries and grades included in the Global Matrix 3.0 and the relevance of conducting international comparisons. Despite the limitations of the underlying data, this encyclopedia of global information of the physical activity of children and youth represents the richest source of such information compiled to date.

Another limitation of the Global Matrix 3.0 was the lack of representativeness of some areas of the world and some specific child and youth populations. Indeed, the participation of a total of 49 countries or nations meant that most of the countries around the world were still missing. In particular, the South Pacific islands nations, where the average body mass indices for child and youth were estimated to be the highest of the world,[103] are missing, as well as countries from Central Asia and North Africa. Additionally, children and youth with disabilities were not explicitly included in this analysis while the Global Matrix process could help to identify and circulate best-practice strategies in terms of physical activity promotion for these specific populations.[19] Furthermore, the disparities and inequities across gender, socioeconomic status, or urban versus rural dwelling were mentioned in only a handful of Report Card articles; thus, they were not analyzed or discussed in this study.

The correlation analyses showed that the Overall Physical Activity grade had a moderate positive association with Sedentary Behaviors and was not statistically related with the 8 remaining indicators (Supplementary Material 1 [available online]). This can potentially be the consequence of the aforementioned limitations, but another hypothesis may explain this absence of relation. The absence of statistically significant correlations between Overall Physical Activity and Organized Sport and Physical Activity, Active Play, and Active Transportation may have resulted from the fact that the physical activity dose related to these indicators was not measured. The absence of a relation between the source of influence indicators and Overall Physical Activity may suggest that a favorable physical and social environment is not enough to induce individual engagement in sufficient amounts of MVPA. In addition, the absence of choice (ie, children who have no other options than using active transportation regardless of safety and any other characteristics of the source of influence), child labor, and the cultural values attributed to physical activity and sports were not evaluated in this study.

Major strengths of this work include the large number of countries who adopted the harmonized Report Card development process and the quantity of data used to inform an international, comprehensive, and meaningful comparison of physical activity behaviors of children and youth. In addition, the AHKGA facilitated and supported the development of Report Cards from 49 countries, by providing the Report Card work groups from each participating country with a platform to capture, synthesize, interpret, and publish the findings with autonomy. With the 49 countries participating and the 10 common indicators being graded by each participating country, the Global Matrix 3.0 represents the most comprehensive and meaningful comparison of the contexts of the physical activity of children and youth. In addition, the identification and discussion of major trends concerning the characteristics of the physical activity of children and youth among the 3 HDI groupings were realized for the first time.[23–25] Finally, major research and surveillance gaps, including the need for the development and the international adoption of standardized methods to conceptualize and measure the ten indicators, were identified and highlighted for each indicator in the present paper.

The launch of the Global Matrix 3.0 is the result of a tremendous amount of work by the AHKGA Executive Committee members and from the physical activity experts and stakeholders from all over the world for the past 15 months. The 49 Report Cards were developed by supported and unsupported work groups of professionals who acknowledge the importance of a healthy and active lifestyle for the present and the future of the children and youth worldwide. The involvement of governmental and nongovernmental organizations in the development of some of the national Report Cards is a potential sign of a growing interest in the childhood physical inactivity crisis, and it is hoped that this awareness will be translated into support for the development of effective interventions increasing physical activity opportunities for all. In addition, the development of a national Report Card of physical activity for children and youth and the participation in the Global Matrix initiative were found to contribute to raising awareness on the childhood physical inactivity issue nationally and internationally, building capacity within participating countries, and potentially influencing the creation of physical activity opportunities in the future.[23] It is hoped that more physical activity experts and stakeholders will rally with AHKGA members to pursue and expand the Global Matrix initiative and will help fill the identified gap in physical activity research and surveillance. The AHKGA, with the contribution of its international network of researchers, will be available to offer guidance to the countries willing to develop national surveillance of physical activity and policies or interventions promoting physical activity among children and youth.

Conclusions

A comprehensive summary of the grades, comparison, and interpretation of 10 physical activity indicators among 49 countries were presented in this Global Matrix 3.0 paper. Higher behavioral

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grades and lower source of influence grades were generally observed in the low and medium HDI countries, whereas lower behavioral grades and higher source of influence grades were observed for the very high HDI countries, and generally low average grades for each indicator in the high HDI countries. International research and surveillance gaps were also identified by the Global Matrix 3.0 and the Report Card initiatives. Internationally collaborative and collective efforts are needed to redirect the persisting trend of low physical activity and high sedentary behavior among children and youth worldwide. Strategic public investments to implement effective interventions within families, communities, and schools to increase physical activity opportunities are needed. It is hoped that researchers and relevant stakeholders will collaborate internationally to address the research and surveillance gaps highlighted in this paper and expand the Global Matrix initiative to include more countries.

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Online supplementary file S1: Correlation Matrices of the physical activity indicators and Sociodemographic Indicators

Correlation coefficients between physical activity indicators and sociodemographic characteristics

	HDI	Life expectancy at birth	Mean years of schooling	GNI per capita	Public health expenditure (% of GDP)	Gini index	Gender Inequality Index (GII)	Global Food Security Index	Urban population %	Improved drinking water coverage (%)	Summer Olympic medal count	Population density	Distance to equator
Overall physical activity	-0.3052	-0.3066	-0.2181	-0.3343	0.0804	0.1435	0.2013	-0.2690	-0.2644	-0.3218	-0.3040	-0.0052	-0.1436
Organized sport participation	0.4912	0.3914	0.3996	0.3634	0.6273	-0.4046	-0.5595	0.4804	0.0202	0.4148	0.3824	-0.0449	0.4402
Active play	-0.1181	-0.1022	-0.4048	-0.0632	0.0274	0.1122	0.1091	-0.1359	0.1453	-0.0635	0.0891	0.1566	-0.2267
Active transportation	-0.3153	-0.2332	-0.3575	-0.1845	-0.0153	-0.0894	0.0319	-0.3981	-0.0324	-0.1960	-0.0426	0.1712	-0.2378
Sedentary behaviors	-0.1631	-0.0321	-0.3058	-0.1746	-0.0358	0.0457	0.0764	-0.3131	-0.1292	-0.1956	-0.5682	0.1546	-0.2093
Physical fitness	0.1993	0.1901	0.4459	0.3736	0.6187	-0.6383	-0.6310	0.5378	0.1036	0.5190	0.0791	-0.0435	0.4507
Family and Peers	0.3356	0.2224	0.2262	0.3842	0.5125	-0.5798	-0.5392	0.3756	-0.0425	0.3991	0.3115	0.0287	0.3375
School	0.5324	0.4625	0.5068	0.3751	0.4901	-0.6566	-0.6492	0.5185	0.0284	0.4986	0.3074	0.0787	0.5548
Community and the Built environment	0.7290	0.7432	0.6361	0.8025	0.6659	-0.6248	-0.8278	0.7126	0.5091	0.7750	0.3308	-0.2045	0.5792
Government	0.2148	0.1931	0.2938	0.4821	0.3803	-0.4508	-0.4496	0.3504	0.1894	0.4438	0.0163	-0.1188	0.3109
Behavioral score	-0.1503	-0.0963	-0.1970	-0.2178	0.2967	-0.1189	-0.0889	-0.2530	-0.2089	-0.2255	-0.1054	0.1066	-0.0719
Sources of influence score	0.4105	0.3914	0.4110	0.5134	0.5645	-0.6234	-0.6052	0.4536	0.1432	0.5241	0.2151	-0.0203	0.4812
Overall score	0.2458	0.2670	0.1971	0.2796	0.5996	-0.5221	-0.5119	0.2588	-0.0140	0.2638	0.1412	0.0513	0.3210

Legend

	$0.3 \leq r < 0.5$		$0.7 \leq r < 0.9$		$-0.3 \geq r > -0.5$		$-0.7 \geq r > -0.9$	$-0.3 < r < 0.3$
	$0.5 \leq r < 0.7$		$0.9 \leq r < 1$		$-0.5 \geq r > -0.7$		$-0.9 \geq r > -1$	

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Correlation p values between physical activity indicators and sociodemographic characteristics

	HDI	Life expectancy at birth	Mean years of schooling	GNI per capita	Public health expenditure (% of GDP)	Gini index	Gender Inequality Index (GII)	Global Food Security Index	Urban population %	Improved drinking water coverage (%)	Summer Olympic medal count	Population density	Distance to equator
Overall physical activity	0.0370	0.0361	0.1549	0.0248	0.6129	0.3587	0.2012	0.1074	0.0793	0.0377	0.0503	0.9728	0.3356
Organized sport participation	0.0010	0.0104	0.0106	0.0195	0.0000	0.0106	0.0003	0.0047	0.9017	0.0096	0.0178	0.7806	0.0035
Active play	0.6201	0.6682	0.0767	0.7912	0.9115	0.6475	0.6565	0.6030	0.5411	0.7902	0.7167	0.5096	0.3364
Active transportation	0.0309	0.1147	0.0172	0.2249	0.9232	0.5594	0.8409	0.0147	0.8329	0.2135	0.7890	0.2552	0.1075
Sedentary behaviors	0.2788	0.8322	0.0461	0.2569	0.8241	0.7740	0.6351	0.0630	0.4031	0.2203	0.0001	0.3106	0.1628
Physical fitness	0.3738	0.3968	0.0488	0.0952	0.0047	0.0018	0.0038	0.0317	0.6549	0.0273	0.7403	0.8513	0.0353
Family	0.0870	0.2648	0.2666	0.0526	0.0088	0.0024	0.0054	0.0850	0.8332	0.0534	0.1295	0.8872	0.0852
School	0.0003	0.0023	0.0010	0.0171	0.0021	0.0000	0.0000	0.0024	0.8619	0.0017	0.0570	0.6295	0.0002
Community and the built environment	0.0000	0.0000	0.0001	0.0000	0.0000	0.0001	0.0000	0.0000	0.0018	0.0000	0.0600	0.2385	0.0002
Government	0.1774	0.2264	0.0734	0.0019	0.0221	0.0051	0.0059	0.0533	0.2482	0.0067	0.9238	0.4652	0.0479
Behavioral score	0.3025	0.5105	0.1894	0.1413	0.0505	0.4365	0.5660	0.1202	0.1587	0.1411	0.4960	0.4709	0.6235
Sources of influence score	0.0034	0.0054	0.0046	0.0002	0.0001	0.0000	0.0000	0.0037	0.3371	0.0003	0.1609	0.8908	0.0005
Overall score	0.0887	0.0637	0.1892	0.0570	0.0000	0.0002	0.0004	0.1116	0.9258	0.0836	0.3604	0.7291	0.0245

Legend

	$p > 0.05$
	$p \leq 0.05$
	$p \leq 0.001$

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Correlation coefficients within physical activity indicators

	Overall physical activity	Organized sport participation	Active play	Active transportation	Sedentary behaviors	Physical fitness	Family	School	Community and built environment	Government	Behavioral score	Sources of influence score
Organized sport participation	0.0761											
Active play	0.3439	0.0524										
Active transportation	0.2456	0.1820	0.4222									
Sedentary behaviors	0.3934	0.1096	0.0929	0.1542								
Physical fitness	0.1144	0.1310	-0.4907	0.0367	0.0864							
Family and Peers	-0.1339	0.4665	-0.6046	0.1167	0.1435	0.4559						
School	-0.0964	0.4088	-0.4751	-0.0212	-0.0267	0.6572	0.7972					
Community and the Built environment	-0.2448	0.4708	-0.4507	-0.2776	0.0350	0.3364	0.5047	0.6154				
Government	-0.0629	0.2118	-0.2677	0.0039	0.0893	0.4946	0.4972	0.4358	0.6890			
Behavioral score	0.6627	0.5656	0.5169	0.6511	0.5438	0.1251	0.0961	0.1648	-0.0454	0.0684		
Sources of influence score	-0.1006	0.4083	-0.4412	0.0377	0.0442	0.6202	0.8495	0.8357	0.8148	0.8302	0.1232	
Overall score	0.2967	0.6347	0.0605	0.3768	0.3849	0.5806	0.7311	0.7085	0.6299	0.6033	0.6539	0.7915

Legend

	$0.3 \leq r < 0.5$		$0.7 \leq r < 0.9$		$-0.3 \geq r > -0.5$		$-0.7 \geq r > -0.9$	$-0.3 < r < 0.3$
	$0.5 \leq r < 0.7$		$0.9 \leq r < 1$		$-0.5 \geq r > -0.7$		$-0.9 \geq r > -1$	

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Correlation p values within physical activity indicators

	Overall physical activity	Organized sport participation	Active play	Active transportation	Sedentary behaviors	Physical fitness	Family	School	Community and built environment	Government	Behavioral score	Sources of influence score
Organized sport participation	0.6364											
Active play	0.1494	0.8363										
Active transportation	0.1038	0.2546	0.0637									
Sedentary behaviors	0.0082	0.5066	0.7053	0.3175								
Physical fitness	0.6215	0.5820	0.2636	0.8710	0.7023							
Family	0.5142	0.0248	0.0170	0.5621	0.4937	0.0877						
School	0.5593	0.0108	0.0463	0.8981	0.8717	0.0012	0.0000					
Community and the built environment	0.1564	0.0065	0.0918	0.1012	0.8468	0.1591	0.0086	0.0002				
Government	0.7035	0.2150	0.3161	0.9813	0.5939	0.0266	0.0158	0.0089	0.0000			
Behavioral score	0.0000	0.0001	0.0196	0.0000	0.0001	0.5792	0.6336	0.3031	0.7925	0.6708		
Sources of influence score	0.5010	0.0073	0.0515	0.8014	0.7706	0.0021	0.0000	0.0000	0.0000	0.0000	0.3991	
Overall score	0.0429	0.0000	0.7999	0.0090	0.0083	0.0046	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Legend

	$p > 0.05$
	$p \leq 0.05$
	$p \leq 0.001$

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Online Supplementary File S2: Distribution of the grades ("A-B", "C", "D-F", or "INC" grades) for the 10 common indicators and the average grades across the world

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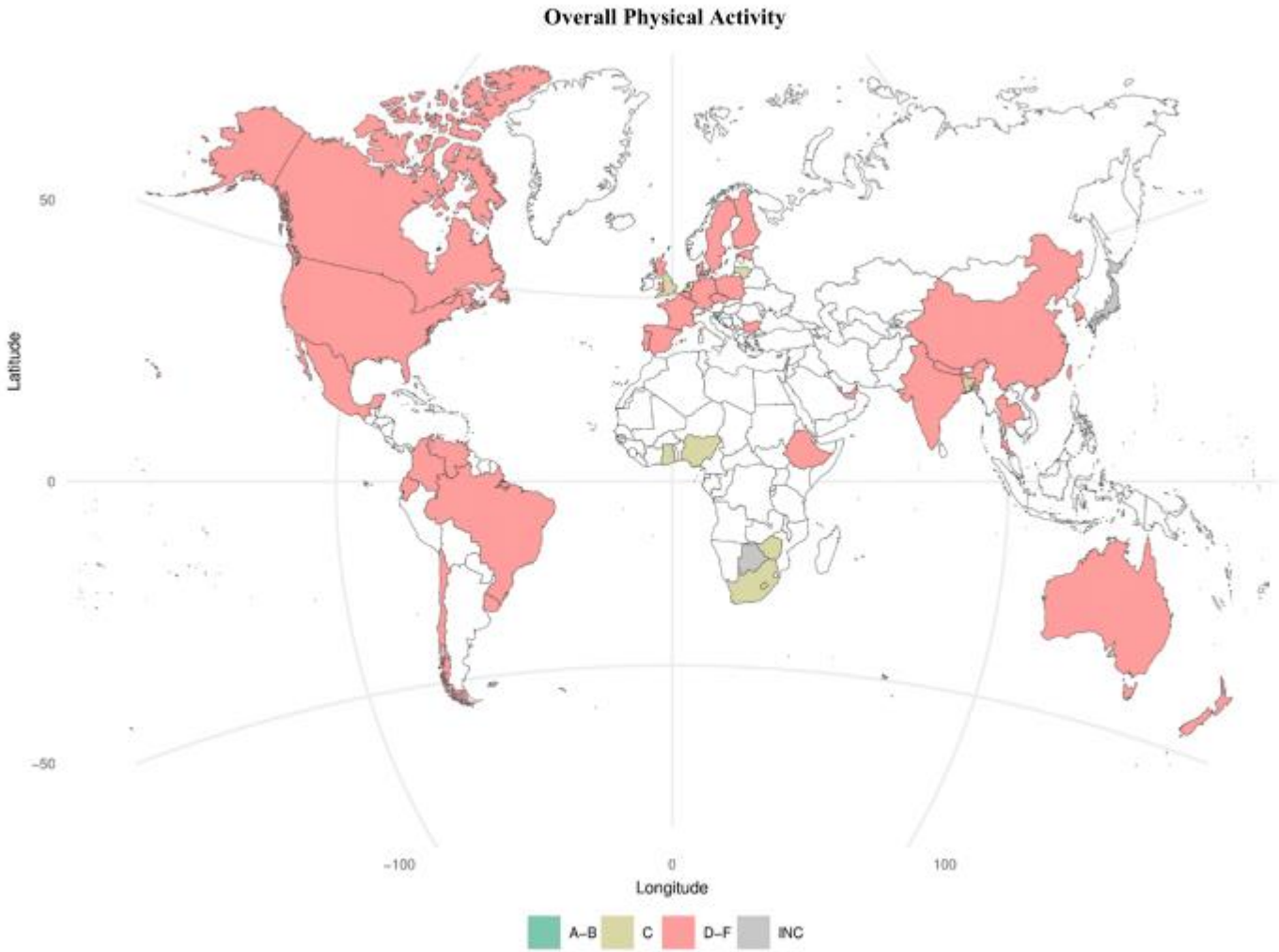

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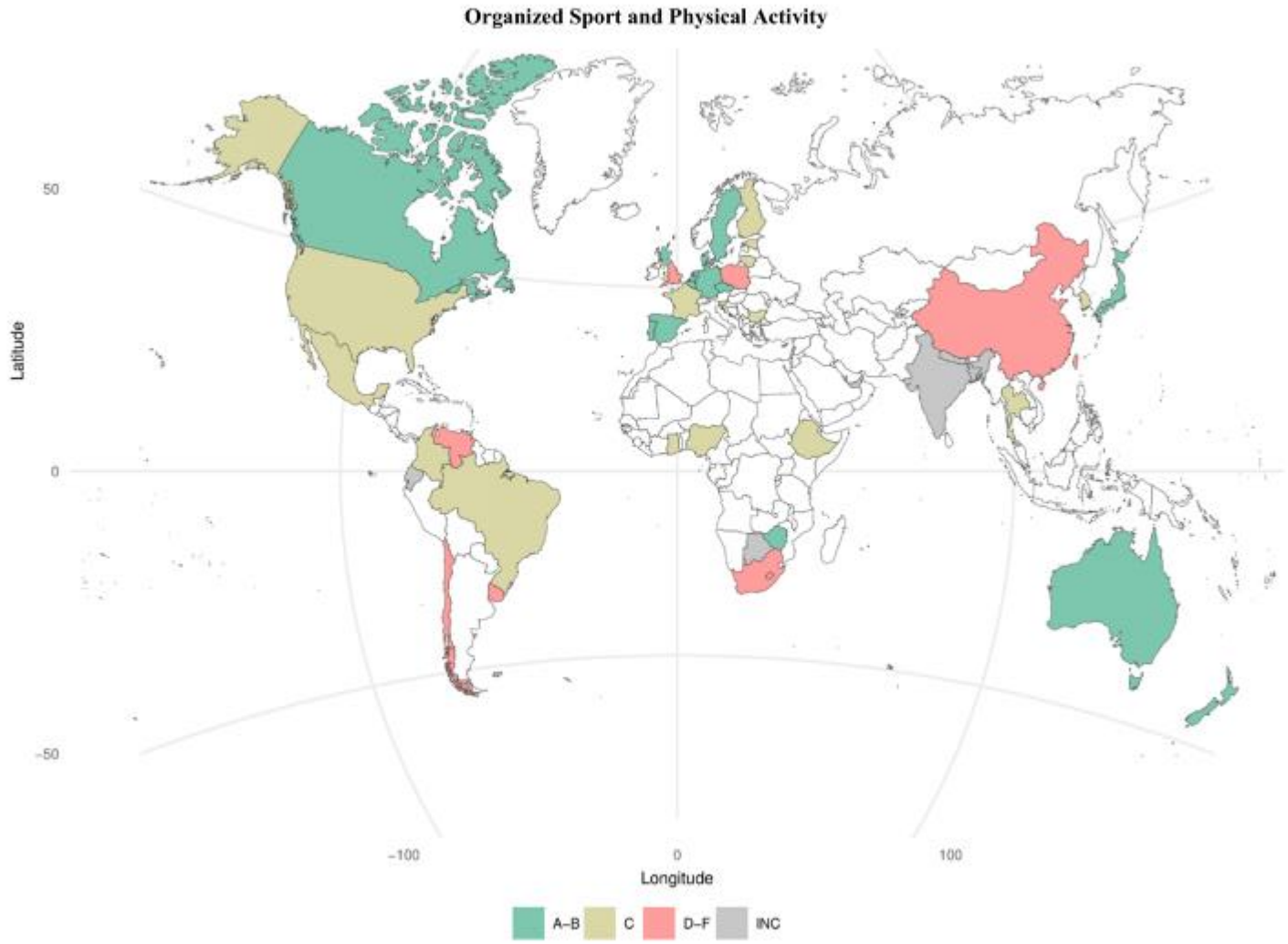

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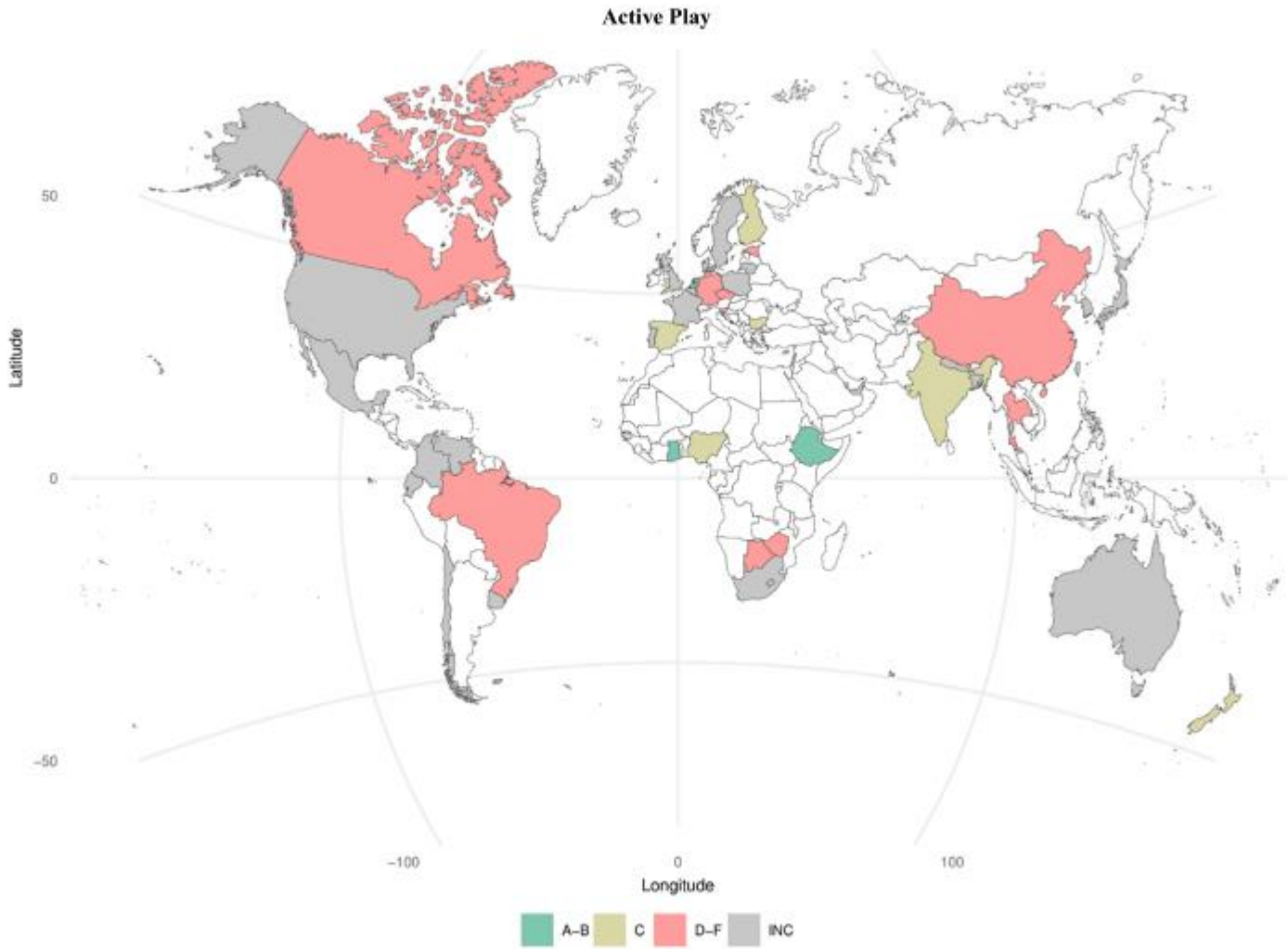

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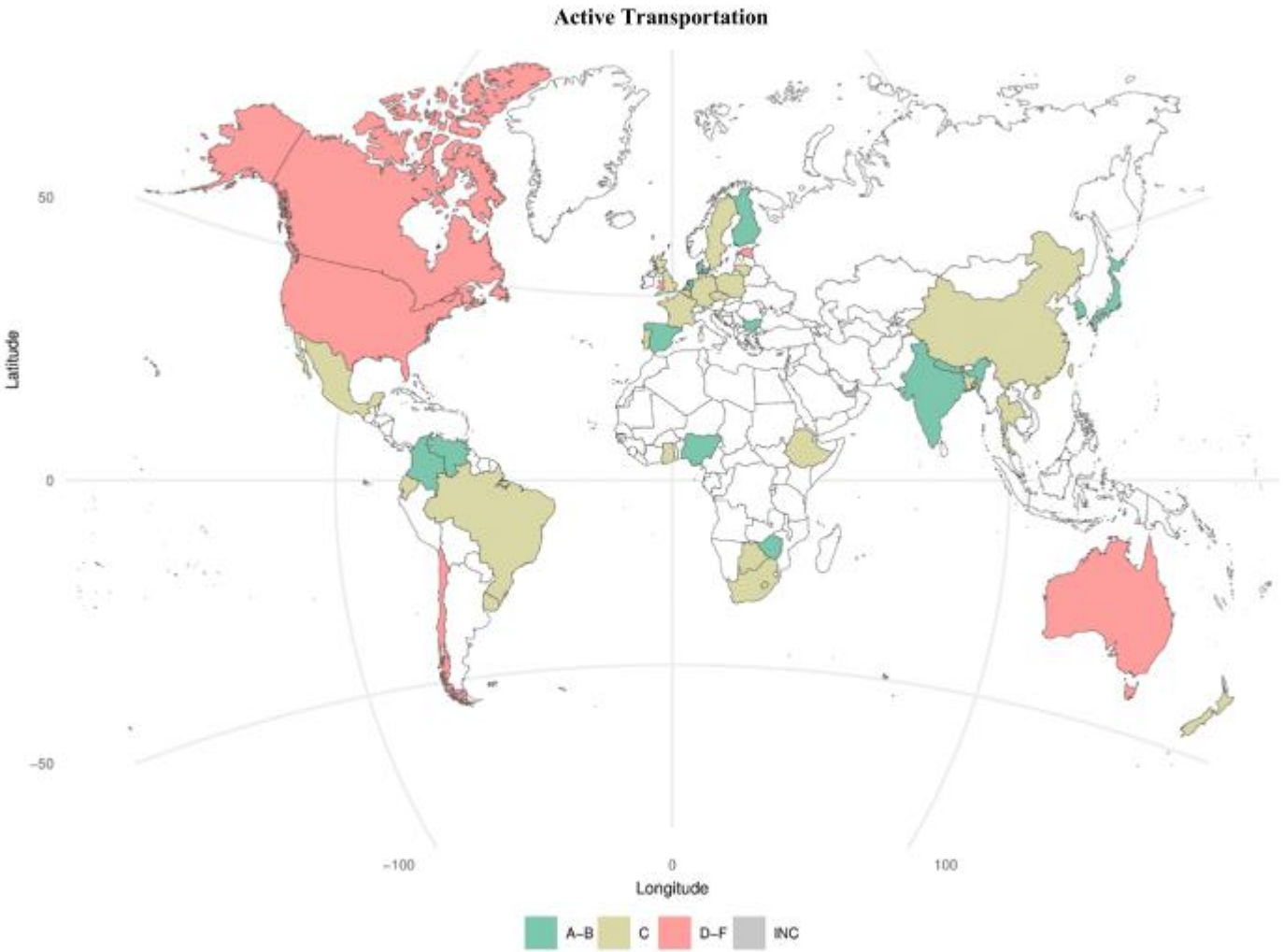

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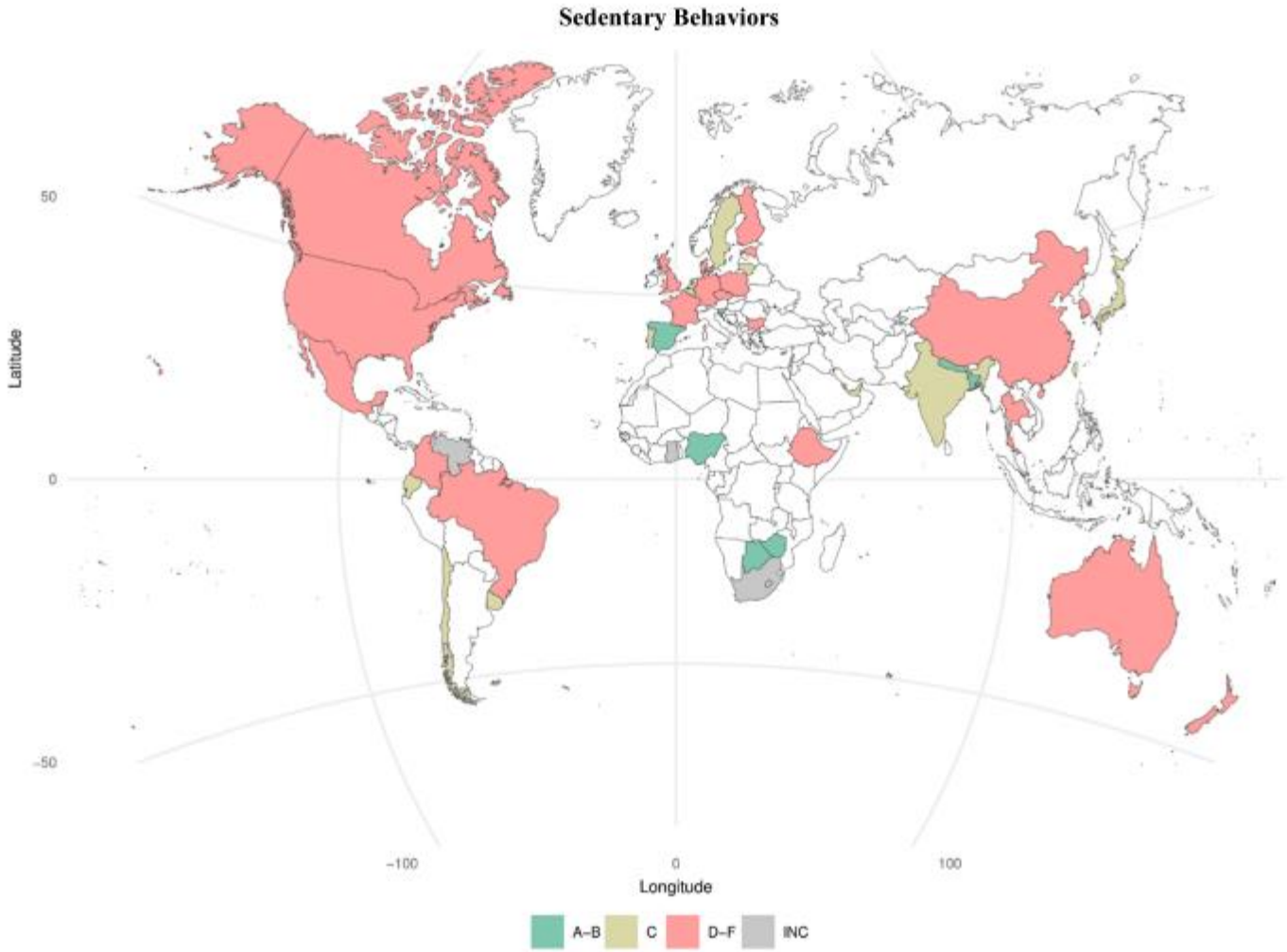

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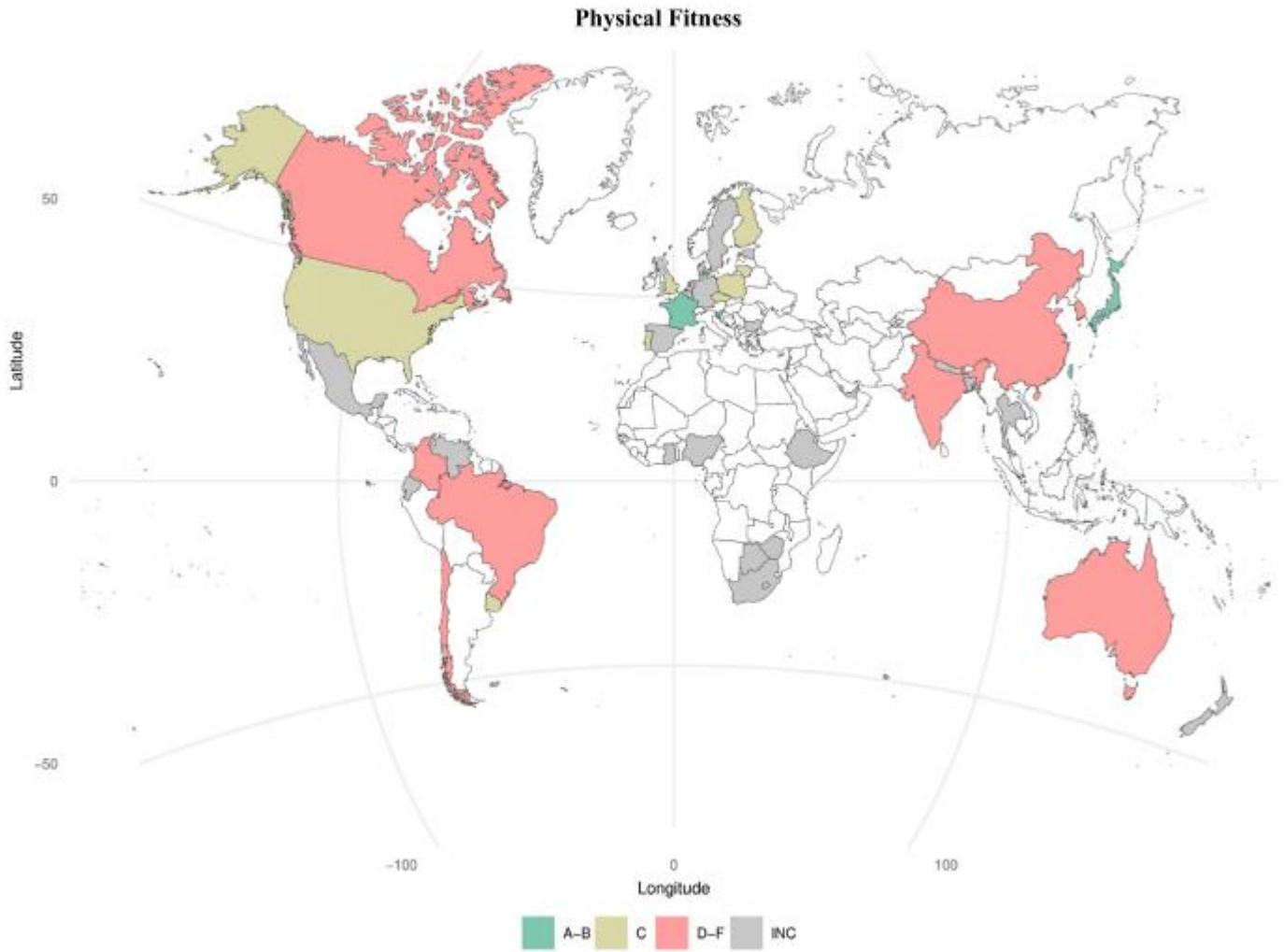

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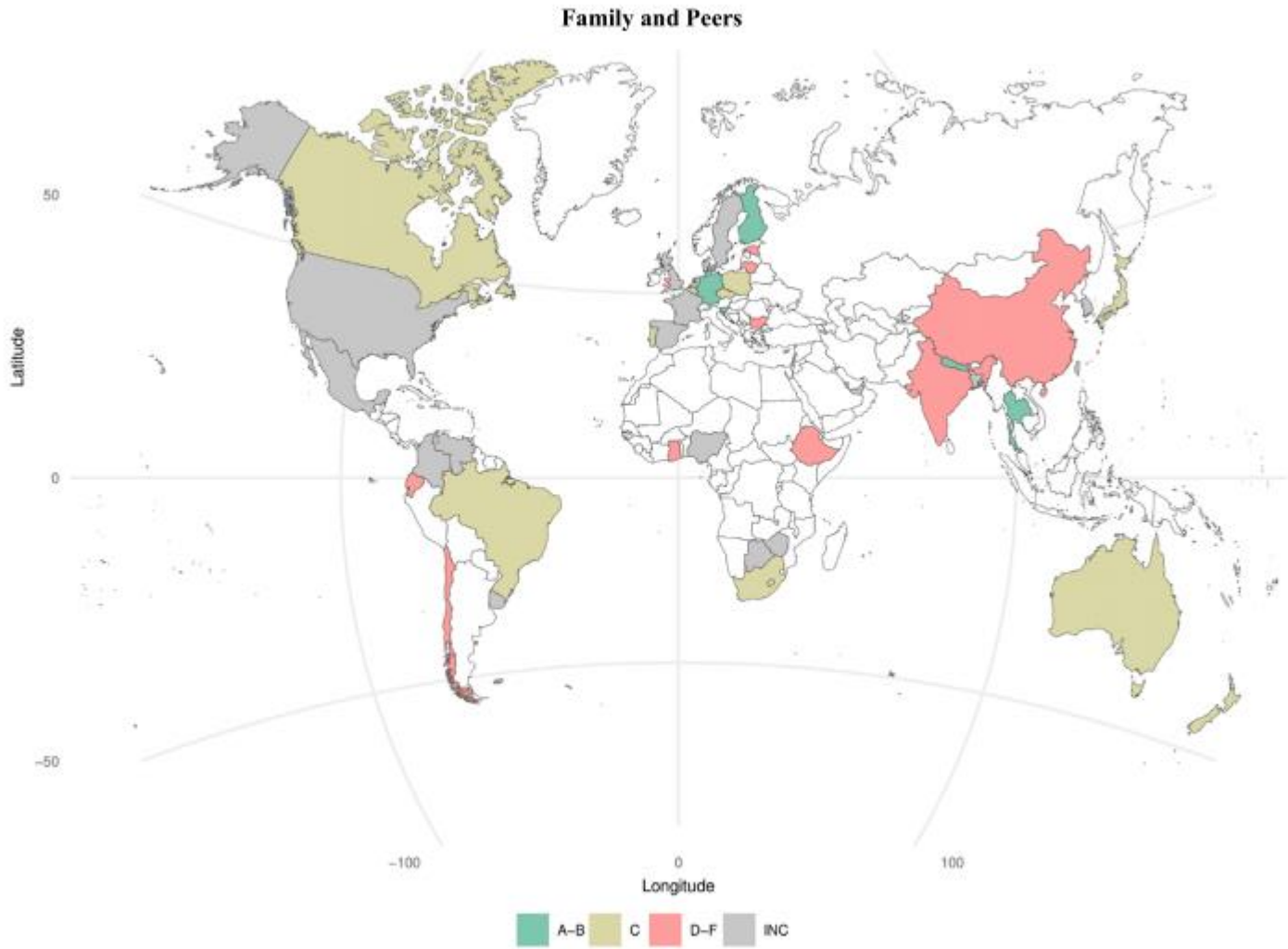

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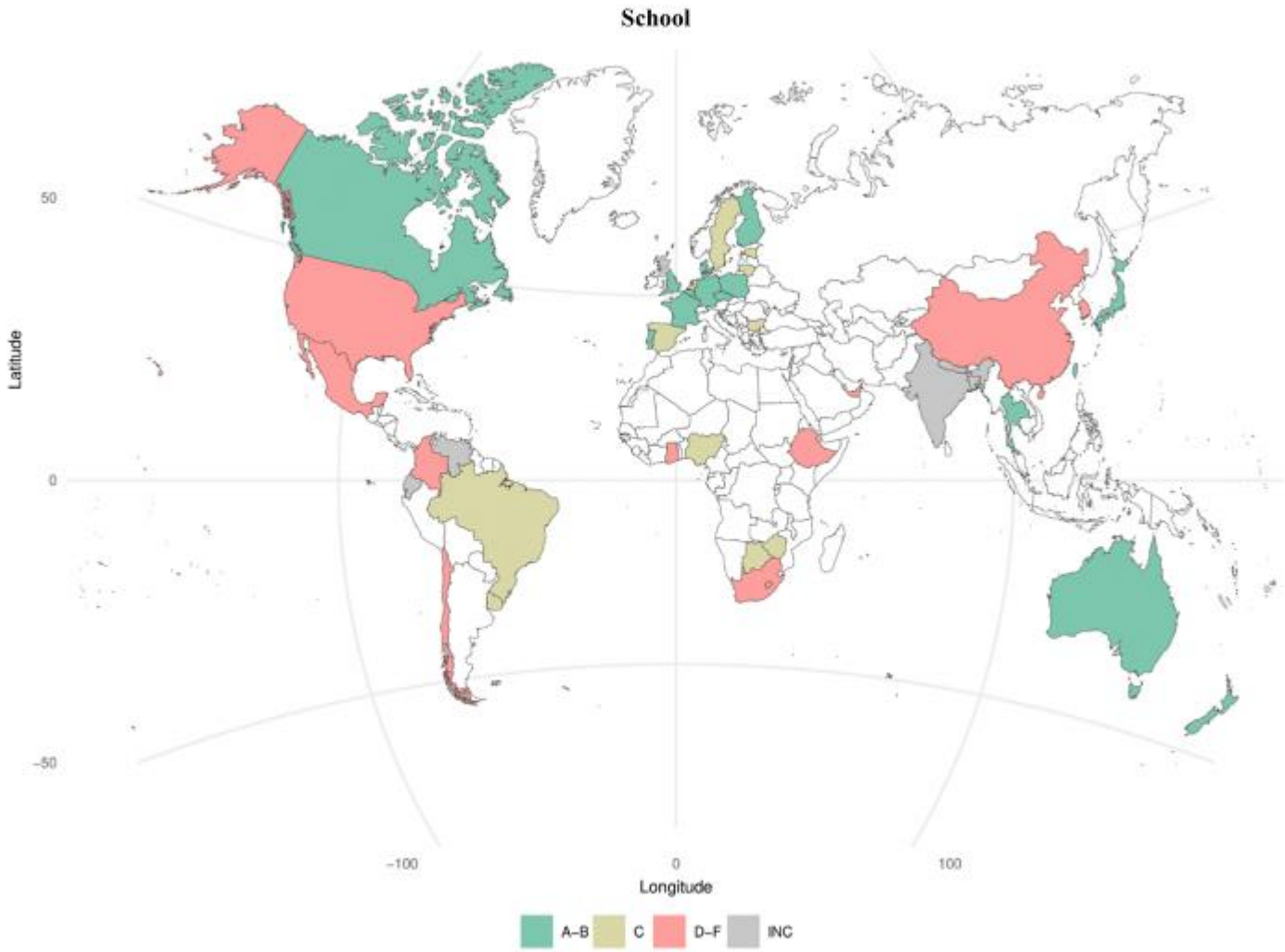

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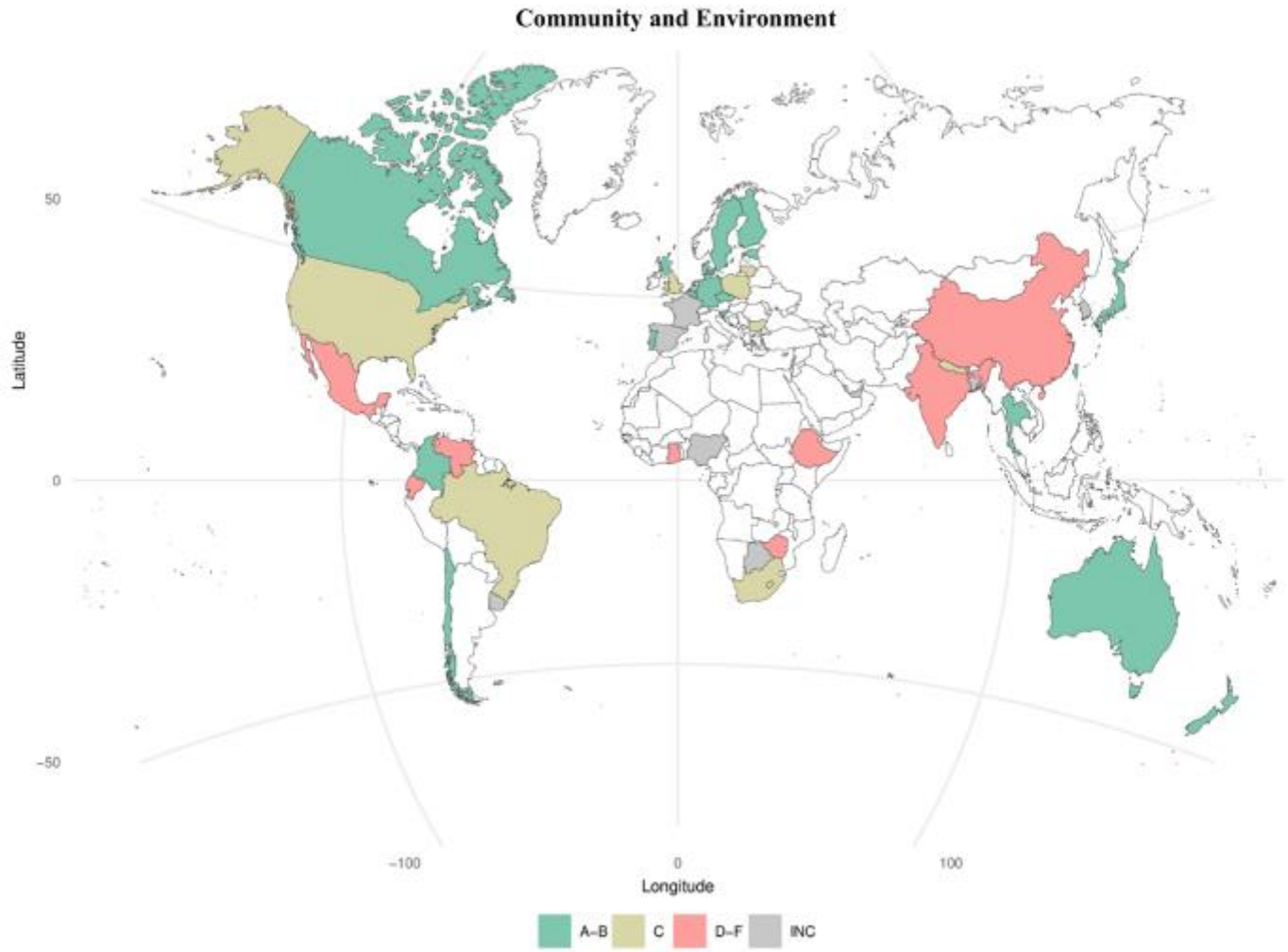

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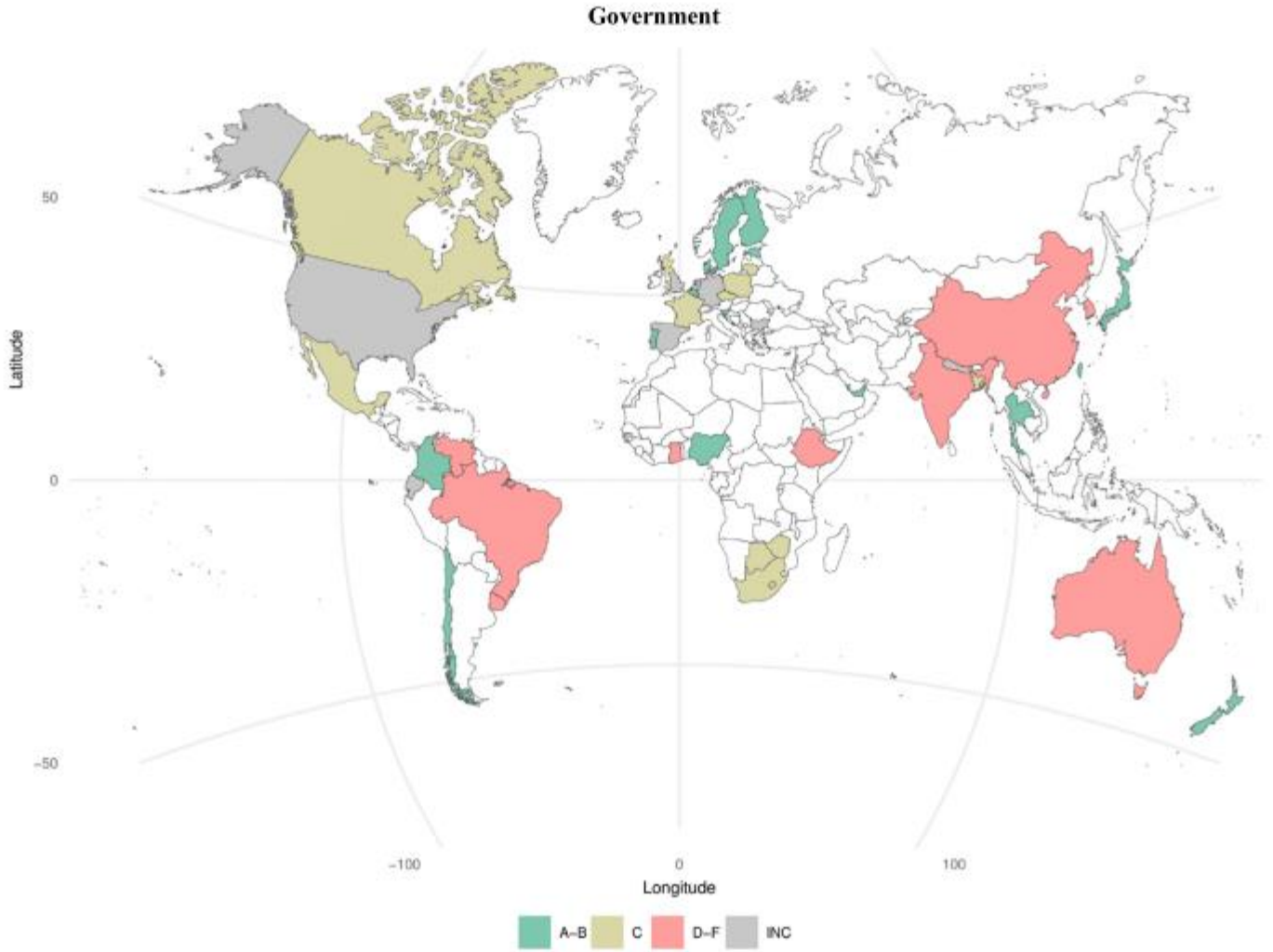

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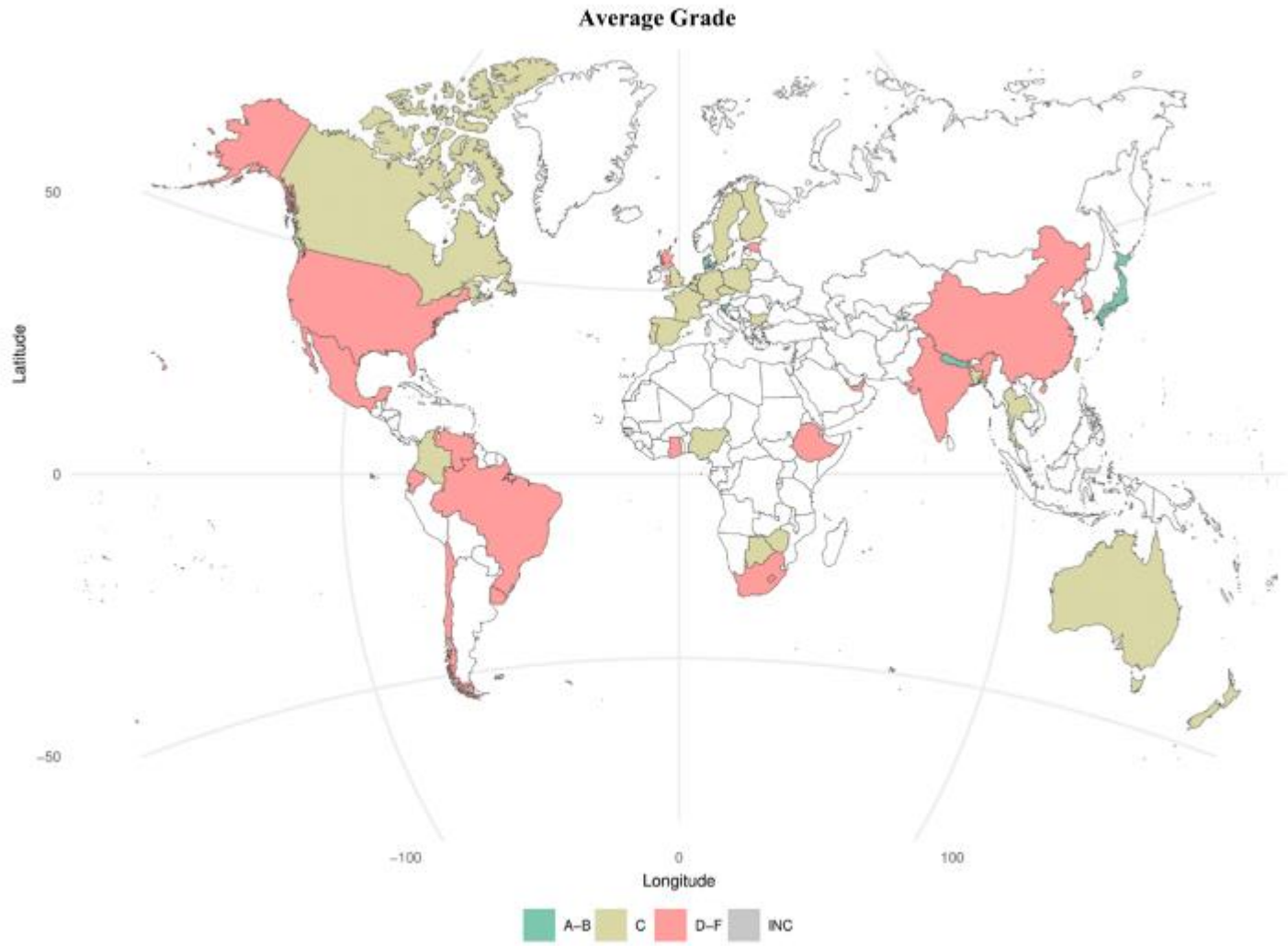

Chapter 7: Manuscript 4

This manuscript has been written and formatted following the publication standards of the *Journal of Physical Activity and Health*. It appears in its published format.

Title:

Report Card Grades on the Physical Activity of Children and Youth Comparing 30 Very High Human Development Index Countries

Citation:

Aubert S, Barnes JD, Aguilar-Farias N, et al. Report Card Grades on the Physical Activity of Children and Youth Comparing 30 Very High Human Development Index Countries. *Journal of Physical Activity and Health*. 2018;15(S2):S298–S314. doi:https://doi.org/10.1123/jpah.2018-0431

This article summarizes the findings of the Report Cards of physical activity grades from the 30 very high HDI countries that participated in the Global Matrix 3.0. I am the primary (first) author on this article. Joel Barnes performed the statistical analysis and I wrote a draft manuscript. The co-authors edited the manuscript and approved the final version of the manuscript before it was submitted for peer-review. All co-authors contributed significantly and met the International Committee of Medical Journal Editors guidelines for authorship. This article is now published in open access. The published manuscript and a supplement material are presented in this chapter.

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ORIGINAL RESEARCH

Report Card Grades on the Physical Activity of Children and Youth Comparing 30 Very High Human Development Index Countries

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Background: To better understand the childhood physical inactivity crisis, Report Cards on physical activity of children and youth were prepared concurrently in 30 very high Human Development Index countries. The aim of this article was to present, describe, and compare the findings from these Report Cards. **Methods**: The Report Cards were developed using a harmonized process for data gathering, assessing, and assigning grades to 10 common physical activity indicators. Descriptive statistics were calculated after converting letter grades to interval variables, and correlational analyses between the 10 common indicators were performed using Spearman's rank correlation coefficients. **Results**: A matrix of 300 grades was obtained with substantial variations within and between countries. Low grades were observed for behavioral indicators, and higher grades were observed for sources of influence indicators, indicating a disconnect between supports and desired behaviors. **Conclusion**: This analysis summarizes the level and context of the physical activity of children and youth among very high Human Development Index countries, and provides additional evidence that the situation regarding physical activity in children and youth is very concerning. Unless a major shift to a more active lifestyle happens soon, a high rate of noncommunicable diseases can be anticipated when this generation of children reaches adulthood.

Keywords: children physical activity, sedentary behavior, international comparison, Global Matrix

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A compelling body of empirical work shows moderate to high levels of physical activity to be associated with a lower risk of cardiovascular disease and all-cause mortality among adults.[1] Conversely, physical inactivity has been recognized by some as "the biggest public health problem of the 21st century."[2,3] Among school-aged children and adolescents, meeting physical activity guidelines is associated with positive physical, psychological, social, and cognitive health indicators,[4,5] while physical inactivity, defined as not meeting physical activity guidelines, is associated with adverse physical, mental, social, and cognitive health outcomes.[4–7]

The Human Development Index (HDI) is a composite index, ranging from 0 to 1, calculated using education, life expectancy, and per capita income.[8] This index was created by the United Nations Development Programme to rank countries on a scale of human development conceptualized in terms of capabilities of humans within the countries to function.[9] To be classified as very high HDI, the score of a country must be equal or superior to 0.80. Among children living in countries categorized as being very high by the HDI, moderate- to vigorous-intensity physical activity (MVPA) was positively related to markers of cardiovascular health[10–13] and self-reported health-related quality of life.[14] Physical inactivity has been estimated to be responsible for at least 10% and 9% of all-cause mortality in North American and in European countries, respectively.[15] Furthermore, very high-income countries bear the largest proportion of economic burden of physical inactivity worldwide (81% of health care costs and 60% of indirect costs).[16] However, the majority of children[17–21] and youth[19–25] do not meet the current recommendations of 60 minutes of MVPA per day[26] in very high HDI European and North American countries and regions. Similar findings were observed among children and/or adolescents from other very high HDI countries or regions such as Australia,[6] Chile,[27] Chinese Taipei (Taiwan),[28] Hong Kong,[29] Japan,[30] South Korea,[31] Qatar,[32] and the United Arab Emirates.[32–34] Very high HDI countries share similar characteristics in terms of education, life expectancy, and income; however, differences also exist geographically, politically, culturally, religiously, and environmentally that may influence physical activity behavior differently across the very high HDI countries. Cooper et al[35] found that there was substantial between-country variation in objectively measured MVPA in the International Children's Accelerometry Database, even between apparently similar countries, and concluded that further research is needed to explore environmental and sociocultural explanations for these differences.

To develop a better understanding of childhood physical activity and inactivity across countries, the first Global Matrix (Global Matrix 1.0) of Report Card grades on physical activity was launched in 2014.[36] Report Cards, based on the Canadian Report Card model,[37] were developed by research teams from 15 countries (including 8 very high HDI countries) using a harmonized process for data gathering, assessing, and assigning grades.[36] For each participating country, grades were assigned to 9 common physical activity indicators: Overall Physical Activity, Organized Sport Participation, Active Play, Active Transportation, Sedentary Behaviors, Family and Peers, School, Community and Environment, and Government Strategies and Investments. Global Matrix 1.0 grades provided new information upon which researchers, advocates, practitioners, and policy-makers could reflect and derive inspiration for children's physical activity research projects and promotion activities around the world.[36]

Building on the Global Matrix 1.0, investigators from each participating country committed to repeat and further develop the Global Matrix initiative along with teams of researchers from 23 new countries. The Global Matrix 2.0, which was released in 2016 in Bangkok, presented a comprehensive summary of the physical activity behaviors and sources of influence indicators from 38 countries (including 24 very high HDI countries).[38] Findings suggested the presence of a complex variety of strengths and limitations across the participating countries, with some universal patterns emerging when comparing countries by continent, HDI, or income inequality. For example, a strong positive correlation was found between the source of influence grades (combining the grades from Family and Peers, School, Community and Environment, and Government Strategies and Investments) and HDI.[38]

In 2017, the Active Healthy Kids Global Alliance[39] (AHKGA) called for more countries to participate in the Global Matrix 3.0. Forty-nine countries registered and followed the harmonized steps to develop their country's Report Card. Out of the 49 participating countries, 30 (61%) were very high HDI countries, from 5 different continents: Asia (n = 6), Europe (n = 19), North America (n = 2), Oceania (n = 2), and South America (n = 1). The aim of this article is to present, describe, and compare the Report Card grades from the very high HDI countries and regions participating in the Global Matrix 3.0: Australia, Belgium (Flanders), Canada, Chile, Taiwan, Czech Republic, Denmark, England, Estonia, Finland, France, Germany, Guernsey, Hong Kong, Japan, Jersey, Lithuania, The Netherlands, New Zealand, Poland, Portugal, Qatar, Scotland, Slovenia, South Korea, Spain, Sweden, the United Arab Emirates, the United States, and Wales. Companion papers published in this issue of the *Journal of Physical Activity and Health* present the collective results from the low and medium HDI countries, and the high HDI countries.

Methods

The AHKGA distributed an open call through established networks for interested countries and opened registration for the Global Matrix 3.0 in April 2017. As a result, 49 countries from 5 different continents fully participated in the Global Matrix 3.0. Workgroups consisting of experts and stakeholders were established in each country to gather the highest quality and most recently published and unpublished evidence. The workgroups critically appraised the available evidence and reported on 10 common indicators (Overall Physical Activity, Organized Sport and Physical Activity, Active Play, Active Transportation, Sedentary Behaviors, Physical Fitness, Family and Peers, School, Community and Environment, and Government) for school-aged children and youth (~5–17 y old). Through a harmonized and transparent Report Card development process, each country's workgroup compiled the available evidence from local, national, or international studies, national surveys, and official reports, and then synthesized findings and reached consensus for the grading of each indicator. Full details of the Report Card development process based on the Canadian Report Card model[37] have been previously described and the detailed methods for the Global Matrix 3.0 are described in a companion paper published in this issue of the *Journal of Physical Activity and Health*.[40]

For each of the 49 registered countries, up to 3 joint Report Card leaders were charged with forming a multidisciplinary research workgroup (including physical activity experts, stakeholder groups, and communication specialists) to manage the Report Card project, and to ensure the effective communication between AHKGA and the Report Card team. The workgroups

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identified and finalized the list of indicators to be graded (ie, the 10 common indicators and potential additional ones that would be included in their national Report Card but not in the Global Matrix 3.0), and compiled potentially relevant data sets and documents that would be used to inform the grades. Countries were advised to consider and synthesize the best available evidence from approximately the past 5 years for each indicator. Common benchmarks, presented in Table 1, and a common grading scheme, shown in Table 2, were provided by the AHKGA to the 49 Report Card workgroups. Experts in each country evaluated the compiled evidence and reached consensus on the grade assigned for each indicator. Draft country Report Card grades were submitted along with their rationale and were audited by the members of the AHKGA Executive Committee to ensure that the grades were consistent with the harmonized benchmarks and grading scheme. The Report Card leaders were also asked to report details concerning the data sets used to inform their overall physical activity grade (ie, subjective or objective measures, representativeness, instrument used, age range, and sample size).

For analysis purposes, the 49 participating countries and regions were divided into 3 categories using the United Nations' HDI groupings (low or medium, high, and very high). The results and analyses presented in this article are on the 30 very high HDI participating countries.

Descriptive statistics (average grade and SD) were calculated after converting categorical variables (letter grades) to interval variables (see corresponding numbers in Table 2), and the incomplete grades (INC) converted into "No Grade" which was treated as a missing value. Averages were calculated from the interval values and the floor (for a given value, the greatest integer less than or equal to the average value) was converted back to a letter grade. Three scores were computed for analysis: (1) overall score,

Table 1 Global Matrix 3.0 Indicators and Benchmarks Used to Guide the Grade Assignment Process

Indicator	Benchmark
Overall Physical Activity	% of children and youth who meet the Global Recommendations on Physical Activity for Health, which recommend that children and youth accumulate at least 60 minutes of moderate- to vigorous-intensity physical activity per day on average. Or % of children and youth meeting the guidelines on at least 4 days a week (when an average cannot be estimated).
Organized Sport and Physical Activity	% of children and youth who participate in organized sport and/or physical activity programs.
Active Play	% of children and youth who engage in unstructured/unorganized active play at any intensity for more than 2 hours a day. % of children and youth who report being outdoors for more than 2 hours a day.
Active Transportation	% of children and youth who use active transportation to get to and from places (eg, school, park, mall, friend's house).
Sedentary Behaviors	% of children and youth who meet the Canadian Sedentary Behaviour Guidelines (5- to 17-year-olds: no more than 2 hours of recreational screen time per day). Note: the Guidelines currently provide a time limit recommendation for screen-related pursuits, but not for non-screen-related pursuits.
Physical Fitness	Average percentile achieved on certain physical fitness indicators based on the normative values published by Tomkinson et al.[41]
Family and Peers	% of family members (eg, parents, guardians) who facilitate physical activity and sport opportunities for their children (eg, volunteering, coaching, driving, paying for membership fees and equipment). % of parents who meet the Global Recommendations on Physical Activity for Health, which recommend that adults accumulate at least 150 minutes of moderate-intensity aerobic physical activity throughout the week or do at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week or an equivalent combination of moderate- and vigorous-intensity physical activity. % of family members (eg, parents, guardians) who are physically active with their kids. % of children and youth with friends and peers who encourage and support them to be physically active. % of children and youth who encourage and support their friends and peers to be physically active.
School	% of schools with active school policies (eg, daily PE, daily physical activity, recess, "everyone plays" approach, bike racks at school, traffic calming on school property, outdoor time). % of schools where the majority (≥ 80%) of students are taught by a PE specialist. % of schools where the majority (≥ 80%) of students are offered the mandated amount of PE (for the given state/territory/region/country). % of schools that offer physical activity opportunities (excluding PE) to the majority (>80%) of their students. % of parents who report their children and youth have access to physical activity opportunities at school in addition to PE classes. % of schools with students who have regular access to facilities and equipment that support physical activity (eg, gymnasium, outdoor playgrounds, sporting fields, multipurpose space for physical activity, equipment in good condition).
Community and Environment	% of children or parents who perceive their community/municipality is doing a good job at promoting physical activity (eg, variety, location, cost, quality). % of communities/municipalities that report they have policies promoting physical activity. % of communities/municipalities that report they have infrastructure (eg, sidewalks, trails, paths, bike lanes) specifically geared toward promoting physical activity. % of children or parents who report having facilities, programs, parks and playgrounds available to them in their community. % of children or parents who report living in a safe neighborhood where they can be physically active. % of children or parents who report having well-maintained facilities, parks and playgrounds in their community that are safe to use.
Government	Evidence of leadership and commitment in providing physical activity opportunities for all children and youth. Allocated funds and resources for the implementation of physical activity promotion strategies and initiatives for all children and youth. Demonstrated progress through the key stages of public policy making (ie, policy agenda, policy formation, policy implementation, policy evaluation and decisions about the future).

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Table 2 Global Matrix 3.0 Grading Rubric

Grade	Interpretation	Corresponding number for analysis
A+	94%–100%	15
A	We are succeeding with a large majority of children and youth (87%–93%)	14
A–	80%–86%	13
B+	74%–79%	12
B	We are succeeding with well over half of children and youth (67%–73%)	11
B–	60%–66%	10
C+	54%–59%	9
C	We are succeeding with about half of children and youth (47%–53%)	8
C–	40%–46%	7
D+	34%–39%	6
D	We are succeeding with less than half but some children and youth (27%–33%)	5
D–	20%–26%	4
F	We are succeeding with very few children and youth (<20%)	2
INC	Incomplete—insufficient or inadequate information to assign a grade	No Grade

(2) behavioral score (Overall Physical Activity, Organized Sport and Physical Activity Participation, Active Play, Active Transportation, and Sedentary Behaviors), and (3) sources of influence score (Family and Peers, School, Community and Environment, and Government). Scores for each group of indicators were calculated by summing the relevant interval data. INC grades were removed and the scores were reweighted accordingly. Categorical variables (letter grades) were grouped into 1 of 4 levels ("A–B," "C," "D–F," and "No Grade") based on the overall score. These categories were then used to rank countries by letter grade/score and category level in scatter plot data visualizations. Correlational analyses between the 10 common indicators were performed using Spearman's rank correlation coefficients. Pairwise deletion was used to treat missing data (INC) instead of other techniques (eg, listwise deletion) in order to minimize the number of cases excluded from the analysis. All statistical analyses were performed using R (version 3.4.1; The R Foundation for Statistical Computing, Vienna, Austria). Several packages were loaded to extend base R including corrplot,[42] ggplot2,[43] UpSetR,[44] and VIM.[45] In addition, descriptive statistics of the qualitative information regarding the measurement of overall physical activity were performed.

Results

The sociodemographic characteristics of the 30 very high HDI countries are presented in Table 3. The HDI scores ranged from 0.840 for the United Arab Emirates to 0.985 for Jersey. Chile was the country with the lowest gross national income per capita, the highest Gini index (highest income inequality), and the highest child poverty rate (0.225). Qatar had the highest gross national income per capita, the lowest relative public health expenditure, and the highest Gender Inequality Index. Slovenia had the lowest Gini index (least income inequality) and the lowest percentage of urban population (49.8%). The life expectancy at birth was above 80 years for most of the countries (23 countries, 77%), with a maximum of 84.2 years for Hong Kong. Lithuania had a notably lower life expectancy of 73.5 years compared with other countries. The mean years of schooling ranged from 8.9 years in Portugal to 13.3 years in the United Kingdom nations (England, Scotland, and Wales). Finally, population density ranged from 3.2 people/km^2 of land area for Australia, to 6987.2 people/km^2 of land area for Hong Kong. In summary, despite all 30 countries being within the very high HDI category, countries varied substantially in other characteristics.

The 30 country grades for the 10 core Report Card indicators (300 grades or INC in total) and the average grades for each country are shown in Table 4, and the corresponding descriptive information is presented in Table 5. In total, 233 letter grades and 67 INC grades were assigned (Table 4). The country with the highest average grade was Slovenia with "B," and the countries with the lowest average grade were Chile and the United States with "D." All 30 countries assigned a grade to Sedentary Behaviors, 29 countries (97%) to Overall Physical Activity, and 28 countries (93%) to Organized Sport and Physical Activity and to Active Transportation. Active Play was the indicator with the largest number of INC grades (n = 20), followed by Physical Fitness (n = 13), and Family and Peers (n = 13). The indicator with the highest average grade was Community and Environment with "B –," while the indicator with the lowest average grade was Overall Physical Activity with "D–." An average grade of "D+" was obtained for the behavioral indicators combined, "C+" for the source of influence indicators combined, and "C–" was the overall average for the 233 grades. Qatar's Report Card workgroup decided not to evaluate Active Transportation and considered it "not applicable" because of unsafe road conditions and the hot climate during most times of the year.[56] Correlation analyses showed that there were no relationships between the Overall Physical Activity grade and any of the other 9 core indicator grade (results not shown). Frequency plots illustrating the distribution of the overall 233 grades as well as the behavioral and the sources of influence indicators are presented in Figures 1A and 1B, respectively. A normal distribution of the letter grades is evident in both Figures 1A and 1B, with the mode being "C" for the 233 letter grades overall, "D" for the behavioral indicators, and "B" for the sources of influence indicators.

A plot for the overall score for each country estimated from the 10 indicators is presented in Figure 2, and the behavioral and the

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Table 3 Sociodemographic Information of the 30 Very High HDI Countries in the Global Matrix 3.0

Country	HDI[a]	GNI per capita[a]	Public health expenditure (% of GDP)[a]	GII[a]	Life expectancy at birth[a]	Mean years of schooling[a]	Gini index[b]	Global food security index[c]	Child poverty rate[d]	Urban population percentage[e]	Population density (people/km^2)[f]
Australia	0.939	42,822	6.3	0.12	82.5	13.2	34.7	83.3	0.13	89.4	3
Belgium	0.896	41,243	8.3	0.073	81.0	11.4	27.7	79.8	0.11	97.5	374
Canada	0.92	42,582	7.4	0.098	82.2	13.1	34.0	82.2	0.171	80.8	4
Chile	0.847	21,665	3.9	0.322	82.0	9.9	47.7	74.7	0.225	89.4	24
Czech Republic	0.878	28,144	6.3	0.129	78.8	12.3	25.9	75.8	0.105	73.4	137
Denmark	0.925	44,519	9.2	0.041	80.4	12.7	28.2	80.3	0.029	87.1	136
England	0.909	37,931	7.6	0.131	80.8	13.3	33.2	84.2	0.112	79.7	271
Estonia	0.865	26,362	5.0	0.131	77.0	12.5	32.7		0.121	69.5	31
Finland	0.895	38,868	7.3	0.056	81.0	11.2	27.1	81.0	0.037	83.8	18
France	0.897	38,085	9.0	0.102	82.4	11.6	32.7	82.3	0.113	86.4	122
Germany	0.926	45,000	8.7	0.066	81.1	13.2	31.7	82.5	0.095	74.1	236
Guernsey[f]	0.975				82.6		40.0				850
Hong Kong	0.917	54,265			84.2	11.6				100.0	6987
Japan	0.903	37,268	8.6	0.116	83.7	12.5	32.1	79.5		91.9	348
Jersey[g]	0.985				81.9		41.0				845
Lithuania	0.848	26,006	4.4	0.121	73.5	12.7	37.4		0.191	67.2	46
The Netherlands	0.924	46,326	9.5	0.044	81.7	11.9	29.3	82.8	0.102	83.6	506
New Zealand	0.915	32,870	9.1	0.158	82.0	12.5		81.0	0.141	86.3	18
Poland	0.855	24,117	4.5	0.137	77.6	11.9	31.8	74.1	0.134	60.8	124
Portugal	0.843	26,104	6.2	0.091	81.2	8.9	35.5	79.0	0.155	61.6	113
Qatar	0.856	129,916	1.9	0.542	78.3	9.8		73.3		98.9	221
Scotland	0.909	37,931	7.6	0.131	80.8	13.3	33.2	84.2	0.112	79.7	271
Slovenia	0.89	28,664	6.6	0.053	80.6	12.1	25.4			49.8	103
South Korea	0.901	34,541	4.0	0.067	82.1	12.2	31.6		0.071	83.5	526
Spain	0.884	32,779	6.4	0.081	82.8	9.8	36.2	78.1	0.221	77.6	93
Sweden	0.913	46,251	10.0	0.048	82.3	12.3	29.2	81.7	0.091	85.4	24
Taiwan[h]	0.885	45,582			80.2		33.6				
United Arab Emirates	0.84	66,203	2.6	0.232	77.1	9.5		70.9		84.7	111
United States	0.92	53,245	8.3	0.203	79.2	13.2	41.5	84.6	0.199	82.6	35
Wales	0.909	37,931	7.6	0.131	80.8	13.3	33.2	84.2	0.112	79.7	271

Abbreviations: GDP, Gross Domestic Product; GII, Gender Inequality Index; GNI, Gross National Income; HDI, Human Development Index.

Sources of information: [a]United Nations Development Programme.[8] [b,f]The World Bank.[46,47] [c]The Economist Intelligence Unit.[48] [d]Organisation for Economic Co-operation and Development Child (OECD) Well-Being Data Portal.[49] [e]United Nations, Department of Economic and Social Affairs.[50] [f]For Guernsey, the HDI sourced from the United Nations Economic and Social Commission for Asia and the Pacific,[51] the life expectancy at birth, population size, and the population density sourced from the United States Central Intelligence Agency,[52] and the Gini index sourced from the State of Guernsey.[53] [g]For Jersey, the HDI sourced from the United Nations Economic and Social Commission for Asia and the Pacific,[51] and the life expectancy at birth, population size, and the population density sourced from the United States Central Intelligence Agency,[52] and the Gini index sourced from the State of Jersey.[54] [h]For Taiwan, the HDI, the GNI per capita, the life expectancy at birth, and the Gini index come from the National Statistics, Republic of China (Taiwan).[55] For England, Scotland, and Wales, the official data for the United Kingdom were reported.

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Table 4 Grades Assigned to the 10 Core Physical Activity Indicators for the 30 Very High HDI Countries of the Global Matrix 3.0

	PA	SP	AP	AT	SB	PF	FAM	SCH	COM	GOV	AVG
Australia	D–	B–	INC	D+	D–	D+	C+	B+	A–	D	C–
Belgium (Flanders)	F	B	INC	C+	C	INC	C+	B–	B	B	C
Canada	D+	B+	D	D–	D+	D	C+	B–	B+	C+	C–
Chile	D–	D–	INC	F	C–	D	F	D	B	B–	D
Czech Republic	D	B–	D–	C+	D–	C+	C+	B+	B	C+	C
Denmark	D–	A–	INC	B+	D+	INC	INC	A–	B+	A–	B–
England	C–	D+	INC	C–	D+	C–	INC	B+	C	INC	C–
Estonia	D–	C	F	D	F	INC	D	C+	B	B	D+
Finland	D	C+	C	B+	D–	C	B–	A	B+	A–	C+
France	D	C–	INC	C–	D–	B–	INC	B	INC	C	C–
Germany	D–	B	D–	C–	D–	INC	B–	B+	B+	INC	C
Guernsey	D	C+	INC	D	C	INC	INC	INC	INC	D	D+
Hong Kong	C–	C	INC	B+	C–	D	D–	C	B	C	C–
Japan	INC	B–	INC	A–	C–	A	C–	B+	B–	B	B–
Jersey	D–	INC	INC	D+	C	D	C	B–	C	D	D+
Lithuania	C–	C	INC	C–	C–	C+	D	C+	C	C	C–
The Netherlands	C	B	B	B–	C–	INC	INC	C	INC	INC	C+
New Zealand	D–	B	C+	C–	D	INC	C	B–	B	B+	C
Poland	D–	D	INC	C	D	C–	C–	B	C	C+	C–
Portugal	D	B–	INC	C–	C–	C	C	A	B	B	C+
Qatar	D	D+	INC	N/A	D+	INC	INC	C	INC	B+	C–
Scotland	F	B	INC	C	F	INC	INC	INC	B–	C	D+
Slovenia	A–	C+	D	C	B+	A–	B+	A	B	A	B
South Korea	F	C	INC	B+	D	D+	INC	D+	INC	D	D+
Spain	D	B	C–	B–	B+	INC	INC	C+	INC	INC	C+
Sweden	D+	B+	INC	C	C+	INC	INC	C+	A	B	C+
Taiwan	F	D–	INC	C–	C–	B–	INC	B+	B+	B+	C
United Arab Emirates	F	INC	INC	INC	C–	INC	INC	D–	INC	B+	D+
United States	D–	C	INC	D–	D	C–	INC	D–	C	INC	D
Wales	D+	C+	C–	D+	F	INC	D	INC	INC	C+	D+

Abbreviations: AP, Active Play; AT, Active Transportation; AVG, average; COM, Community and Environment; FAM, Family and Peers; GOV, Government; HDI, Human Development Index; INC, incomplete grade; N/A, not applicable; PA, Physical Activity; PF, Physical Fitness; SB, Sedentary Behaviors; SCH, School; SP, Organized Sport and Physical Activity Participation.

source of influence scores in Figures 3 and 4, respectively. For the overall score, Slovenia ranked first while Chile ranked 30th (see more rankings in Figure 2). In terms of the grading completion, the United Arab Emirates had only 4 graded indicators that were included in the calculation of this score, while 4 other countries (Slovenia, Finland, Czech Republic, and Canada) had all 10 indicators graded. For the behavioral score, Japan ranked first while Estonia ranked 30th (see more rankings in Figure 3). The United Arab Emirates had only 2 out of 5 indicators, and Japan and Qatar only had 3 graded indicators that were included in the calculation of the behavioral score. Similar to the overall score, Slovenia also ranked first for the sources of influence score, while Guernsey, with only one out of 4 graded indicators available, ranked 30th (see more rankings in Figure 4).

Finally, the description of the data sources used to inform the Overall Physical Activity grade for each country (except for Japan that had an INC) are presented in Supplemental Material [available online]. In total, 87 surveys or studies informed the grades of the very high HDI countries, representing a total sample size of 1,005,989 children and youth. A total of 21 surveys/studies used an objective measurement of physical activity, while 66 used a subjective method, mostly via self-administered questionnaires. Out of 21 surveys/studies that measured physical activity objectively, 20 used accelerometry and one study used pedometry. A minimum wear time for accelerometer ranged between 3 and 7 consecutive days, and 9 different accelerometer cut points were applied for analysis across 20 surveys/studies with the most commonly used cut points (n = 8) from Evenson et al.[57] Regarding the subjective measurement of physical activity, survey-specific questionnaires were used in a significant number of surveys (n = 35), followed by original or adapted versions of the *Health Behaviour in School-Aged Children* questionnaire (n = 14), uniquely in European countries, the *Global School-based Student Health Survey* questionnaire (n = 5), the *Youth Risk Behavior Surveillance System* questionnaire (n = 4), the *International Physical Activity Questionnaire* (n = 3), and others (n = 5).

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Table 5 Descriptive Statistics of the Grades by Indicator and Group of Indicators for the Very High Human Development Index Countries of the Global Matrix 3.0

	Grade count	Incomplete grades	Mean number grade	SD	Mean letter grade	Range
Overall Physical Activity	29	1	4.9	2.2	D–	F to A–
Organized Sport and Physical Activity Participation	28	2	9	2.4	C+	D– to A–
Active Play	10	20	6.2	2.7	D+	F to B
Active Transportation	28	2	7.8	2.7	C–	F to A–
Sedentary Behaviors	30	0	6.1	2.4	D+	F to B+
Physical Fitness	17	13	7.9	2.7	C–	D to A
Family and Peers	17	13	7.5	2.6	C–	F to B+
School	27	3	9.9	2.9	C+	D– to A
Community and Environment	22	8	10.7	1.7	B–	C to A
Government	25	5	9.6	2.7	C+	D to A
Behavioral indicators	30	0	6.8	1.6	D+	D– to B–
Sources of influence indicators	30	0	9.3	2	C+	D to A–
All indicators	30	0	7.9	1.5	C–	D+ to B

Note: Behavioral indicators = average of Overall Physical Activity, Organized Sport Participation, Active Play, Active Transportation, and Sedentary Behavior indicator grades; source of influence indicators = average of Family and Peers, School, Community and Environment, and Government Strategies and Investments indicator grades. Physical fitness was not included in the behavioral indicators cluster. There are no missing grades for the bottom 3 rows because these scores are adjusted for missing grades.

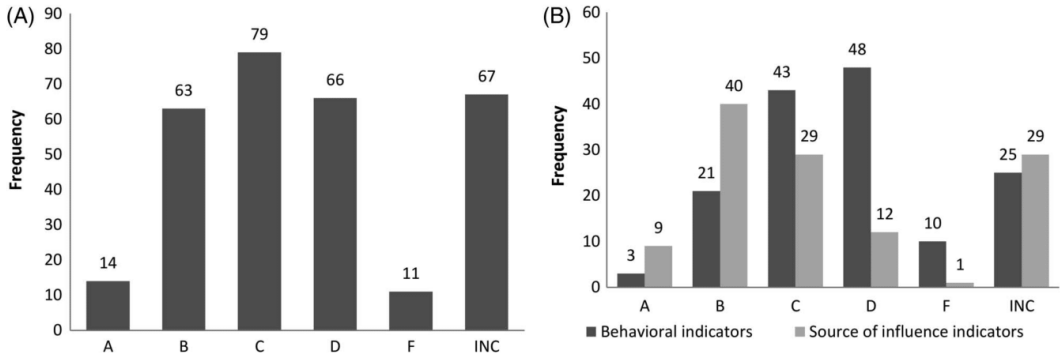

Figure 1 — Frequency plot by letter grade among 30 very high Human Development Index countries in the Global Matrix 3.0. (A) For the 10 core indicators. (B) For the behavioral indicators and for the source of influence indicators. Note: Behavioral indicators = average of Overall Physical Activity, Organized Sport Participation, Active Play, Active Transportation, and Sedentary Behavior indicator grades; source of influence indicators = average of Family and Peers, School, Community and Environment, and Government Strategies and Investments indicator grades. Physical fitness was not included in the behavioral indicators cluster.

Discussion

The objective of this paper was to present, describe, and compare the Report Card grades from the 30 very high HDI countries and nations participating in the Global Matrix 3.0. A wide range of grades was observed for most indicators across countries. These 30 countries are geographically distributed across Asia, Europe, North America, Oceania, and South America and have very different climatic, geographic, demographic, and cultural characteristics. Despite these contextual differences, most of these countries shared concerning low grades for Overall Physical Activity and Sedentary Behaviors. No country was consistently leading nor falling behind the others across the 10 common indicators, however, some countries showed greater or less success than others. The characteristics of the most and the least successful countries are discussed below, followed by a discussion of the findings for each indicator, and an integrated discussion of the findings including the strengths and limitations of this study.

Most Successful Countries

Slovenia had sufficient data to inform the 10 indicators and obtained the best grades for Overall Physical Activity ("A–"), Family and Peers ("B+"), and Government ("A"), as well as on average ("B"); and shared the best grades for Sedentary Behaviors with Spain ("B+"), and for School ("A") with Finland and Portugal. A notable feature of Slovenia is the importance of sport for the culture of this almost 30-year old country as "Slovenes tend to view

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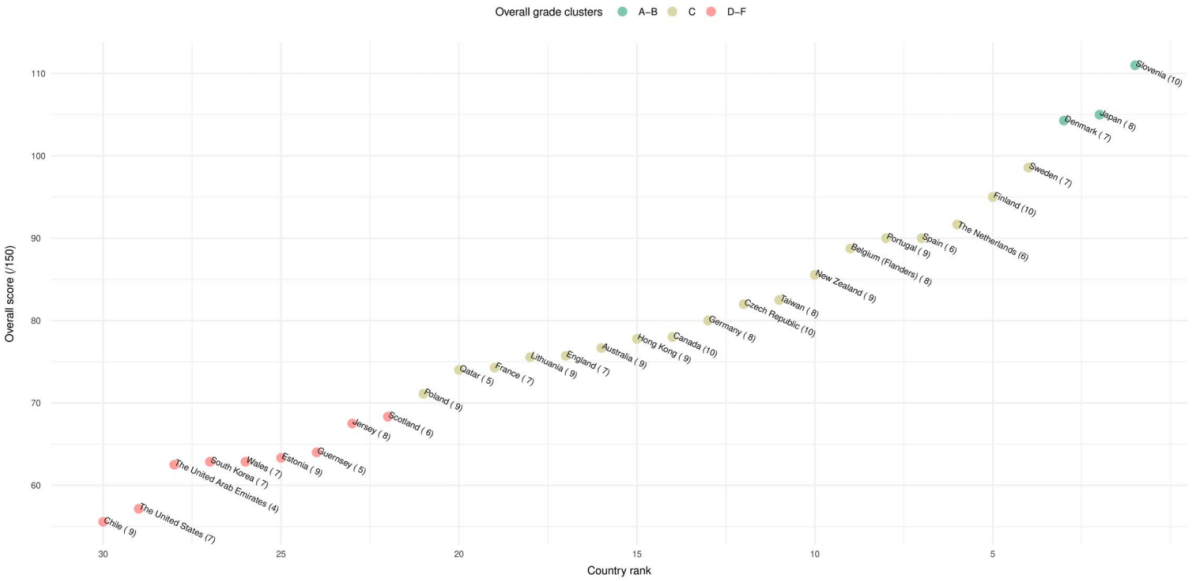

Figure 2 — Plot of the overall score estimated for the 10 core indicators for the 30 very high Human Development Index countries of the Global Matrix 3.0. Note: The overall score was adjusted for missing and incomplete grades. The number in parenthesis shows the number of grades available for the calculation of the score.

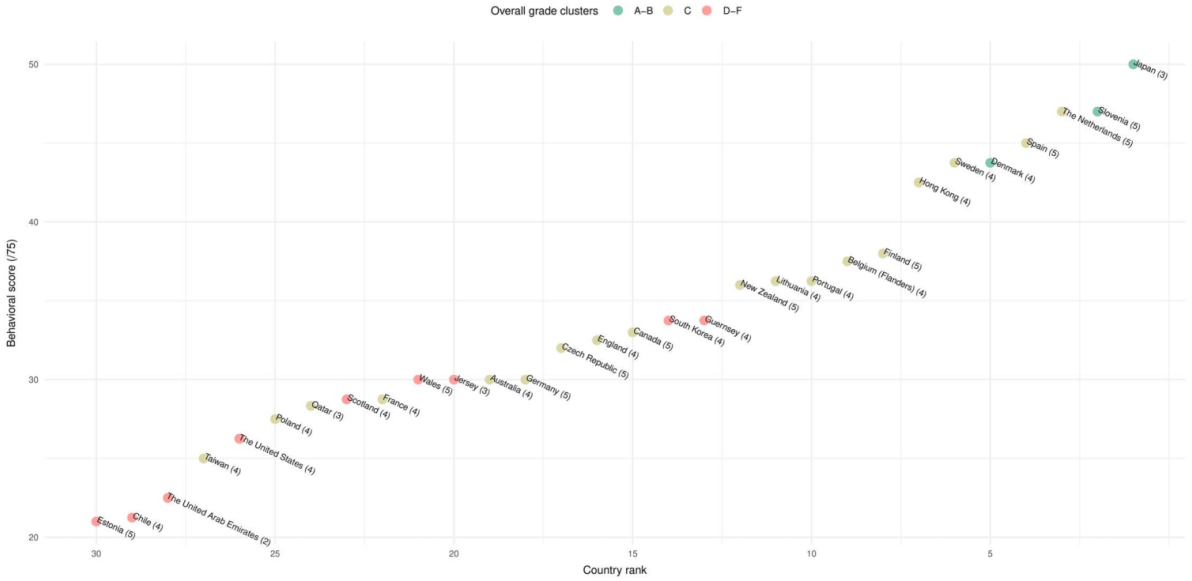

Figure 3 — Plot of the behavioral score estimated for the very high Human Development Index countries of the Global Matrix 3.0. Note: The overall score was adjusted for missing and incomplete grades. The number in parenthesis shows the number of grades available for the calculation of the score.

sports as an effective tool in fostering national identity among citizens and making successful global identity claims."[58] Every April since 1987, a national school-based surveillance system of physical fitness (named *Slofit*) takes place, targeting the majority of Slovenian school children and youth aged 6–19 years.[59] Negative trends in motor skills and physical fitness were observed for over 2 decades in Slovenia, but since 2011, these trends have been reversed after the implementation of a health-oriented physical

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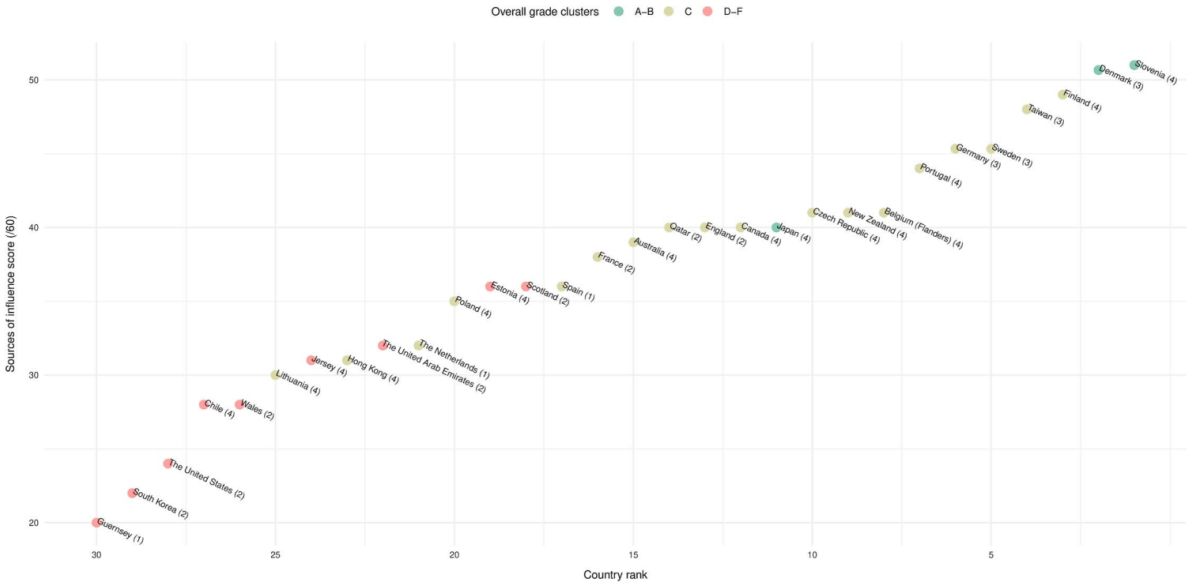

Figure 4 — Plot of the source of influence indicators score for the very high Human Development Index countries of the Global Matrix 3.0. Note: The overall score was adjusted for missing and incomplete grades. The number in parenthesis shows the number of grades available for the calculation of the score. These estimates of sources of influence score are interpreted with a high degree of caution as they are likely imprecise estimates of sources of influence due to the level of missing data used to determine this score.

activity intervention program, which offers children 2 (optional) additional hours of physical activity per week.[60] The estimated proportion of Slovenian children and youth meeting the recommended levels of daily physical activity is now high (over 80%), and this encouraging outcome seems to be the result of the collective support for childhood physical activity from the government, the educational system, and the parents themselves.[61]

The next 2 most successful countries were Denmark and Japan with an average grade of "B–." The positive result for these 2 countries should be interpreted with caution as both had "INC" grades for some indicators. Active Play, Physical Fitness, and Family and Peers for Denmark, and Overall Physical Activity and Active Play for Japan were not graded due to the lack of data. Nonetheless, Denmark was the country with the best grade for Organized Sport and Physical Activity ("A–"), and also obtained a grade of "A–" for both School and Government indicators. Sport is an important part of the Danish culture, and considered important not only for individual and population health, but also in relation to issues such as social inclusion and community cohesion.[62] Despite Denmark performing rather well on the strategic and political levels, low grades were attributed to Overall Physical Activity ("D–") and Sedentary Behaviors ("D+"), indicating an implementation gap between the governmental and individual levels.[63]

Japan had the best grades for Active Transportation ("A–") and Physical Fitness ("A"), and had no grades lower than "C–." In fact, Japan has a highly established "walking to school practice" that has been implemented since the School Education Act enforcement order, enacted in 1953, stating that public elementary schools should be sited within no more than 4 km, and for public junior high schools no more than 6 km from the student's home. This policy is still successful today at promoting active transportation among Japanese children and youth.[64] The Physical Fitness grade was assigned based on the performance of Japanese children and youth on the 20-m shuttle run test. On average, Japanese children were in the 90th percentile,[65] based on age- and sex-specific international normative data.[41] The Organized Sport and Physical Activity Participation (graded "B–") and the favorable School environment (graded "B+") may explain this high level of physical fitness; however, this is speculative and more research is necessary. It was observed that only a minority of time in physical education classes was spent in MVPA (27.3%/45 min/class) in Japanese primary school students.[66]

Least Successful Countries

Chile and the United States were the 2 countries with the lowest average grade: "D." They were followed by Guernsey, Jersey, Scotland, South Korea, the United Arab Emirates, and Wales, who obtained an average grade of "D+." Chile had the lowest grades for Active Transportation ("F"), Family and Peers ("F"), and shared the lowest grades for Organized Sport and Physical Activity with Taiwan ("D–"), and for Physical Fitness with Canada, Hong Kong, and Jersey ("D"). In Chile's first Report Card (2016), all indicators had low grades, and data from different surveys indicated that there were consistent disparities across genders, socioeconomic status, and school types.[67] In 2018, Chile's grades remained low in comparison with the first Report Card in 2016 but progress was made on environmental and policy aspects,[68] raising hope that these improvements will positively affect behavioral indicators in the future.

The low average grade of the United States should be interpreted carefully because 3 indicators were assigned an "INC"

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grade: Active Play, Family and Peers, and Government. The United States shared the lowest grades with the United Arab Emirates for School ("D–"), and the Community and Environment ("C") with England, Jersey, Lithuania, and Poland. Overall, none of the indicators were graded above "C" in the United States. This is the third Report Card for the United States, and the grade for Overall Physical Activity ("D–") remained consistent with the 2014 and 2016 Report Card.[69,70] Similarly to Chile, major disparities in physical activity participation across gender, race/ethnicity, age, and socioeconomic status were observed.[71]

Overall Physical Activity

Among the 30 very high HDI countries, only Japan assigned an "INC" grade for Overall Physical Activity. The grades ranged from "F" to "A–" for this indicator; however, Slovenia was the only country with a "good" grade ("A–"), and all the other countries' grades fell between "F" and "C." Five countries received an "F" (Flanders, Scotland, South Korea, Taiwan, and the United Arab Emirates), 4 countries assigned "C" grades (England, Hong Kong, Lithuania, and The Netherlands), and all the remaining countries had a "D–," "D," or "D+." The comparison and interpretation of the Overall Physical Activity grades should be conducted carefully given the important variation in the methods used to measure Overall Physical Activity between the countries, as seen in Supplemental Material [available online]. In fact, objective data were used in 13 of 29 countries with an Overall Physical Activity letter grade, and subjective data in 27 countries (11 countries combined subjective and objective data to inform their Overall Physical Activity indicator). In addition, even among the subjective or the objective data, the methods differed largely in terms of instruments, analysis, age range, sample size, and representativeness of samples.

The correlational analyses showed that there was no relationship between Overall Physical Activity and the physical activity-related indicators (Organized Sport and Physical Activity, Active Play, and Active Transportation). For example, only 56% of children and 33% of adolescents met the international physical activity recommendations in The Netherlands despite a high level of Organized Sport and Physical Activity, Active Play, and Active Transportation (graded "B," "B," and "B–," respectively).[72] A similar pattern was observed in Belgium (Flanders), Denmark, Scotland, South Korea, and Spain where Overall Physical Activity was graded "F" or "D/D–" despite the fact that grades between "A" and "C" were assigned to Organized Sport and Physical Activity, Active Play, and Active Transportation (note: an "INC" grade was assigned to Active Play for Flanders, Denmark, Scotland, and South Korea).[63,73–76] The opposite situation was observed in Slovenia where Overall Physical Activity was graded "A–," while Organized Sport and Physical Activity, Active Play, and Active Transportation were graded "C+," "D," and "C," respectively.

The absence of a relationship between Overall Physical Activity and other behavioral indicators can potentially be explained by the aforementioned differences in methods used to measure these indicators and the diversity of benchmarks between countries. The recommended benchmark for physical activity was "% of children and youth [. . .] who accumulate at least 60 minutes MVPA per day on average, or % of children and youth meeting the guidelines on at least 4 days a week (when an average cannot be estimated)" (Table 1). The available data in each country did not necessarily allow them to use either of these benchmarks strictly when estimating the prevalence of physically active children and youth in their sample. For example, in France, a "high level of physical activity" corresponded to engage in physical activity 5 or more days a week, and the regular use of active transportation, for 6- to 10-year olds (reported by the parents); and practicing a MVPA at least 5 days a week for 11- to 17-year olds (self-reported).[77] While in England's 2018 Report Card, the percentage of children and youth accumulating at least 1 hour of MVPA 7 days a week was evaluated.[78] In addition, among the countries where objective methods were used to measure physical activity, the estimated number of children meeting the physical activity guidelines could also have been significantly affected by the cutoff point that defines the count per minute threshold for MVPA.[79] Although the majority of studies included in the Global Matrix 3.0 used the Evenson cutoff point,[57] several studies used different ones. For example, the Freedson cutoff point[80] was used in Hong Kong, while the Puyau cutoff point[81] was used in Canada (Supplemental Material [available online]).

Notwithstanding the presented methodological issues across countries, 29 out of 30 very high HDI countries assigned a letter grade to the Overall Physical Activity indicator, and for 28 of them, this grade was between "C" and "F," with an average of "D–." These results are consistent with the current literature. A systematic review of physical activity in European children and adolescents found that 5% to 47% of children and adolescents when measured subjectively, or 0% to 60% of children and adolescents when measured objectively, achieved the recommended levels of physical activity.[82] In another study describing objectively measured physical activity and sedentary time patterns in children and youth in 10 countries (9 very high HDI countries and Brazil), only 9% of boys and 2% of girls accumulated ≥60 minutes of MVPA on all measured days.[35] The present study provides additional evidence that the situation regarding the physical activity of children and youth is very concerning in very high HDI countries, and public investment to implement effective interventions for increasing physical activity opportunities is needed urgently. Unless a major shift to a more active lifestyle happens soon, a high rate of premature noncommunicable diseases can be anticipated when this generation of children will reach adulthood.

Organized Sport and Physical Activity

Most of the countries assigned a letter grade to Organized Sport and Physical Activity, excepting Jersey and the United Arab Emirates. With an average grade of "C+," Organized Sport and Physical Activity was the most successful behavioral indicator in the very high HDI countries. Only 3 countries had a low grade for this indicator: Chile ("D–"), Taiwan ("D–"), and France ("C–"); while 12 countries had relatively higher grades ("B+," "B," and "B–") behind the lead of Denmark ("A–"). In Canada, Organized Sport and Physical Activity was the only behavioral indicator with a high grade ("B+"),[83] in which the high participation rate (77%) has been relatively stable since 2005.[84] Similarly, Organized Sport and Physical Activity was also the highest graded indicator in Sweden.[85] In relation to its geographical and population size, Sweden is considered as one of the world's most sporting nations: out of the 7 million inhabitants between the ages of 7 and 70, more than 3 million were active members of sport clubs and more than 2 million were competing regularly in 2012.[86] However, as presented before, these high rates of sport participation were not associated with a sufficient level of physical activity in the population.

Given that the benchmark for Organized Sport and Physical Activity ("% of children and youth who participate in organized

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sport and/or physical activity programs") does not specify intensity, duration, or frequency, we are missing important contextual information of this indicator. These characteristics should be evaluated to estimate the dose of physical activity associated with sport participation among children and youth. However, the popularity of sport among children and youth from very high HDI countries suggests that increasing organized sport opportunities and accessibility could be a strategic solution to address the prevalence of childhood physical inactivity in these countries. Further research focusing on this indicator is needed to evaluate if the available organized physical activity opportunities are indeed saturated. Moreover, are all countries providing free or affordable and appealing physical activity and sport participation opportunities for the entire youth population including different age, gender, socioeconomic, ethnic, and special population groups (eg, children with learning and/or physical disabilities)?

Active Play

The main finding concerning Active Play was the amount of missing data: 20 out of the 30 very high HDI countries assigned an "INC" grade to this indicator. Among the 10 countries with a letter grade, The Netherlands attained the highest grade ("B"); Estonia the lowest grade ("F"); and the 8 remaining countries had "C"s or "D"s. The average grade of "D+" for this indicator suggests that there is a low level of engagement in this behavior, and/or that researchers were not able to detect it with the measurement instruments they used. Indeed, valid and reliable tools to assess active play are largely limited.[87] In the Czech Republic, Active Play was measured using self-reports of unstructured/unorganized active play for at least 2 hours per day[88]; while in New Zealand, surveys asked parents/guardians or youth report to indicate if the children or youth had been active while playing (on their own or with others) in the last 7 days, if they had been active while playing for at least 7 hours in the last 7 days, and if they were allowed to go out on their own in the neighborhood.[89] The development of standardized tools for the measurement of Active Play is challenged by the need for consensus on a definition. In a recent systematic review synthesizing the literature to identify key concepts used to define and describe active play among young children, Truelove et al[87] proposed the following definition: "a form of gross motor or total body movement in which young children exert energy in a freely chosen, fun, and unstructured manner." But a consensus definition needs to be officially internationally agreed upon and acknowledged to advance the development and acceptance of standardized measurement tools.

Active Transportation

For Active Transportation, the grades ranged from "A–" (Japan) to "F" (Chile), with an average of "C–." Qatar and the United Arab Emirates were the only 2 countries that did not assign a letter grade to this indicator. Interestingly, 3 of the 4 countries from Eastern Asia are leading this indicator: Japan ("A–"), Hong Kong ("B+"), and South Korea ("B+"). The successful school policy that has been identified underlying this high prevalence of active transportation among children and youth in Japan was discussed previously in this paper. In Hong Kong, a high proportion of children using active transportation can be explained by the very high population density of the city: most districts are highly self-contained so children usually attend schools close to their home.[90] Similarly, because most students live within 10-minute walking distance to/from school, national data showed that active commuting is prevalent in South Korea: 79.4% of children and youth reported that they take active modes of transport to/from places.[75] Previous research has shown that active transportation is associated with increased physical activity[91]; however, the Active Transportation indicator was not correlated with Overall Physical Activity among children in very high HDI countries in this study. Similar to Organized Sport and Physical Activity and Active Play, the benchmark for this indicator does not indicate duration or intensity of activity. Therefore, it is not possible to evaluate the extent to which this indicator is contributing to the Overall Physical Activity of children and youth.

Sedentary Behaviors

Sedentary behavior corresponds to any waking behavior characterized by an energy expenditure ≤1.5 metabolic equivalents, while in a sitting, reclining, or lying posture.[92] For example, in children and youth, it includes to the use of electronic devices while sitting, reclining, or lying, as well as reading, writing, or drawing while sitting.[92] While reading is associated with positive outcomes such as higher academic achievement, screen time, often used as a proxy for sedentary behavior in research, has been shown to be associated with a variety of negative health outcomes among children and youth.[93] For this reason, guidelines focusing specifically on screen time were developed for the first time in Canada in 2011, recommending limiting screen time to 2 hours daily for the 5- to 17-year olds.[94] Consistent with the current guidelines, the benchmark for Sedentary Behaviors was solely based on screen time: "% of children and youth who meet the *Canadian Sedentary Behaviour Guidelines* (5- to 17-year-olds: no more than 2 hours of recreational screen time per day)."

Sedentary Behaviors was the only indicator without any "INC" grades. Estonia, Scotland, and Wales were the 3 countries with the lowest grade for this indicator ("F"), while Slovenia and Spain had the highest grade ("B+"). The remaining countries all had "C"s or "D"s, and the average for this indicator was "D+." In total, only 5 out of the 30 very high HDI countries had a grade of "C" or higher. A small methodological difference was observed between the very high HDI as few countries such as Estonia, France, and Sweden reported the percentage of children and youth who had less than 2 hours (<2 h/d) of daily screen time, while most of the countries reported those spending 2 hours or less (≤2 h/d) in front of a screen. Another potential source of bias was not taking into account the potential multitasking use of screens (eg, using a phone while watching a movie) as it was the case for France, which could have led to an overestimation of screen time.[77] Despite these potential methodological issues, the grades observed for this indicator are extremely concerning among the very high HDI countries. In Estonia, the prevalence of children meeting the screen time recommendation was estimated as low as 7%.[95] The development of more effective interventions targeting the reduction of screen time among children and youth in very high HDI countries should be a public health priority.

Physical Fitness

This is the first time that Physical Fitness has been evaluated in the Global Matrix. Physical fitness corresponds to a state characterized by an ability to perform daily activities with vigor, and a demonstration of traits and capacities that are associated with a lower risk of the premature development of diseases associated with physical

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inactivity.[96] The health-related components of physical fitness are cardiorespiratory endurance, muscular endurance, muscular strength, body composition, and flexibility.[97] A recent systematic review of the relationship between the 20-m shuttle run performance and health indicators among children and youth found that performance on this test was associated with favorable indicators of adiposity, and some indicators of cardiometabolic, cognitive, and psychosocial health in boys and girls, and concluded that physical fitness can be used as a holistic indicator of population health in children and youth.[98]

The benchmark for this indicator was the average percentile achieved on certain health-related physical fitness component based on the normative values published by Tomkinson et al.[41] On average, Physical Fitness was graded "C–." The highest grade was obtained by Japan ("A"), closely followed by Slovenia ("A–"); and 4 other countries (Canada, Chile, Hong Kong, and Jersey) shared the lowest grade ("D"). An "INC" grade was assigned to Physical Fitness in 13 countries. Various health-related physical fitness components and different normative values were used to calculate the percentile achieved by their sample of children and youth and inform this indicator from one country to another. For example, in Hong Kong this indicator was graded based on peak oxygen consumption, estimated with the performance on the 20-m shuttle run performance among 9- to 17-year olds[99]; Jersey had data on cardiorespiratory fitness, muscular strength, muscular endurance, flexibility, and motor fundamental movement skills development for school-aged children.[100] Lithuania had data on endurance, lower-body muscular power, upper-body muscular endurance, and lower-body muscular endurance for 11- to 18-year olds. Given these significant variations, the comparison of the Physical Fitness indicator between very high HDI countries is compromised and this highlights the need for developing international standardized measurements of health-related physical fitness components.

Family and Peers

Similarly to Physical Fitness, 13 countries assigned an "INC" grade to the Family and Peers indicator. On average, this indicator was graded "C–," with Slovenia having the highest grade ("B+") and Chile having the lowest grade ("F"). Parental support and significant others support has been identified as 2 of the 16 correlates that are consistently associated with physical activity of children and/or adolescents in a systematic review of reviews.[101] Because of the complexity of this indicator, several benchmarks were proposed for its evaluation (Table 1), and measurement variations were observed. In Poland, the grade was based on self-report of their parents' (material, emotional) support to their physical activity participation, on self-report of their parents' regular participation in physical activity, and on the prevalence of youth who declared being regularly physically active with their father, their mother, and their siblings.[102] In Germany, the prevalence of parents regularly participating in physical activity and the prevalence of children feeling that they receive positive support from their parents and friends to be physically active informed the Family and Peers indicator.[103] These findings show that there is still a need for an established definition of Family and Peer Influence, and then standardized and validated methods of measurement for the Family and Peers indicator.

School

The School indicator had an average of "C+," and only 3 countries had an "INC" grade for this indicator: Guernsey, Scotland, and Wales. The United Arab Emirates and the United States had the lowest grade ("D"), and Finland and Portugal shared the best grade for School ("A"). A variation in data was used to inform this indicator within the countries. In Finland, 87% of the schools participated in the national *Finnish Schools on the Move* program. This program aims at achieving more pleasant and active schooldays for children and encourages schools to increase physical activity during the schoolday as well as commuting.[104] In Portugal, physical education classes are mandatory for all students from preschool to 12th grade. The time allocated to physical education classes ranges from 90 to 150 minutes per week over 2 or 3 sessions/wk, and these classes are taught by a certified physical education teacher. In addition, 85% of Portuguese schools offer school clubs under the supervision of a physical education teacher, including competitions within and between schools.[105] The correlational analyses did not find an association between the School and the Overall Physical Activity indicators, but similarly to other indicators, the heterogeneity of data used to inform the School indicator is potentially affecting this relationship.

A review of the relationship between academic performance and participation in school-based physical activities, including physical education, free school-based physical activity, and school sports, found that adding time to academic or curricular subjects by taking time from physical education programs does not enhance grades in the corresponding academic subjects, and could be detrimental to health.[106] On the contrary, the authors also suggested that more time can be allocated to physical activity from other subjects without the risk of hindering students' academic achievement.[106] These findings suggest that the school environment, policy, and curriculum have the potential to increase physical activity among children and youth, and more specific interventions targeting the creation of daily physical opportunities at school need to be developed in very high HDI countries.

Community and Environment

With an average of "B–," Community and Environment was the highest graded indicator of the 10 core indicators among the 30 very high HDI countries. The lowest grade for this indicator was "C," shared by 5 countries (England, Jersey, Lithuania, Poland, and the United States), and the highest grade, "A," was assigned by Sweden. Eight countries assigned an "INC" grade for this indicator. With an "A–," Australia was the second most successful country for this indicator. In the Australia's 2018 Report Card, parent-report data showed that most of youth were not faced with problematic traffic in their home or school neighborhood, had access to good roads and footpaths and to public transport in their neighborhood, had a park or playground near their home, and lived in a safe neighborhood.[107] In Taiwan, where this indicator was graded "B+," 81% of 13- to 17-year olds felt that there were sufficient exercise facilities in their neighborhood, and they reported spending an average of 9.7 minutes to reach their primary exercise facilities.[108] The lack of significant correlation between this indicator and the Overall Physical Activity does not align with some of the research available on access to facilities.[101] For Community and Environment, in accordance with previous Global Matrices,[36,38] the available evidence from this indicator may suggest that the characteristics of the built environment potentially influencing the physical activity of children are already meeting the criteria to be considered favorable in the very high HDI countries. This indicates that having favorable environmental infrastructure alone is not sufficient to promote physical activity in very high HDI

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countries. Social factors such as family, home, school, and community are also important to promote physical activity among children and youth.

Government

The average grade for the Government indicator was "C+," and the grades ranged from "A" (Slovenia) to "D" (Australia, Guernsey, Jersey, and South Korea). Five countries assigned an "INC" grade to this indicator. With the exception of the 4 countries with a "D," all the other very high HDI countries obtained a favorable grade ("C" or higher) for the Government indicator. Despite the recommended benchmark for this indicator, Government grades were informed by different types of data in different countries. For example, in Wales, 21 policy documents assessed across different sectors including Health, Sport, Education, Environment, Transport, and Urban Design/Planning were evaluated using the *Health-Enhancing Physical Activity Policy Audit Tool*, obtaining a final score of 54% that was converted to a letter grade of "C+."[109] In some other countries that did not have relevant quantitative data, a letter grade was graded primarily based on expert opinion. Although most countries reported government physical activity strategies and policies, the absence of a relationship between the Government grades and the Overall Physical Activity grades and the mostly low behavioral grades suggest that these actions are not singularly effective at increasing the prevalence of MVPA among children and youth.

Integrated Discussion

Generally, higher grades were reported for the source of influence indicators in comparison with the behavioral indicators among the 30 very high HDI countries integrated in this study. The average grade for the behavioral indicators was "D+" (ranging from "B–" to "D–"), while the average grade for the sources of influence indicators was "C+" (ranging from "A" to "D"). This finding is consistent with previous Global Matrices,[36,38] and may be partially explained by the fact that more than half of the countries that participated in the Global Matrix 1.0 and 2.0 belonged to the very high HDI category.

Japan, The Netherlands, and Slovenia had the highest behavioral score, while Estonia, Chile and the United Arab Emirates had the lowest score (Figure 3). This score was calculated based on the grades for 5 indicators, and most of the countries had 4 to 5 letter grades to inform the score, with the exception of the United Arab Emirates with only 2 letter grades, and Qatar, Jersey, and Japan with only 3 letter grades. The amount of "INC" grades for these 4 countries questions the accuracy of their ranking, in particular for Japan, in the leading position. For the sources of influence score, Slovenia, Denmark, and Finland led the ranking, while the United States, South Korea, and Guernsey ranked at the bottom (Figure 4). While the calculation of the source of influence score was based on the letter grades for 4 indicators, 8 countries had only 2 letter grades to inform this score, and Guernsey, The Netherlands, and Spain had only one. The amount of "INC" grades challenges the correctness of this classification, in particular for the 3 countries with only one source of influence indicator graded. The comparison of these groups of indicators suggests that the adequate to good grades observed for the source of influence indicators are not translated in good behavioral grades for the very high HDI countries.

In total, 24 countries had 3 or less "INC" grades, but 6 countries were missing data to grade 4 to 6 indicators. Including countries with a significantly large number of "INC" grades in the Global Matrix 3.0 is a limitation to this study as it limits the comparisons. For example, the United Arab Emirates had 6 "INC" grades,[110] Guernsey had 5 "INC" grades,[111] and Qatar had 4 "INC" grades, and a "not applicable" for Active Transportation.[56] Another major limitation of this study is the diversity of the data that was used to inform the 10 core indicators, challenging the comparativeness of the grades within the same indicator. Two identical grades for the same indicator can potentially reflect very different situations from one country to another. An alternative approach would have been to exclude the countries with insufficient data from the Global Matrix 3.0, and to have assigned "INC" grades to all the countries with data that were not fitting exactly with the benchmarks for each indicator. Yet, this strategy would have considerably reduced the number of countries and indicators included in the analyses of this study and decrease the relevance of conducting international comparisons within an HDI category. Finally, a loss of information potentially occurs when translating original data to a letter grade, as letter grades provide less information than continuous variables.

The main strength of this study is the large number of participating countries who adopted the harmonized data gathering, assessing, and grading process, and the quantity of data that are informing the international physical activity comparisons. This was possible as a result of the inclusive strategy adopted by AHKGA. This project offers the opportunity to paint a picture of the characteristics of childhood physical activity in each country, as determined and explained by a diverse group of experts within each country. In addition, despite the presented methodological issues, this study allows the identification of major trends concerning the characteristics of the physical activity of children and youth among very high HDI countries. The need for the development and the international adoption of standardized methods to conceptualize and measure the 10 indicators was also highlighted in this paper. An "INC" grade can be useful for advocacy in individual countries in future cards, and the Global Matrix project has the potential to influence the physical activity national surveillance systems in the short to long term. Finally, the development of a national Report Card of physical activity for children and youth, and the participation in the Global Matrix initiative, contributes to raising awareness on the childhood physical inactivity issue nationally and internationally, building capacity within participating countries, and potentially influencing the creation of physical activity opportunities in the future.

Conclusion

This analysis and comparison of the Global Matrix 3.0 grades provide a comprehensive summary of the level and context of the physical activity of children and youth among the participating very high HDI countries. While methodological limitations and research gaps were identified, this work allowed the portrayal of major trends across the 10 physical activity indicators. The majority of very high HDI countries had better grades on the sources of influence levels, but this was not translated in positive outcomes concerning childhood physical activity and sedentary behavior, indicating an implementation gap between the policy/governmental and individual level. This paper provides additional evidence that the situation regarding physical activity in children and youth living in very high HDI countries is extremely concerning. Strategic public investments to implement effective interventions within families, communities, and schools to increase physical activity

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opportunities are needed. Unless a major shift to a more active lifestyle happens soon, a high rate of noncommunicable diseases can be anticipated when this generation of children will reach adulthood.

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Supplementary Material

Country	Method	Representativeness: Survey/study (year); instrument details	Respondents	
			Age range	Sample size
Australia	Subjective (self-report)	Nationally representative: Australian Bureau of Statistics National Health Survey (2014-2015); survey specific questionnaire	15-17 years old	854
	Subjective (self-report)	Nationally Representative: National Secondary School Diet and Activity Survey (2012-2013); survey specific questionnaire	12-17 years old	8888
	Subjective (self-report)	State-based representative: Australian School Students Alcohol and Drug Survey South Australia (2014); survey specific questionnaire	12-17 years old	1518
	Subjective (self-report)	State-based representative: Australian School Students Alcohol and Drug Survey Queensland (2014); survey specific questionnaire	12-17 years old	3930
	Subjective (self-report)	State-based representative: Australian School Students Alcohol and Drug Survey Tasmania (2014); survey specific questionnaire	12-17 years old	1888
	Subjective (self-report)	State-based representative: Australian School Students Alcohol and Drug Survey Victoria (2014); survey specific questionnaire	12-17 years old	3806
	Subjective (self-report)	State-based representative: ACT Year 6 Physical Activity and Nutrition Survey (2015); survey specific questionnaire	11 -12 years old (grade 6)	1353
	Subjective (parent/guardian-report)	State-based representative: NSW Child Health Survey (2015-2016); survey specific questionnaire	5-15 years old	3217
	Subjective (self-report)	State-based representative: NSW Secondary Schools Health Behaviours Survey (2014); survey specific questionnaire	12-17 years old	5125
	Subjective (parent/guardian-report)	State-based representative: QLD Child Health Status Survey (2017-2018); survey specific questionnaire	5-17 years old	2663
	Subjective (parent/guardian-report for 5-14 years old, self-report for 15-17years old)	State-based representative: SA Monitoring and Surveillance Survey (2016-2017); survey specific questionnaire	5-17 years old	1034

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	Subjective (parent/guardian-report for 5-10 years old, self-report for 11-15 years old))	State-based representative: NSW Schools Physical Activity and Nutrition Survey (2015); survey specific questionnaire	5-15 years old (grades K-10)	7138
	Subjective (self-report)	State-based representative: VIC Student Health and Wellbeing Survey (2016); survey specific questionnaire	10, 13 & 16 years old (grades 5, 8 & 11)	11421
	Subjective (parent/guardian-report)	State-based representative: VIC child Health and Wellbeing Survey (2013); survey specific questionnaire	5-12 years old	4635
Belgium (Flanders)	Objective	Regionally representative: Belgian Food Consumption Survey (2014); accelerometer data (hip-worn ActiGraph GT3Xand accelerometers for 7 consecutive days) analyzed with Evenson 2008 cut-off points	6-9 years old	230
			10-17 years old	353
Canada	Objective	Nationally representative: Canadian Health Measures Survey (2014-2015) ; accelerometer data (hip worn Actical accelerometers for at least 4 consecutive days) analyzed with Puyau 2004 cut-off points	5-17 years old	1300
Chile	Subjective (self-report)	Nationally representative: PISA (2015) using a questionnaire adapted from GSHS	15 years old	245947
	Subjective (self-report)	Nationally representative: GSHS (2013), GSHS questionnaire	14-16 years old	1888
	Subjective (self-report)	Nationally representative: National Survey on Activities of children and adolescents (2012); questionnaire adapted from GSHS.	9-11 years old	2042
	Subjective (self-report)		12-17 years old	6929
Chinese Taipei	Subjective (self-report)	Regionally representative: Nutrition and Health Survey; Chinese version of modified IPAQ questionnaire, 3 waves:		
		2010-2011	13-15 years old (grades 7-9)	1779
		2011	16-18 years old (grades 10 -12)	1169
		2012	7-12 years old (grades 1-6)	1260

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Czech Republic	Objective	Regionally representative: (2013-2014); accelerometer data (ActiGraph, hip-worn for 7 consecutive days) analyzed with Evenson 2008 cut-off points	7–12 years old	365
	Objective	Regionally representative: IPEN study (2015–2016); accelerometer data (ActiGraph, hip-worn for 7 consecutive days) analyzed with Evenson 2008 cut-off points	11–17 years old	367
	Objective	Local study (2017–2018): accelerometer data (ActiGraph, wrist-worn for 7 consecutive days) analyzed with Chandler 2005 cut-off points	8–18 years old	300
	Subjective (self-report)	Nationally representative: HBSC (2014) ; HBSC questionnaire	11–15 years old	5750
	Subjective (self-report)	Nationally representative; (2013–2016); IPAQ-long questionnaire	15–17 years old	3334
Denmark	Subjective (self-report)	Nationally representative: National Health Survey (2017); survey specific questionnaire	16-17 years old	4634
	Subjective (self-report)	Nationally representative: The Youth Profile (2014); survey specific questionnaire	16-17 years old	40022
	Subjective (self-report)	Nationally representative: HBSC (2014); HBSC questionnaire	11-15 years old	3891
England	Subjective (self-report)	Nationally representative: HBSC (2016); HBSC questionnaire	11 years old	2116
			13 years old	1593
			15 years old	1608
	Subjective (parent/guardian-report for 5-12 years old, self-report for 13-15)	Nationally representative: Health Survey for England (2015); survey specific questionnaire	5-15 years old	3827
	Objective	Regionally representative: B-PROACT1V 2012-2016; accelerometer data (hip worn Actigraph wGT3X for 5 consecutive days) analyzed with Evenson 2008 cut-off points	5-6 years old (Phase 1)	1299
			8-9 years old (Phase 2)	1223
	Objective	Regionally representative: ISCOLE 2015-2016; accelerometer data (hip worn Actigraph wGT3X+ for 7consecutive days) analyzed with Evenson 2008 cut-off points	9-11 years old	374

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Estonia	Objective	Nationally representative: Children´s Physical Activity Study (2015); accelerometer data (hip-worn GT3X for 7 consecutive days) analyzed with Evenson 2008 cut-off points	6-13 years old	492
	Subjective (self-report)	Nationally representative: HBSC (2014); HBSC questionnaire	11, 13 & 15 years old	4057
	Subjective (self-report)	Nationally representative: Health Promotion Effectiveness in Estonian Schools (2012-2015);survey specific questionnaire	11-14 years old	1033
	Subjective (self-report)	Nationally representative: Schools in Motion survey (2018); online survey specific questionnaire	10-17 years old	3853
Finland	Subjective (self-report)	Nationally representative: National School Health Promotion Study (2017); survey specific questionnaire	10-11 years old	94531
			14-15 years old	71695
	Subjective (self-report)	Nationally representative: LIITU study (2016); HBSC questionnaire	9-15 years old	7321
	Objective	Nationally representative: LIITU study (2016) ; accelerometer data (hip-worn UKK AM30 and UKK RM42 monitors for 7 consecutive days) analyzed with Aittasalo 2015 cut-off points	9-15 years old	2931
France	Subjective (parent/guardian-report for 6-10 years old; self-report for 11-17 years old)	Nationally representative : INCA3 (2014-2015); survey specific questionnaire	6-10 years old	644
		Nationally representative : INCA3 (2014-2015); modified version of YRBSS questionnaire	11-17 years old	1291
	Subjective (parent/guardian-report for 6-10 years old; self-report for 11-17 years old)	Nationally representative: ESTEBAN (2015); survey specific questionnaire	6-10 years old	1182
		Nationally representative: ESTEBAN (2015); modified version of YRBSS questionnaire	11-17 years old	
Germany	Subjective (parent/guardian-report for 3-11 years old, self report for 12-17 years old)	Nationally representation: KiGGs Study (2009-2017); survey specific questionnaire	3 to 17 years old	12981

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	Subjective (self-report)	Nationally representative: HBSC (2010); HBSC questionnaire	11-15-year	16918
	Objective	Regionally representative: Gini Study (2014); accelerometer data (hip worn ActiGraph GT3X for 7 consecutive days) analyzed with Fredson 1997 cut-off points	Mean age= 15.6 years old	1054
	Objective	Regionally representative: MAAS-Kids Study (2008); pedometers data (StepWatch 3™ System worn for 7 consecutive days)	6-17 year old	1020
	Objective	Regionally representative: IDEFICS Study (2011); accelerometer data (hip-worn ActiGraph GT1M for at least 3 consecutive days) analyzed with Evenson 2008 cut-off points	2-10.9 years old	516
Guernsey	Subjective (self-report)	Nationally representative: Guernsey Young People's Survey (2016); survey specific questionnaire	10-11 years old	564
	Subjective (self-report)	Nationally representative: Guernsey Young People's Survey (2016); survey specific questionnaire	12-13 & 14-15 years old	875
	Subjective (self-report)	Nationally representative: Guernsey Young People's Survey (2016); survey specific questionnaire	16-18 years old	800
Hong Kong	Subjective (self-report)	Regionally representative: National Physical Fitness Survey (2011-2012); survey specific questionnaire	7-12 years old	2723
			13-19 years old	2517
	Subjective (self-report)	Regionally representative (2012-2013); Chinese version of GYTS questionnaire	Mean age = 14.8 year old	44478
	Objective	Regionally representative: IPEN Hong Kong study (2012-2013); accelerometer data data (hip-worn ActiGraph GT3X and GT3X+ for 7 consecutive days) analyzed with Freedson 1997 cut-off points	11-18 years old	552
	Objective	Local study (2009-2010): accelerometer data (hip-worn actigraph GT3X for 8 consecutive days) analyzed with Freedson 1997 cut-off points	6-8 years old	263
Japan	NA	No representative data	NA	NA
Jersey	Subjective (self-report)	Nationally representative: Young People's Health and Lifestyle Survey (2014); HBSC questionnaire	10-15 years old	2842
South Korea	Subjective (self-report)	Nationally representative: Korea National Health and Nutrition Examination Survey (2016); GPAQ	12-17 years old	524
	Subjective (self-report)	Nationally representative: Korea Youth Risk Behavior web-based Survey (2017), online Korean version of YRBSS questionnaire	12-17 years old	57884

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Lithuania	Subjective (parent/guardian-report)	Nationally representative: Lithuanian COSI study (2013); WHO COSI questionnaire	Survey of parents/gardians of primary school children	3802
	Subjective (self-report)	Nationally representative: HBSC survey (2013-2014), HBSC questionnaire	11, 13 & 15 years-old	5730
	Subjective (self-report)	Nationally representative; Lifestyle study of schoolchildren made by Lithuanian Institute of Hygiene (2016); survey specific questionnaire	10-17 years old (grade 5, 7 & 9)	38633
Netherlands	Subjective (parent/guardian-report for 4-11 years old, self report for 12-17 years old)	Nationallly representative: survey name?? 2017; survey specific questionnaire	4-11 years old	837
			12-17 years old	629
	Subjective (self-report)	Nationallly representative (2016-2017): survey specific questionnaire	9-13 year old	1554
New Zealand	Subjective (parent/guardian-report for 5-11 years old; self-report for 12-17 years old)	Nationally representative: Active NZ Survey (2018); survey specific questionnaire	5-17 years old	5990
	Objective	Local study: 2016; accelerometer data (hip worn ActiGraph GT3X+ for minimum 3 valid days) analyzed with Evenson 2008 cut-off points	8-13 years old	1085
	Objective	Local study: 2016; accelerometer data (hip worn ActiGraph GT3X+ for minimum 5 valid days) analyzed with Evenson 2008 Cut-off points	13-18 years old	314
Poland	Subjective (self-report)	Nationally representative: HBSC year (2013-2014); HBSC questionnaire	11, 13 & 15 years old	4516
	Subjective (self-report)	Nationally representative: Physical Activity of School Children Aged 9 - 17 (2013); HBSC questionnaire	10-17 years old	3346
Portugal	Objective	Nationally representative: Observatório da Atividade Física e do Desporto (2012); accelerometer data (hip worn accelerometer for at least 3 valid days including a weekend day) analyzed with a cut-off point of 2,020 counts/min for MVPA	11-17 years old (grades 6-12)	2714

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	Subjective (self report)	Nationally representative: HBSC (2014); HBSC questionnaire	11-18 years-old	5849
	Subjective (self report)	Nationally representative; IANAF Survey (2017) – IPAQ adolescentes	13-17 years old (grades 8-12)	720
Qatar	Objective	Local study: School-time physical activity among Arab elementary school children in Qatar (2017); accelerometer data (ActiGraph wGT3X-BT worn on non-ominant wrist at school for 5 consecutive days) analyzed with Chandler 2015 cut-off point	6-12 years old	183
	Subjective (self-report)	Nationally representative: Qatar National School Survey (2015-2016); Questionnaire adapted from the GSHS	13-17 years old	5862
Scotland	Subjective (self-report)	Nationally representative: HBSC (2014), HBSC questionnaire	11, 13 & 15 years old	10839
Slovenia	Objective	Nationally representative; ACDSi research project (2013-2014); accelerometer data (hip-worn Sensewear Pro for 2 weeken days and minimum 3 week days) analyzed with a 4 MET cut-off point for MVPA	11 & 14 years old	245
	Subjective (parent/guardian-report)	Nationally representative: ACDSi research project (2013-2014); CLASS questionnaire	5-10 years old	2351
	Subjective (self-report)	Nationnally representative: ACDSi research project (2013-2014); SHAPES questionnaire	11-19 years old	2907
Spain	Subjective (self-report)	Local study: ANIVA study (2013-2014 & 2014-2015); survey specific questionnaire	6-9 years old	1371
	Subjective (parent/guardian-report)	Local study (2015); Spanish version of PACE 2 (validated for 13-18 years old adolescent)	3-18 years old	1055
	Subjective (parent/guardian-report)	Regionally representative: ESCA study (2016); survey specific questionnaire	3 -14 years old	1886
Sweden	Subjective (self-report)	Nationally representative: HBSC (2013-2014); HBSC questionnaire	11, 13 & 15 years	8000
	Objective	Regionally representative: IDEFICS (2014); accelreometer data (hip-worn ActiGraph for at least 3 consecutive days including a weekend day) analyzed with Evenson 2008 cut-off points	6-9 years	343
	Objective	Local study (2016): accelreometer data (right ankle worn ActiCal for 7	13-15 years	91

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		consecutive days) analyzed with Heil 2006 cut-off points		
United Arab Emirates	Subjective (self-report)	Nationally representative: GHSH (2016); GSHS questionnaire	13-17 years-old (grades 8-12)	5849
United States	Subjective (self-report)	Nationally representative: YRBSS (2017); YRBSS questionnaire	14-18 years old (grades 9-12)	14765
	Subjective (parent/guardian-report)	Nationally representative: National Survey of Children's Health (2016); survey specific questionnaire	6-17 years old	50212
Wales	Subjective (parent/guardian-report)	Nationally representative: National Survey for Wales (2016-2017): survey specific interview	3-17 years old	2109
	Subjective (self-report)	Nationally representative: HBSC (2017); HBSC questionnaire	11-17 years old	95591
				1005989

Chapter 8: Manuscript 5

This manuscript has been written and formatted following the publication standards of the *Journal of Physical Activity and Health*. It appears in its published format.

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This article summarizes information from a variety of sources including surveys, peer-reviewed publications, e-mails, and gray literature, to assess the impact of the Report Cards on powering the movement to get children and youth moving globally. I am the primary (first) author on this article. The maps presented in Figure 3 and 4, and the first versions of the tables presented in the supplementary files were created by Evan Turner with my guidance, I created the other figures and tables and I wrote the draft manuscript. The co-authors edited the manuscript and approved the final version of the manuscript before it was submitted for peer-review. All co-authors contributed significantly and met the International Committee of Medical Journal Editors guidelines for authorship. I handled the revisions suggested by the reviewer and resubmitted this article. This article is now published in open access. The published manuscript and the three supplementary files are presented in this chapter.

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ORIGINAL RESEARCH

The International Impact of the Active Healthy Kids Global Alliance Physical Activity Report Cards for Children and Youth

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Background: In response to growing concerns over high levels of physical inactivity among young people, the Active Healthy Kids Global Alliance developed a series of national Report Cards on physical activity for children and youth to advocate for the promotion of physical activity. This article provides updated evidence of the impact of the Report Cards on powering the movement to get children and youth moving globally. **Methods**: This assessment was performed using quantitative and qualitative sources of information, including surveys, peer-reviewed publications, e-mails, gray literature, and other sources. **Results**: Although it is still too early to observe a positive change in physical activity levels among children and youth, an impact on raising awareness and capacity building in the national and international scientific community, disseminating information to the general population and stakeholders, and on powering the movement to get kids moving has been observed. **Conclusions**: It is hoped that the Report Card activities will initiate a measurable shift in the physical activity levels of children and contribute to achieving the 4 strategic objectives of the World Health Organization Global Action Plan as follows: creating an active society, creating active environments, creating active lives, and creating active systems.

Keywords: global comparisons, sedentary behavior, health promotion, sport, evaluation, policy

Physical inactivity is a leading risk factor for global mortality in adults, along with high blood pressure, tobacco use, and high blood glucose,[1] and was estimated to be responsible for at least 9% of premature mortality or more than 5.3 million deaths worldwide in 2008.[2] In addition, it was estimated to cause at least 6% of the burden associated with coronary heart disease, 7% of type 2 diabetes, 10% of breast cancer, and 10% of colon cancer.[2] Based on these statistics, physical inactivity is described as one of "the biggest public health problems of the 21st century."[3,4] The most recent global prevalence of physical inactivity (ie, not meeting physical activity guidelines) was estimated to be 27.5% for adults (≥18-y-olds)[5] and 81% for youth (11- to 17-y-olds).[6] Given that physical activity habits in childhood tend to track into adulthood,[7] a high prevalence of physical inactivity among youth is a pressing concern. In addition, an overall decrease in physical fitness levels[8] and an increase in the global prevalence of obesity among 5- to 19-year-olds have been observed since 1975 in many world regions.[9] This compelling evidence suggests that a significant increase in premature health issues can be anticipated if the global physical inactivity crisis is not addressed.[10]

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Background

Report Card of Physical Activity Grades

In response to growing concerns over high levels of physical inactivity among young people in Canada, the *Report Card on Physical Activity for Children and Youth* was first created in 2005 by Active Healthy Kids Canada, a registered not-for-profit organization, to advocate for the promotion of physical activity in Canadian children and youth.[11] A summary of the Report Card background and development process has been published elsewhere.[12] The Report Card is a public-facing document that synthesizes the best available evidence on children's physical activity with the purpose of reporting letter grades, updating scientific information, highlighting research gaps, and providing recommendations for improvement on a number of physical activity indicators for children and youth.[12]

Designed to serve as a knowledge translation tool and to accelerate the dissemination of physical activity research and evidence-based practice, the Report Card has successfully contributed to the movement to help get children moving by influencing priorities, policies, and practices in Canada over a 10-year period.[13] Although the release of this annual research synthesis has resulted in positive changes across several sources of influence indicators (ie, Family and Peers, School, Community and Environment, Government, Nongovernment) in Canada between 2005 and 2016, these changes have not resulted in any meaningful increase in the prevalence of children and youth meeting the recommended 60 minutes of moderate- to vigorous-intensity physical activity per day.[14] In celebration of the 20th anniversary of Active Healthy Kids Canada and the 10th anniversary of the Report Card, Active Healthy Kids Canada organized the *Global Summit on the Physical Activity of Children* in Toronto, Canada, in 2014.[15] The major highlight of the Global Summit was the collaboration among 15 countries that prepared and simultaneously released their respective country-specific Report Cards on physical activity for children and youth.[11,15]

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Internationalization of the Report Card: The Global Matrix of Physical Activity Grades

In 2014, the Canadian Report Card process was replicated in 15 countries from 5 continents (Australia, Canada, Colombia, England, Finland, Ghana, Ireland, Kenya, Mexico, Mozambique, New Zealand, Nigeria, Scotland, South Africa, and United States) for the first time, thus constituting the Global Matrix 1.0.[11] The Report Card and Global Matrix initiatives are deliberately integrated into the larger global context as summarized in Figure 1. All Report Cards were generated through a harmonized development process using 9 common physical activity indicators and a standardized grading framework ("F" = failing to "A" = excellent) as presented in Table 1.[11] Grades for the 9 common indicators were grouped into 2 categories as follows: 5 behavioral indicators (Overall Physical Activity, Organized Sport and Physical Activity Participation, Active Play, Active Transportation, and Sedentary Behaviors) and 4 sources of influence indicators (Family and Peers, School, Community and Built Environment, and Government Strategies and Investment).[11] The Global Matrix 1.0 was a successful pilot project, opening the door to harmonized international comparisons and identifying strengths, disparities, inequities, research and surveillance gaps, and highlighting that none of the participating countries had all of the solutions to effectively promote physical activity among children and youth. The Global Matrix 1.0 facilitated the cross-fertilization of innovative solutions for countries with low grades to learn from those with high grades in particular areas. For example, the Scotland Report Card team learned that in the countries with better grades in physical activity and sedentary behavior than Scotland, children were spending much more time in active outdoor play.[16]

Following the success of the 2014 Global Summit, the Active Healthy Kids Global Alliance (AHKGA)[24] was established. In July 2014, the AHKGA distributed an open call through established networks for interested countries to participate in the Global Matrix 2.0 project. As a result, a 250% increase in the countries involved over the Global Matrix 1.0 was observed with the participation of 38 countries from 6 continents.[16] The AHKGA organized the concurrent preparation of 38 Report Cards on the physical activity of children and youth and their aggregation, creating the Global Matrix 2.0 on *Physical Activity of Children and Youth*, which was released in Bangkok, Thailand, on November 26, 2016. Findings from the second iteration of this global report showed that no one country was leading or lagging in all indicators, but rather, each country was experiencing its own unique successes and challenges.[16] The authors concluded that increasing physical activity opportunities for children and youth around the world remains unresolved, and tackling this challenge internationally through the Global Matrices has the potential to provide unique insights, motivation, and synergies that could not be achieved in isolation.[16]

In April 2017, the AHKGA invited countries that had previously developed report cards and called for new countries to register for the Global Matrix 3.0. Working groups from 49 countries from 6 continents followed the updated harmonized procedures to grade 10 common physical activity indicators (ie, Overall Physical Activity, Organized Sport and Physical Activity, Active Play, Active Transportation, Sedentary Behaviors, Physical Fitness, Family and Peers, School, Community and Environment, and Government) using the best available data to develop their Report Card between July 2017 and July 2018.[23] Details about the amended Report Card development process and the new mentoring structure that were implemented for the Global Matrix 3.0 have been described elsewhere.[23] During this time, the AHKGA officially became an incorporated not-for-profit organization to increase its leadership in advocating for the promotion of physical activity among children and youth of all ages, genders, and abilities. The Global Matrix 3.0 was released at the *Movement to Move Event* in Adelaide, Australia, on November 27, 2018.

Objectives

Between 2005 and 2017, 72 national Report Cards were developed and released, and an additional 49 national Report Cards, developed in 2017–2018, were presented in this supplemental issue of the *Journal of Physical Activity and Health* (volume 15, supplement 2, 2018). The development and release of the Report Cards and of the Global Matrix have potentially created some momentum toward the surveillance and the promotion of physical activity among children and youth. The objective of the present article is to update a previous article assessing the impact of the Active Healthy Kids Canada Report Cards,[13] with a new focus on the international impact of the Report Cards and Global Matrices. To this end, the authors have reviewed a variety of information from published scientific and gray literature, surveys collected by institutions involved in the development of the Global Matrices or Report Cards, media summaries, minutes from the AHKGA executive meetings, and reports from Report Card working groups. This article aims to provide updated evidence of the multiple positive impacts of the Report Cards and Global Matrix initiatives on the international scientific community, on raising awareness among the general population and stakeholders, and on powering the movement to get children and youth moving globally.

International Context of the Report Cards and Global Matrices

In response to increasing noncommunicable diseases related to physical inactivity among individuals of all ages, international calls for action were distributed by major global health institutions including the United Nations,[19,25] the World Health Organization,[22] and the Global Advocacy for Physical Activity group.[26] The international context of the Report Cards and Global Matrices is summarized in Figure 1, showing that these initiatives aligned with, and supported, a global movement toward the surveillance and promotion of physical activity.

The Report Cards and the Global Matrices are guided by 3 principles from the Toronto Charter as follows: building capacity and supporting training in research, practice, policy, evaluation, and surveillance (guiding principle 5); addressing environmental, social, and individual determinants of physical inactivity (guiding principle 3); and ensuring cultural sensitivity and adapting strategies to accommodate various "local realities," contexts, and resources (guiding principle 8).[27] The Global Matrix constitutes the main activity of the AHKGA, whose logic model is presented in Figure 2. AHKGAs mission is to "power the global movement to get kids moving" by means of thought leadership, knowledge translation and mobilization, capacity building, and advocacy. This is facilitated by sustainable partnerships and cross-sectoral collaborations that enable best practice exchanges, networking, and cross-fertilization.

The development and the publication of the individual country Report Cards and Global Matrices aim to facilitate capacity building among the researchers and stakeholders involved, to decrease surveillance gaps and increase understanding of the state of childhood physical activity, and to create relevant networks and partnerships. A long-term goal of AHKGA activities is to contribute to the creation of relevant policy actions for the promotion of physical activity in various contexts to help attain the third

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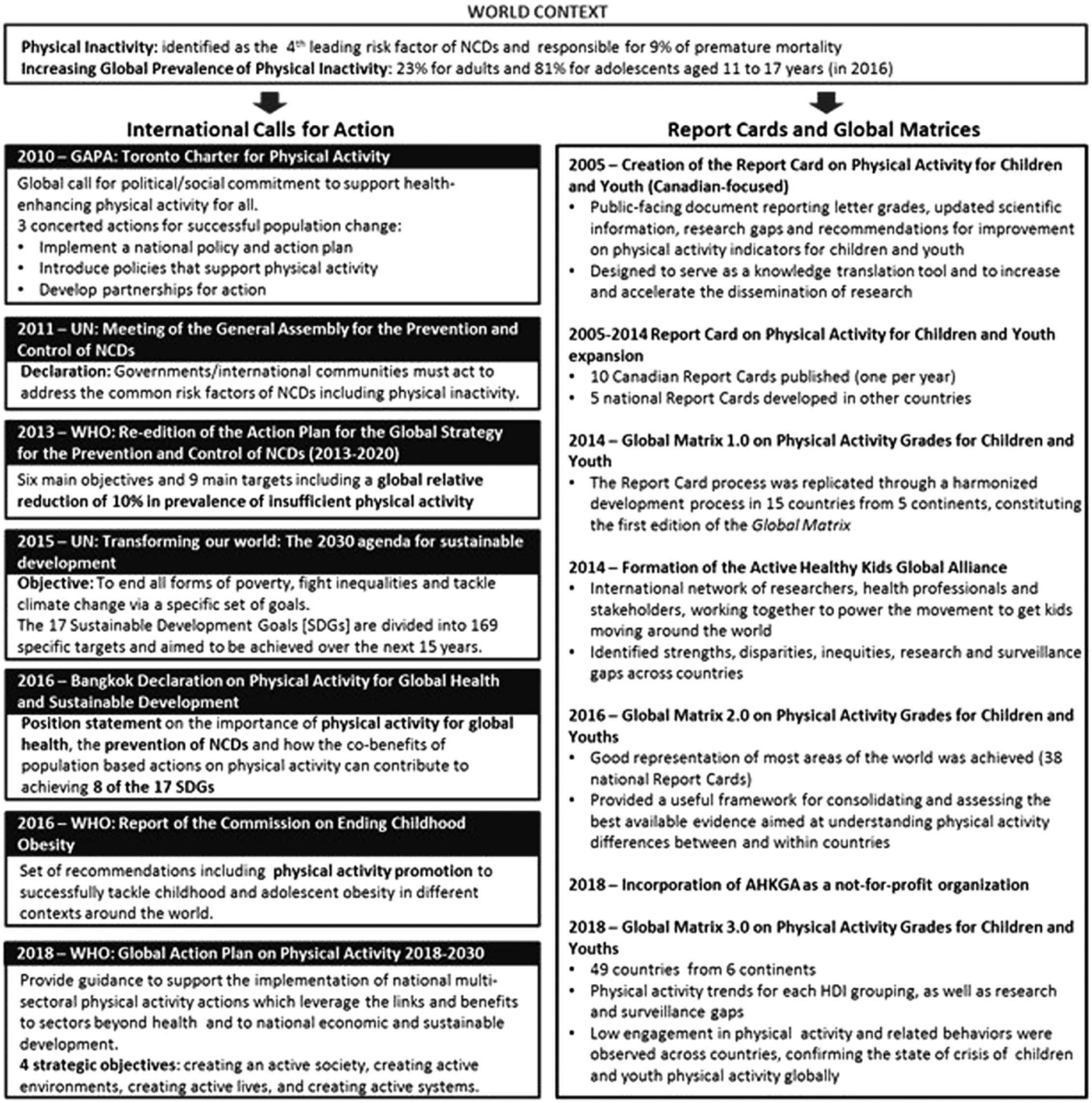

Figure 1 — Integration of the Report Cards and global matrices of physical activity grades for children and youth in the context of global efforts and activities for the promotion of physical activity. Sources: Toronto Charter for Physical Activity,[16] Report of the Secretary General for the Prevention and Control of Noncommunicable Diseases,[17] Action Plan for the Global Strategy for the Prevention and Control of NCDs (2013–2020),[18] Transforming Our World: the 2030 Agenda for Sustainable Development,[19] Bangkok Declaration on Physical Activity for Global Health and Sustainable Development,[20] Report of the Commission on Ending Childhood Obesity,[21] Global Action Plan on Physical Activity 2018–2030,[22] Global Matrix 1.0 on Physical Activity for Children and Youth,[11] Global Matrix 2.0 on Physical Activity for Children and Youth,[16] and Global Matrix 3.0 on Physical Activity for Children and Youth.[23] Note: AHKGA indicates Active Healthy Kids Global Alliance; GAPA, Global Advocacy for Physical Activity; HDI, Human Development Index; NCDs, noncommunicable diseases; UN, United Nations; WHO, World Health Organization.

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Table 1 Grading Scheme and Numerical Equivalents for Analysis for the Global Matrix 1.0 and Global Matrix 2.0

Grade	Interpretation	Numerical equivalents for analysis
A	We are succeeding with a large majority of children and youth (≥80%).	5
B	We are succeeding with well over half of children and youth (60%–79%).	4
C	We are succeeding with about half of children and youth (40%–59%).	3
D	We are succeeding with less than half but some children and youth (20%–39%).	2
F	We are succeeding with very few children and youth (<20%).	1
INC	Incomplete—inadequate information to assign a grade.	No grade

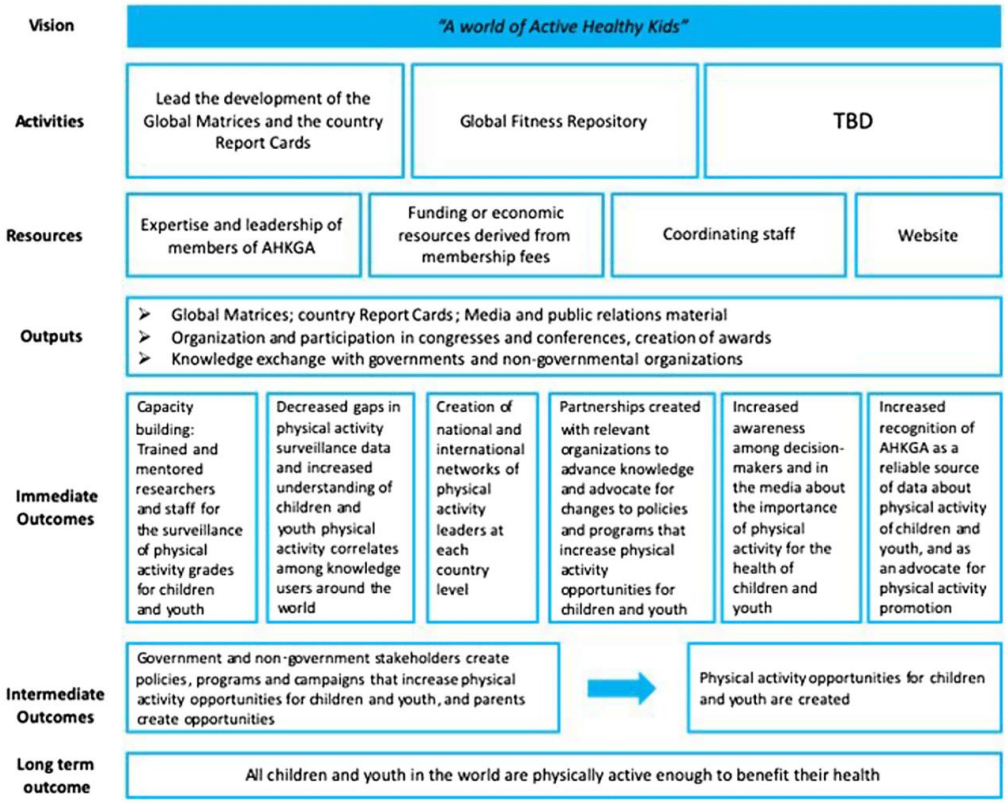

Figure 2 — AHKGA logic model. Note: AHKGA indicates Active Healthy Kids Global Alliance; TBD, to be determined.

global target of the *Action Plan for the Global Strategy for the Prevention and Control of Noncommunicable Diseases*: "a 10% relative reduction in prevalence of insufficient physical activity."[18]

The number and distribution of national Report Cards that have been produced and released as the first Canadian-focused document are presented in Figure 3, and the year, country, and web link (when available) to each of these Report Cards are presented in Supplementary Material 1 (available online). In total, 122 national Report Cards, distributed among 53 different countries, have been developed and published. A total of 13 Canadian Report Cards have been published, while the number of Report Cards for the other participating countries is between 1 and 3, with the exception of South Africa (n = 5) and Mexico (n = 4). There are also several other jurisdictions (eg, cities, provinces, and states) that have replicated the Report Card between 2008 and 2012 (not presented in Supplementary Material 1 [available online]). These Report Cards have already been reported in the previous impact article.[13]

The development of 122 country-level Report Cards distributed across the world highlights the international collaborations between teams of researchers and stakeholders assigning grades to multiple physical activity indicators. To gain insights on the number of people collaborating on the Global Matrix 3.0, Report Card leaders from 49 countries were asked to report the name, title, and city of residence for each member of their Report Card working group. The latitude and longitude coordinates for the center of each city were determined using www.latlong.net, and an identification number was assigned to each individual report. These data were used to build and visualize the network of researchers and staff

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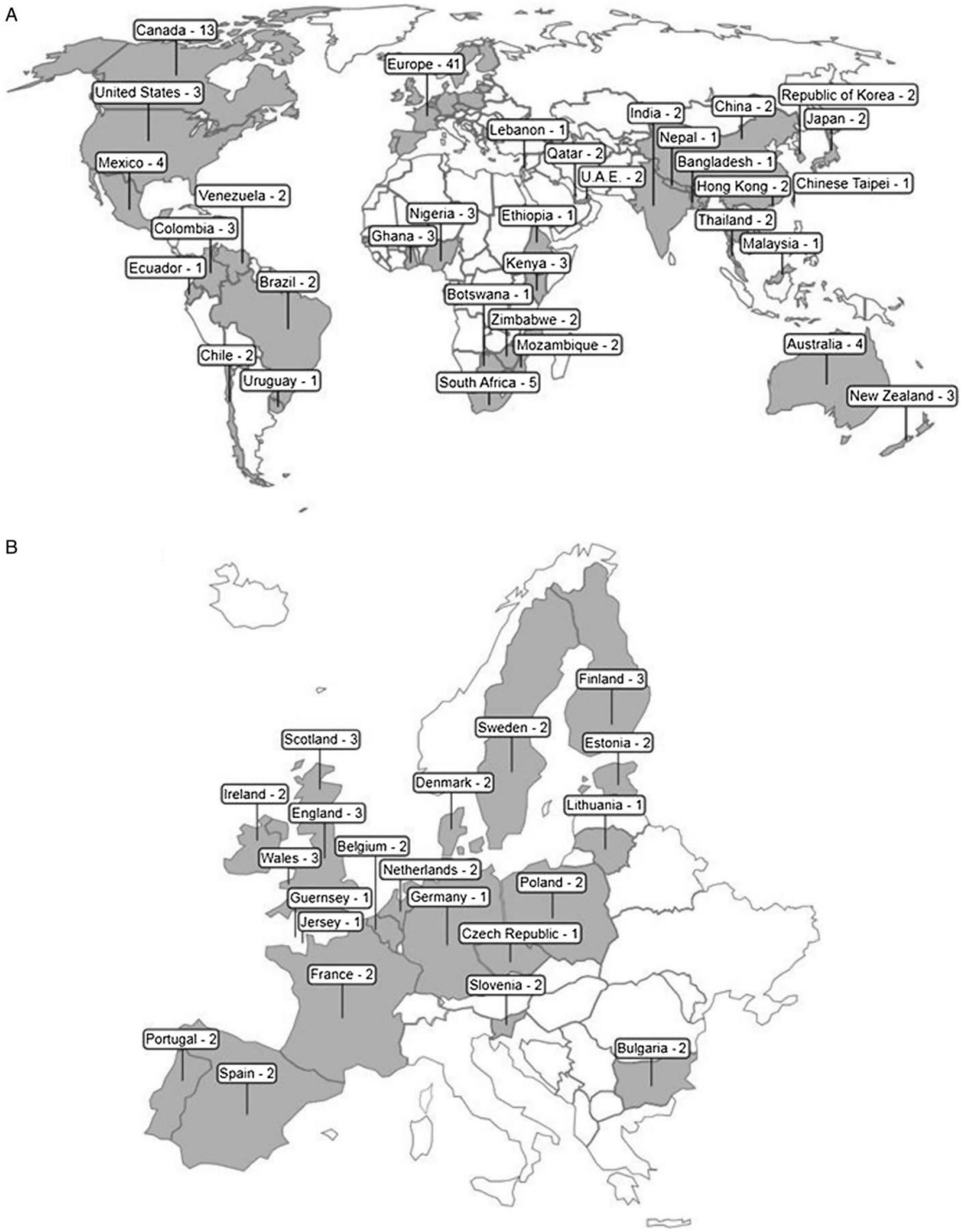

Figure 3 — Distribution of national Physical Activity Report Cards for Children and Youth developed and released between 2005 and 2019. (A) In the world. (B) Zoom on European countries.

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involved in the AHKGA Global Matrix 3.0. The network was visualized with Gephi tool (gephi.org; Gephi Consortium, Compiègne, France), and the GeoLayout plugin was used to add the geographical attributes of the members of the network. In total, 513 individuals (257 men and 256 women) were reported as Report Card working group members. Figure 4 presents the AHKGA Global Matrix 3.0 network. In this network, blue links were generated to illustrate the collaborations between the AHKGA members—within each country's Report Card working group members and between the Report Card leaders/co-leaders, their respective intermediate mentors, continent leaders, and the AHKGA coordinating headquarters (Ottawa, Canada). Although there is a good representation of people in Europe, North and South America, there is still a lack of representation in AHKGA membership from North Africa, North and Southeast Asia, and the South Pacific Islands. Figure 4 shows that even if most of the countries in the world are still not part of this international initiative, the Global Matrix 3.0 brought researchers and stakeholders from most geographical regions together, collaborating to advocate for the promotion of physical activity among children and youth.

Changes in Report Card Grades Nationally and Internationally

Grades from the Global Matrix 1.0 and Global Matrix 2.0 were used to calculate the average grade for each Report Card indicator. The letter grades were converted to a numerical value, following a standard scale format for Global Matrix 1.0 and Global Matrix 2.0 (see Table 1), and using an updated scale for Global Matrix 3.0 (see Table 2). A numerical average was calculated and then converted back to the corresponding letter grade. Incomplete (INC) grades were assigned when the information available was insufficient or inadequate to assign a grade and were not included in the calculation of the average grade. If the numerical average resulted in a decimal, the floor value was converted back to a letter.

Table 3 shows the average grades per indicator and the number and percentage of INC grades per indicator for Global Matrix 1.0, Global Matrix 2.0, and Global Matrix 3.0. The average grades per indicator were stable between the Global Matrix 1.0 and Global Matrix 2.0, despite the participation of 23 additional countries. The only difference observed was a decrease from "C" to "D" for the Active Play indicator. Similarly, the average grades per indicator also remained the same between Global Matrix 2.0 and Global Matrix 3.0, despite modifications to the benchmarks and grading scale, and despite the addition of 11 new countries to the Global Matrix 3.0. Exceptions were observed for Active Play (increased from "D" to "D+"), Sedentary Behaviors (increased from "D" to "D+"), and Family and Peers (decreased from "C" to "D+"). Overall, an average grade of "C," "C," and "C–" was observed for the Global Matrix 1.0, Global Matrix 2.0, and Global Matrix 3.0, respectively. This relative stability may represent a "mass average effect" as changes to the grades were more apparent at the country level.

An increase of INC grades was observed for each indicator between the Global Matrix 1.0 and the Global Matrix 2.0. Similarly, the number of INC grades increased for each indicator between Global Matrix 2.0 and Global Matrix 3.0, except for Organized Sport Participation, Active Transportation, and

Figure 4 — Distribution of the 513 members of Report Card work groups across the world and illustration of the AHKGA network. Note: Only one node appears per city even if there is more than one AHKGA member from the city. AHKGA indicates Active Healthy Kids Global Alliance.

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Table 2 Grading Scheme and Numerical Equivalents for Analysis for the Global Matrix 3.0

Grade	Interpretation	Numerical equivalents for analysis
A+	94%–100%	15
A	We are succeeding with a large majority of children and youth (87%–93%)	14
A–	80%–86%	13
B+	74%–79%	12
B	We are succeeding with well over half of children and youth (67%–73%)	11
B–	60%–66%	10
C+	54%–59%	9
C	We are succeeding with about half of children and youth (47%–53%)	8
C–	40%–46%	7
D+	34%–39%	6
D	We are succeeding with less than half but some children and youth (27%–33%)	5
D–	20%–26%	4
F	We are succeeding with very few children and youth (<20%)	2
INC	Incomplete—insufficient or inadequate information to assign a grade	No grade

Table 3 Comparison of Average Grades and Incomplete Grades Per Indicator Between Global Matrix 1.0 (15 Participating Countries), Global Matrix 2.0 (38 Participating Countries), and Global Matrix 3.0 (49 Participating Countries)

	Average grade			Number and percentage of countries with incomplete grade		
Indicator	Global Matrix 1.0	Global Matrix 2.0	Global Matrix 3. 0	Global Matrix 1.0	Global Matrix 2.0	Global Matrix 3.0
Overall Physical Activity	D	D	D	0 (0%)	1 (3%)	2 (4%)
Organized Sport Participation	C	C	C	2 (13%)	7 (18%)	7 (14%)
Active Play	C	D	D+	10 (67%)	21 (55%)	29 (59%)
Active Transportation	C	C	C	1 (7%)	3 (8%)	2 (4%)
Sedentary Behaviors	D	D	D+	2 (13%)	3 (8%)	3 (6%)
Physical Fitness	N/A	N/A	C–	N/A	N/A	27 (55%)
Family and Peers	C	C	D+	9 (60%)	17 (45%)	22 (45%)
School	C	C	C	1 (7%)	4 (10%)	8 (16%)
Community and Built Environment	C	C	C	3 (20%)	11 (29%)	13 (27%)
Government Strategies and Investment	C	C	C	5 (33%)	6 (16%)	8 (16%)
Average	C	C	C–	3.7 (24%)	8.1 (21%)	12.2 (25%)

Sedentary Behaviors. However, given the difference in the number of countries involved in the 3 Global Matrices, comparing the proportion of INC indicators rather than the absolute value is more relevant. Overall, the proportion of INC grades per Global Matrix was stable over time (see Table 3).

To compare the evolution of the grades by country, the comparison of average grades and INC grades over time per country that participated in Global Matrix 1.0 (2014), Global Matrix 2.0 (2016), and Global Matrix 3.0 (2018) is presented in Table 4. Overall, Table 4 shows that the average grades were stable over time between Global Matrix 1.0 and Global Matrix 2.0. Given the spread of possible values within a letter grade, 2 years is likely not a long enough period to observe a significant letter grade change among the physical activity indicators, particularly with regard to Overall Physical Activity and Sedentary Behaviors. The stability of the grades between the Global Matrix editions may be an indicator of reliability of the Report Cards' standardized development process. In addition, half of the participating countries reported fewer INC grades in subsequent Report Cards, and this decreased number of INC grades suggests improvements in the surveillance of physical activity indicators in these countries, which could potentially be a positive effect of their participation in the Global Matrix initiative.

Case Study: Changes in Report Card Grades Over Time in Canada, South Africa, and Mexico

As a result of several countries producing Report Cards before the Global Matrix 1.0 in 2014, more meaningful comparisons of their grade changes over time were able to be made. Report Cards in Canada were developed and published every year from 2005 to 2016 and biannually after 2016. Changes in grades between 2005 and 2016 were analyzed by Barnes and Tremblay.[14] A total of 25 grade changes were observed over time. Specifically, 64%

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Table 4 Comparison of Average Grades and Incomplete Grades Over Time Per Country That Participated in Global Matrix 1.0 (2014), Global Matrix 2.0 (2016), and Global Matrix 3.0 (2018)

	Average grades			Number of incomplete grades			Comparison between Global Matrix 1.0 and Global Matrix 2.0		Comparison between Global Matrix 2.0 and Global Matrix 3.0	
Country	Global Matrix 1.0	Global Matrix 2.0	Global Matrix 3.0	Global Matrix 1.0	Global Matrix 2.0	Global Matrix 3.0	Number of grades that increased	Number of grades that decreased	Number of grades that increased	Number of grades that decreased
Australia	C	C	C–	1	1	1	3	1	1	2
Canada	C	C	C–	1	0	0	5	0	3	5
Colombia	D	C	C–	4	2	2	2	0	3	1
England	C	C	C–	4	4	3	0	4	2	1
Finland	C	C	C+	0	0	0	1	0	6	1
Ghana	D	D	D+	2	0	2	1	2	4	1
Mexico	D	D	D+	2	1	3	1	3	4	2
New Zealand	B	C	C	1	0	1	2	4	3	4
Nigeria	C	C	C	5	3	3	1	0	1	0
Scotland	C	C	D+	2	2	4	0	0	0	2
South Africa	D	C	D+	2	1	3	2	0	0	3
United States	C	C	D	3	3	3	0	2	3	2
Total	C	C	C–	33	22	25	18	16	30	24

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(16/25) of the grade changes was observed, and 70% (7/10) of child and youth physical activity indicator changes in Canada was improved over time. The majority of the observed grade changes (68%; 17/25), however, were in relation to 5 indicators: Family and Peers, School, Community and Built Environment, Government Strategies and Investment, and Nongovernment (an additional indicator in the Canadian Report Card). These changes represented structural and environmental improvements in contrast to individual behavioral improvements (eg, improved grades in Active Transportation and Sedentary Behaviors), which have undergone very little progress over time.

In South Africa, 5 Report Cards have been developed between 2007 and 2018, but the physical activity indicators used for these Report Cards have changed over time, limiting their across-year comparison. However, physical activity was consistently evaluated, and small changes were observed over time ("C–" in 2007, "D" in 2010, "D" in 2014, "C" in 2016, and "C" in 2018). This indicates that about half of the children and youth in South Africa are meeting the recommended 60 minutes of moderate- to vigorous-intensity physical activity daily.[28] A finding consistently observed in the 5 South African Report Cards was the absence of nationally representative data, limiting the validity and reliability of their physical activity grades, which were based on local and regional studies.[28–30]

Finally, 4 Report Cards have been developed in Mexico between 2012 and 2018. Some negative trends concerning the Overall Physical Activity ("C" in 2012, "C+" in 2014, "C" in 2016, and "D+" in 2018) and Sedentary Behaviors grades ("C" in 2012, "D" in 2014, "D" in 2016, and "D–" in 2018) were observed across 6 years. In contrast, a positive trend was observed for the Community and Environment grades (INC in 2012, "F" in 2014, "D" in 2016, and "D+" in 2018) across the 6-year period. An encouraging finding from the comparison of Mexico's Report Cards is the increasing number of indicators that the working group was able to assign grades (4 in 2012 and 7 in 2018), indicating an increase in availability of physical activity data within the country.[31–33]

More details concerning the country physical activity grades are available in the Report Card documents listed in Supplementary Material 1 (available online) and in the articles listed in Supplementary Material 2 (available online).

Impact on Raising Awareness and Capacity Building in the National and International Scientific Community

Scientific Publications Related to the Report Cards and the Global Matrices

Since its creation, the Report Card has received much attention in the research community, nationally and internationally. Report Cards and related articles published since 2005 are summarized in Supplementary Material 2 (available online), including the scientific articles associated with specific Report Cards (where available), in addition to the international comparison articles and additional secondary analyses using data from the Report Cards or Global Matrices.

A first draft of this list of articles was created with a database search conducted using PubMed on March 26, 2019, with filters capturing articles published in 2015 or later. The search terms used were "report card on physical activity" and "report card global matrix"; 51 relevant peer-reviewed articles were captured. The list was then completed by the members of the AHKGA executive committee. The articles included in the final version of the list were then entered into the Scopus database to determine the number of times each article had been cited and into the Google Scholar database to confirm and cross-reference the number of times each article had been cited in the literature. Duplicate citations and citations from non-peer-reviewed articles were excluded from the count. The 49 short Report Card articles that were published in 2018 in the supplemental issue of the *Journal of Physical Activity and Health* were treated as peer-reviewed articles for this analysis. Although these articles were externally audited before publication, they did not go through a formal peer-review process.

In total, the Global Matrix and Report Card initiatives have generated many impactful publications: 149 scholarly articles have been published, accumulating more than 1600 citations at the time of the count. The *Journal of Physical Activity and Health* was the host of 3 Global Matrix Special Supplements and was therefore the most reported journal in this list (n = 118); however, 31 peer-reviewed publications in 13 other journals were also reported.

Scientific Oral Presentations and Posters Related to the Report Cards and the Global Matrices

In addition to the publication of many articles, a great number of oral and poster presentations including symposia related to the Report Cards or the Global Matrix were made at international scientific conferences, meetings or congresses, as well as at national and local events. A poster was presented for each country Report Card at the release of the Global Matrix 1.0 at the *Global Summit on the Physical Activity of Children* in Toronto, Canada, in 2014; at the release of the Global Matrix 2.0 at the *International Society of Physical Activity and Health Congress* in Bangkok, Thailand, in 2016; and at the release of the Global Matrix 3.0 at the *Movement to Move Event* in Adelaide, Australia, in 2018. In addition, numerous other posters, oral presentations, and symposiums have been delivered. A list of the academic presentations including those related to the Report Cards or the Global Matrices that were reported by AHKGA members is presented in Supplementary Material 3 (available online).

In total, 240 academic presentations, including 7 keynote presentations, 9 invited presentations, 81 oral presentations, 22 oral presentations from symposia, 1 panel discussion, and 120 poster presentations were performed at 84 different international, national, or local events.

Impact on Research Gap Surveillance

For each participating country, research and surveillance needs were highlighted using 2 mechanisms as follows: (1) the INC grades in the Report Card documents and Report Card articles and (2) the research gap section included in several articles related to the Report Cards. An INC grade is a formal way to communicate a call for action to the health surveillance community, concerned researchers, and interested end users. Similarly, the identified research gaps published in peer-reviewed articles highlight relevant research and publication opportunities for researchers.

The decrease in INC grades associated with the availability of new physical activity data in a given country cannot be automatically considered to be a positive effect of the Report Card or Global Matrix process. However, several cases of new physical activity surveillance projects directly resulting from the participation of a

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country in the Global Matrix were reported to the AHKGA. For example, in Thailand, the Report Card working group developed the Thailand Physical Activity Children Survey 2015, a nationally representative school-based survey used to collect data for each Report Card physical activity indicator for their participation in the Global Matrix 2.0 in 2016.[34] On a smaller scale, Report Card leaders from Canada and Ethiopia reported planning to survey key government officials to identify the past and present policies and actions in place for promoting physical activity among children and youth.

Numerous Report Card team members also reported initiating some work to cover the gaps highlighted by their first or previous Report Card(s) and were able to collect new data before starting the development of their next Report Card. For example, China's first Report Card (in 2016) focused only on data collected in Shanghai, highlighting the need for nationally representative data. The Chinese Report Card working group managed to obtain support for and developed the "Physical Activity and Fitness in China – The Youth Study" (PAFCTYS) in 2016. The PAFCTYS is a national surveillance protocol that covers the evaluation of the 10 common physical activity indicators of the Global Matrix from a nationally representative group of school children across the country and is now conducted on a yearly basis.[35] Similarly, in Colombia, the first and second versions of the national Report Card identified research gaps in the national surveillance of physical activity. This helped to advocate for the inclusion of a broader age group (3–17 y) and new components to assess physical activity among children and youth in the latest version of the National Survey of Nutrition (2015),[36] which is the main source of data on physical activity at the national level in Colombia. Another example was observed in Scotland, where following the release of the Global Matrix 2.0 in 2016, the Report Card team managed to obtain an agreement from the Scottish Health Survey (the main annual health surveillance mechanism in Scotland), which agreed to modify the reporting of specific health data. Scottish Health Surveys were revised in 2018 to distinguish between compliance with recommendations for early years and school-age children and to improve the way active and outdoor play is reported. The reporting of these indicators will also be changed so that data from school-age children can be extracted separately from adult data and graded in future Scottish Report Cards. Finally, the leader of V4SPORT Foundation, the organization that led the Report Card for Poland, reported that their participation in Global Matrix 2.0 helped the organization to acquire funds to measure physical fitness of over 10,000 kids in Poland.

Impact on Capacity Building Among Physical Activity Researchers Around the World

The Report Card and the Global Matrix development is a long process involving a structured and harmonized approach as well as collective mentorship by experienced AHKGA members. In addition to the generation of new scientific knowledge and authorship/publications and presentations, participation in the Global Matrix initiative has had beneficial impacts for teams of researchers from around the world by providing the opportunity for the development of new skills in project management, data synthesis, advocacy, knowledge translation, and national and international collaboration.

In fact, after the development of their national Report Cards in 2018, 19 (38%) Report Card leaders declared that this process allowed them to uncover physical activity data they were not aware of, and 33 (67%) Report Card leaders reported that they expected their Report Card to improve their ability to keep up with research in the field, identify research gaps, and address surveillance needs. Several Report Card leaders articulated how their participation in the Global Matrix was a valuable learning and training experience with the help of the AHKGA board members. The Botswana Report Card leader stated that "this has been a great opportunity for the Botswana team as we learnt a lot from working with you all. It has opened up an area of very important research that has been lacking"; similarly, the Report Card leader of Bulgaria commented that "since I'm not a researcher myself and don't have the background, it was a bit more difficult to create the two-page Report Card. I managed, thanks to the support of the AHKGA team and mentors. [. . .] The lack of academic background was a challenge for the participation and the contribution to the HDI grouping article, but it was also an opportunity to be part of the process and to understand it better."

Furthermore, 8 (16%) Report Card leaders reported that they believed that their Report Card created program development and training, and one commented that the development of the Report Card was a training opportunity for "young researchers."

The AHKGA represents a great network of researchers, health professionals, and stakeholders who are working together for the promotion of healthy active lifestyles among children and youth, as presented in Figure 4. The development of the Report Cards and the Global Matrices creates networking opportunities for all participants involved. Early career researchers have the opportunity to work closely with high-profile researchers in the field of physical activity and health, creating several partnerships between researchers and between researchers and relevant organizations within their country. Several Report Card leaders declared that they expected their Report Card to "power the movement to get kids moving" by forming partnerships (n = 23 or 47%) and by improving communications and public relations (n = 26 or 53%). In addition, according to the leader of Lebanon's Report Card, the Report Cards contributed to "building bridges across cultures and communities," and the leader of South Africa's Report Card stated that "it is a good exercise to bring together experts in the field and consolidate the available evidence." The leader of the United States' Report Card also commented that the Global Matrix provides a "strengthening of networks for research and practice at the regional level, as well as the identification of opportunities to work together with other countries to solve similar difficulties in the promotion of physical activity among children." The leader of Botswana's Report Card even reported that their participation in the Global Matrix 3.0 allowed them to "now have a research team to also work on other projects." Finally, in accordance with these findings, 47 Report Card leaders (96%) reported that participating in the Global Matrix 3.0 was professionally rewarding.

Impact on Generating Funds for Participating Countries and Individuals

The funding of the Global Matrix project has evolved over time. The Global Matrix 1.0 was orchestrated by Active Healthy Kids Canada that funded it through internal sources and revenues from the 2014 Global Summit. The publication cost for the 2014 Report Card and Global Matrix 1.0 articles as open access in the *Journal of Physical Activity and Health* was similarly covered by Active Healthy Kids Canada. Nine travel scholarships were awarded to leaders of Report Cards from low- and middle-income countries through a grant from the International Development Research Centre (www.idrc.ca). Countries receiving subsidies included Ghana (n = 1), South Africa (n = 3), Colombia (n = 1), Malaysia (n = 2), Kenya (n = 1), and Mexico (n = 1).

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In contrast to its previous edition, the Global Matrix 2.0 was funded by the participating countries. All countries that registered for the Global Matrix 2.0 had to pay a registration fee of US $500. The money was used for project management, development of the AHKGA website, publication costs of all the country Report Card articles and the Global Matrix 2.0 comparison article in a special supplement in the *Journal of Physical Activity and Health*, and participating country gifts.

As the funds from the Global Matrix 2.0 were marginally sufficient to cover the associated costs, the registration fees were modified for the Global Matrix 3.0. Instead of a flat fee, the AHKGA Executive Committee decided to adopt a fee structure based on current Human Development Index (HDI) rankings by country as follows:

(1) Low HDI countries: US $500
(2) Medium HDI countries: US $750
(3) High HDI countries: US $1000
(4) Very High HDI countries: US $1500

In exceptional circumstances, special rates were approved for some countries. This money was used to finance the creation of a new AHKGA website, the publication of the 49 Report Card scholarly articles in 2018 and the 4 integrated articles in a special supplement of the *Journal of Physical Activity and Health*, the creation of gifts and awards for the Report Card leaders, a strategic planning meeting of the AHKGA Board members in early 2018, and the technical and research support and coordination of the Global Matrix 3.0.

In addition, during the early stages of the development of the Global Matrix 3.0, a fundraising committee was created within the AHKGA Board. The aim of the AHKGA fundraising committee is to brainstorm strategies to attract new sources of funding through sponsorships, partnerships, and parallel activities to reduce or ideally eliminate the Global Matrix registration fees for the participating countries, support specific research/surveillance projects, and potentially offer scholarships/grants to Report Card working groups in the future. No new sources of financial support have been secured yet, but the AHKGA Board members will focus on this before the commencement of the Global Matrix 4.0.

Finally, for each iteration of the Global Matrix, the AHKGA encouraged all Report Card working groups to apply for funding to financially support the development, design, and printing of their Report Card, and to allow a representative to travel to the international Global Matrix release event. In 2017, during the early stage of Global Matrix development, a document summarizing a review of the international calls for surveillance and promotion of physical activity was provided by AHKGA to all the Report Card working groups involved to support their potential grant applications. In 2016, Report Card leaders from 22 out of 38 countries reported that they had internal or external funding to develop and produce their Report Card, and 23 reported that they had internal or external funding at least partially covering their travel and attendance at the release of the Global Matrix 2.0 at the *6th Congress of the International Society of Physical Activity and Health* in Bangkok, Thailand. In 2018, Report Card leaders from 30 out of 49 countries declared that they applied for funding or sponsorship to support the production of their Report Card, and/or their travel to the Global Matrix 3.0 release at the *Movement to Move Event* in Adelaide, Australia. However, Report Card leaders from 23 countries reported that they secured funding only for the development of their Report Card, and Report Card leaders from 20 countries reported that they only had funding to partially or entirely cover their travel costs to the release of Global Matrix 3.0.

Impact on Disseminating Information to the General Population and Stakeholders

The Report Cards and the Global Matrices were created to "power the movement to get children and youth moving" nationally and internationally, through raising awareness about the importance of physical activity in terms of the health of children and youth among the general population, stakeholders, and decision makers. Indeed, parental support for physical activity is associated with children's physical activity,[37,38] and as such, parents are one of the strategic targets of the Report Cards dissemination through the general media. Additional specific targets in these projects are concerned stakeholders and their related decision makers who have a vested interest in children's physical activity and health. The knowledge exchange between members from governmental and nongovernmental organizations can lead to the creation of policies, programs, and campaigns by government and nongovernment stakeholders, which, in turn, can help increase physical activity opportunities for children and youth.[12]

Findings From Global Matrix 1.0

Nearly 900 delegates from 31 countries were present at the *Global Summit of Physical Activity for Children and Youth*, and 288 delegates completed a survey after the event. Among the respondents, 10% reported to be from government agencies, 14% from a nongovernmental organization, and 15% from a public health organization. Based on the attendance breakdown, this event served as an ideal opportunity to raise awareness internationally among attending stakeholders. The media attention that was generated by the launch of the Global Matrix 1.0 was collected by Canada's Report Card working group. A total of 515 media hits (individual news stories), including 160 online, 57 print, 92 on television, and 206 on the radio were generated, achieving a total of 219 million media impressions nationwide within Canada.

Findings From Global Matrix 2.0

The release of the Global Matrix 2.0 took place during the Sixth *International Congress on Physical Activity and Public Health* in Bangkok, Thailand, in November 2016, where over 1000 international delegates were attending the conference. The number of media hits online, on television, in newspapers (printed), and on the radio generated by the launch of the Global Matrix 2.0 was reported by the Report Card leaders to the AHKGA. The total number of media hits per participating country is summarized in Figure 5A. This figure includes the reported media hits that were generated by the launch of the Global Matrix 2.0 and by the release of the country Report Cards. With the exception of Australia, Hong Kong, Thailand, and Canada, the reported impact on the mainstream media was small or nonexistent for most countries, with only 18 out of 38 countries reporting media hits. Most of the media hits generated in Hong Kong and Thailand were online, with 30 and 71 hits, respectively, whereas in Canada and Australia, most of the media hits generated were on the radio (213 hits for Canada and 59 for Australia) followed by online (116 in Canada and 10 in Australia). In the Global Matrix 2.0 post-launch survey circulated by the AHKGA to the 38 Report Card leaders, 72% reported that

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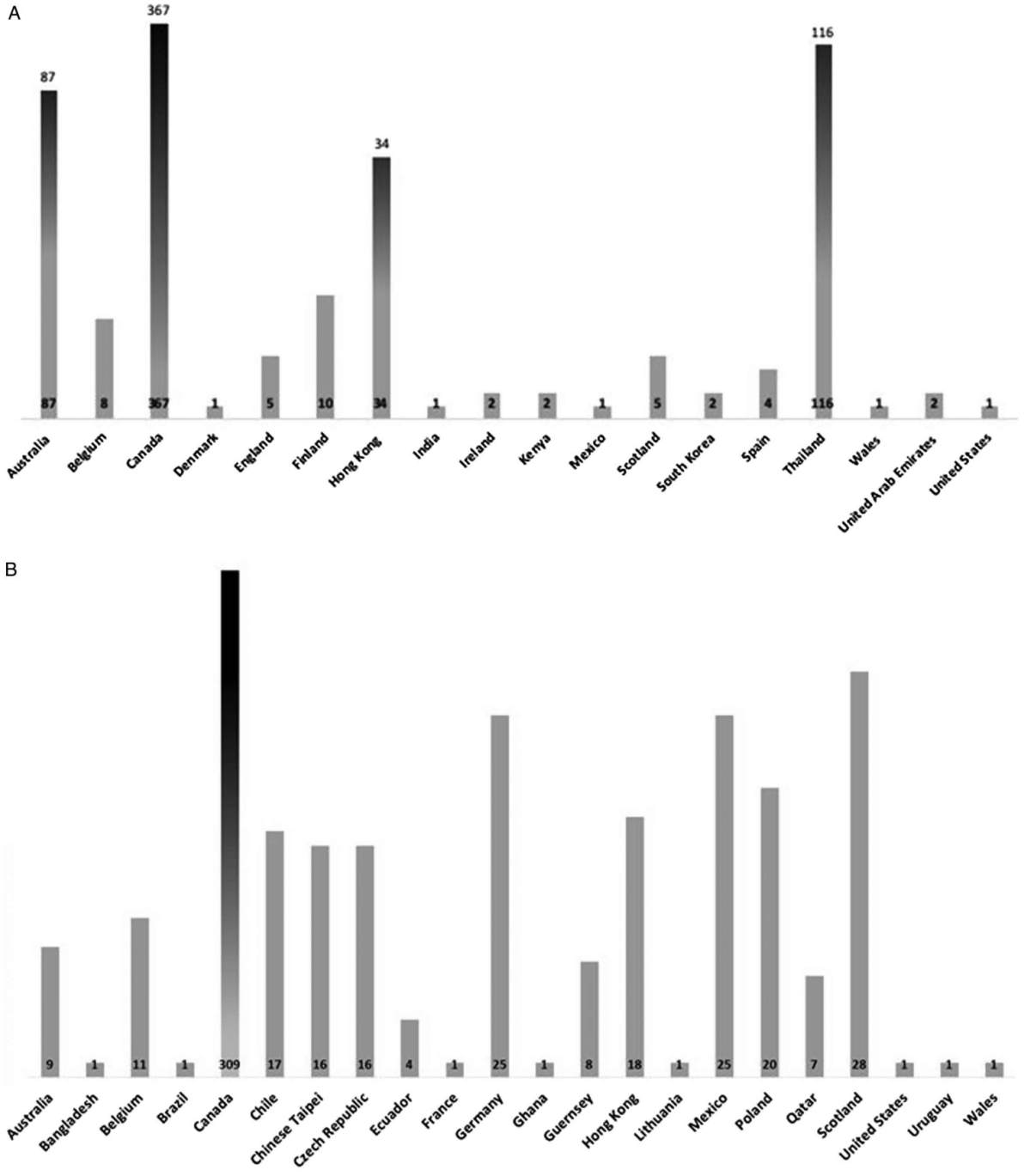

Figure 5 — Summary of the media attention reported by the Report Card leaders to AHKGA. (A) Media hits generated by the launch of the Global Matrix 2.0 (2016) and the publication of its related Report Cards. (B) Media hits generated by the launch of the Global Matrix 3.0 (2018) and the publication of its related Report Cards. Note: The size of the bars filled with a gradient was reduced for a better visualization of the graphics. AHKGA indicates Active Healthy Kids Global Alliance.

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they were satisfied with the media coverage for their Report Card, and 80% reported that they were satisfied with the overall media coverage for the Global Matrix 2.0 launch.

To support the dissemination of the Report Card and Global Matrix information in the media, several resources and specific instructions were provided by the AHKGA to the Report Card working groups before the release of the Global Matrix 2.0 and the release of the Global Matrix 3.0. These resources are detailed in the following section.

Findings From Global Matrix 3.0

The Global Matrix 3.0 was released on November 27, 2018 at the *Movement to Move Event* in Adelaide, Australia. A total of 161 delegates and speakers attended the event, including 97 attendees from Australia and 64 from 29 other countries. In anticipation of the launch of the Global Matrix 3.0 and of the country Report Cards, a detailed dissemination package was provided by the AHKGA to the Report Card working groups to support the dissemination of this information through various media outlets. This package included:

(1) Two infographics summarizing what the Global Matrix 3.0 is and its main findings.

(2) Social media material suggesting the use of specific hashtags and providing examples of Tweets/Facebook posts.

(3) Three press release documents: one focusing on the Global Matrix 3.0 and its findings, a neutral template that was adaptable to each country, and one focusing on findings at the country level (using Canada as an example).

(4) A sample article that could be used to promote the release of the Global Matrix 3.0 via websites or newsletters.

(5) A questions and answers document to provide guidance to the Report Card leaders when being interviewed by media.

All the Report Card leaders and communication coordinators in each country were encouraged by the AHKGA to use this material and to share, disseminate, and promote the launch of the Global Matrix 3.0 and their Report Card. The total number of media hits per participating country generated by the launch of the Global Matrix 3.0 and by the release of the national Report Card is summarized in Figure 5B, where only the countries with at least one media hit reported appear. A total of 521 media hits were reported by the Report Card leaders, including 309 hits for Canada alone. Twenty-two countries reported having one or more media hits, and 27 countries reported no media hits. In the Global Matrix 3.0 post-launch survey completed by the Report Card leaders, only 51% declared they were satisfied with the media coverage for their country Report Card. However, more than 3 quarters of respondents declared being satisfied with the overall media coverage for the Global Matrix 3.0.

Several possibilities may explain the large discrepancies with regard to media impact observed between the countries. Some countries did not officially release a Report Card document in addition to the launch of the Global Matrix. Countries also invested various amounts of time and effort to communicate with local and national media outlets, collect and synthesize media hits achieved, and report to the AHKGA. The timing of the releases may also have impacted media interest within each country as the space in media outlets is substantially higher when there is less news competition. Finally, it is possible that physical activity is not a priority in some countries, which may have contributed to the lack of media attention.

In Canada, great efforts were made to increase the dissemination and uptake of the Report Cards and Global Matrix findings to the media. Specific public relations and media strategies were established by Canada's Report Card working group to facilitate this exceptional impact. For every release of Canadian Report Card or Global Matrix, physical activity experts collaborated with communication professionals from ParticipACTION, the Canadian Report Card strategic communication partner, to develop dissemination materials (eg, press release and key findings documents). All these materials were produced in both English and French to increase their reach. ParticipACTION also hired a public relations agency that was in charge of posting the press release documents on a newswire, a day before the release of the concerned Report Card or Global Matrix and monitored the media hits and impressions generated by the release. In addition, ParticipACTION communication professionals also developed a social media strategy for the dissemination of the Report Card and Global Matrix information on Facebook, Twitter, and Instagram in both English and French.

Online and Social Media Presence

Other potential vectors of dissemination of the Global Matrices and country Report Cards' information to the general population and stakeholders are publicly available online via websites and social media platforms. Indeed, numerous countries Report Card working groups and institutions have created web pages, websites, and/or social media accounts, where they are able to share information and documents related to their country's Report Card and/or the Global Matrices with the public. Report Card leaders were asked to report websites and social media accounts in the Global Matrix 3.0 post-launch survey. A total of 32 websites or web pages, 7 active Facebook accounts, 9 Twitter accounts, and 2 Instagram accounts were reported by the Report Card leaders. In addition, the AHKGA Twitter account (@activehealthykids.org), AHKGA LinkedIn page (www.linkedin.com/company/ahkga), and AHKGA website (www.activehealthykids.org) were created to communicate the AHKGA activities, the Global Matrices development, and relevant Global Matrix or Report Card news. A special web page for each country (eg, www.activehealthykids.org/australia) that has participated in any of the past Global Matrices is also available on the AHKGA website since the launch of Global Matrix 3.0, presenting all the available country Report Card documents and articles, Report Card leaders' testimonials, the top 3 strategies to improve the physical activity grades identified by the Report Card working groups, and any other relevant information a Report Card leader asked to be posted.

The AHKGA website was first created in 2015 to support the development of Global Matrix 2.0 and was then used for the dissemination of Global Matrix and Report Card–related information. Within the 3 months following the release of the Global Matrix 2.0, a total of 13,129 pages were visited by 4930 visitors. And, a total of 22,884 pages were visited by 6505 visitors during the 3 months after the launch of the Global Matrix 3.0. The observed increased use of the AHKGA website between Global Matrix 2.0 and Global Matrix 3.0 releases can potentially be explained by the greater number of participating countries in Global Matrix 3.0, but also the general augmentation of the use of Internet resources in the modern society over time. This finding shows that the AHKGA website is also a reliable source of dissemination of the Global Matrix and Report Card–related information to the population.

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Impact on Powering the Movement to Get Kids Moving Nationally and Internationally

Although the comparison of the physical activity grades over the 3 Global Matrices showed that it was still too early to observe a positive change in physical activity levels among children and youth, positive outcomes in terms of the promotion of physical activity have already been directly linked to the Global Matrix and Report Card initiatives.

A sample of success stories that were reported to the AHKGA by the Report Card leaders during the development and after the launch of the Global Matrix 3.0 are presented in Table 5. Numerous stories describe how the Global Matrix and the Report Card activities have helped to raise awareness, build capacity, increase government involvement, generate attention in the media, initiate new policies, provide positive outcomes in research, and improve surveillance. These samples are in addition to the selection previously presented in the Global Matrix 2.0 integrated article.[16] These success stories show that participation in the Global Matrices, combined with efforts and initiatives of the Report Card working group members, has the potential to generate favorable outcomes with regard to the promotion of physical activity among children and youth. These success stories are organized in 8 categories in Table 5, an example from each category is developed in the following paragraphs.

The "awareness" category contains reports of how the national Report Card within a given country has contributed to increase interest in the child and youth physical inactivity issue, in particular at the government level. For example, at a 2018 National Assembly of Wales—Health, Social Care and Sport Committee meeting, the 2016 Welsh Report Card[40] was mentioned, and the 2018 Report Card[41] was included on the meeting agenda. The discussion of the Report Card provided evidence that increased cabinet minister's involvement in debates surrounding data and issues related to active healthy kids in Wales.

The "capacity building" category contains examples of how the Report Card development process or final product(s) have supported, or continue to support, the development of sustainable local resources that are relevant for physical activity promotion. The 2016 Colombia Report Card[42] became part of the main source of information for the theory training of practitioners at the National Program of Healthy Lifestyles in Colombia. The Report Card allowed them to understand the current situation and importance of physical activity behaviors of children and youth and provided guidance to set goals for the program.

The "expanded Report Card" category reports cases where a country Report Card working group took the initiative to expand their Report Card in a way that goes beyond adding a few indicators. For instance, in The Netherlands, due to the success of the 2016 Dutch Report Card, a grant was received to develop the first ever "Physical Activity Report Card+" as a sequel to the Report Card. The Report Card+ reported evidence and grades about the 10 physical activity indicators, focusing on Dutch children with chronic conditions or disabilities.[43]

The "media impact" category provides examples of noticeable achievements that were generated by the release of a Report Card in terms of mainstream media mobilization. For example, because of the successful grades assigned to the physical activity indicators in the 2018 Slovenia Report Card, the Warner Bros Belgium is currently filming a documentary on physical activity in Slovenian schools.

The "national conference" category reports cases where a national conference was organized for or following the release of a Report Card, potentially generating media impact and raising awareness among stakeholders. On May 4, 2017, the Danish Report Card working group held a national conference entitled "Children, Youth and Movement: From Policy to Practice" based on the findings from their 2016 Report Card.[44] The conference included several oral presentations by members of the Danish Report Card work group that were related to the various physical activity indicators included in the Report Card. About 100 individuals from research institutions, sports federations, municipalities, schools, organizations working with children, and government ministries attended this event. The conference received significant social media attention and Denmark's Report Card Leader gave interviews with local news media. In 2019, following the release of the Denmark 2018 Report Card,[45] a new conference was held by the Danish Report Card working group to present updated findings on the 10 physical activity indicators.

The "policy" category lists cases where the Report Card development or release activities in a country facilitated discussion around the development of physical activity promotion policies between members of a Report Card working group and the government of a country. Following the publication of their first Report Card in 2016 showing that Chilean children and youth were among the least active of any country,[46] Chile's Report Card working group assisted the government with the establishment of new regulations aiming to ensure that all children attending public schools are engaging in at least 1 hour of physical activity outside of physical education classes.

In the "research" category, examples of notable academic achievements, as well as cases where the Report Card or Global Matrix activities have generated the initiation of more scientific investigation are presented. For instance, an achievement that was noted by the AHKGA Board of Directors is that the Global Matrix 3.0 main article[23] is currently used as the "go-to" reference for academics citing recent data concerning the global state of childhood physical activity and differences observed among countries.

Finally, cases where the Report Card development or release activities have facilitated the collection of new physical activity data in a country are listed in the "surveillance" category. In response to the first Report Card of China (2016),[46] focusing only on data from Shanghai, the Chinese Report Card working group developed the PAFCTYS. The PAFCTYS is a national surveillance protocol that is conducted on a yearly basis to collect physical activity data from a nationally representative group of school children across the country. Data from the first cycle of PAFCTYS informed China's 2018 Report Card.[35]

After the release of the Global Matrix 2.0 in 2016, the Report Card leaders from 38 countries completed the post-launch survey, and 81% reported feeling that the Global Matrix 2.0 was contributing to an increase in scientific knowledge and to "powering the movement to get kids moving." A large majority (97%) expected their Report Card to have a positive influence on "powering the movement to get kids moving" in their country: mostly by increasing public awareness (92%), improving the ability to keep up with research in the field and identifying research gaps and surveillance needs (89%), improving capacity for advocacy (75%), forming partnerships (72%), and creating policy/strategy development (64%). Furthermore, 72% of the Report Card leaders thought that the Global Matrix 2.0 provided other benefits to society, mostly by helping raise awareness with parents and the general public and contributing to public health promotion on physical activity (19%) and because it engages people at a global level for

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Table 5 Success Stories Reported to the AHKGA by the Report Card Leaders

Category	Country	Description and link
Awareness	Flanders (Belgium)	Following the publication of the 2018 Flanders' Report Card, the Ministers for Education and for Sport were called upon in the Parliament based on findings reported in the Report Card.
Awareness	United Arab Emirates	The United Arab Emirates' inaugural Report Card has helped to raise awareness about physical inactivity as a major public health issue in the country and region. The Report Card and article can act as an excellent resource for any researchers/practitioners interested in the epidemiology of physical activity in the United Arab Emirates.
Awareness	Venezuela	The Report Card leader was contacted by the Commission of Health of the National Assembly of Venezuela to discuss nutrition and physical activity in Venezuelan children.
Awareness	Wales	Active Healthy Kids Wales and the Welsh Report Cards have generated media attention and the attention of the Welsh government and assembly members.
Awareness	Wales	At a 2018 National Assembly of Wales Health, Social Care and Sport Committee meeting, the 2016 Welsh Report Card was mentioned, and the 2018 Report Card was included on the meeting agenda. The discussion of the Report Cards provided evidence that increased cabinet minister's involvement in debates surrounding data and issues related to active healthy kids in Wales.
Capacity building	Colombia	The 2016 Colombia's Report Card became part of the main sources of information for the training of practitioners at the National Program of Healthy Lifestyles in Colombia.
Capacity building	Ghana	The development of the 2018 Ghana's Report Card allowed to involve and train senior students in physical education and sport in data monitoring and surveillance.
Expanded Report Card	Japan	Japan's Report Card working group developed a Report Card detailing the grades for the 10 physical activity indicators for each of the 47 Japanese prefectures. It means that the equivalent of 47 "mini" Report Cards, one for each prefecture of Japan, were developed and compiled in a final document, offering a detailed cartography of the physical activity behaviors and sources of influence across Japan.
Expanded Report Card	The Netherlands	Due to the success of the 2016 Dutch Report Card, a grant was received to develop the first ever Physical Activity Report Card+ as a sequel to the Report Card. The Report Card+ reported about the movement achievements and sedentary behavior of Dutch children with chronic conditions or disabilities.
Media impact	Slovenia	Feedback from Slovenia Report Card article coauthors was that this was an exceptional project to be a part of and that there was more publicity for the Slovenian school physical activity programs than anything that has taken place in the past number of years.
Media impact	Slovenia	Because of the successful grades assigned to the physical activity indicators in the 2018 Slovenia's Report Card, the Warner Bros Belgium is filming a documentary on physical activity in Slovenian schools.
National conference	Australia	A stakeholder engagement forum was held in Australia immediately after the Global Matrix 2.0 release.
National conference	Denmark	In 2017, the Danish Report Card working group held a national conference based on the findings from their 2016 Report Card. The conference included presentations related to the various physical activity indicators included in the Report Cards. About 100 individuals from research institutions, sports federations, municipalities, schools, organizations working with children, and government ministries attended this event. The conference received significant social media attention and Denmark's Report Card Leader gave interviews with local news media. In 2019, following the release of the Denmark 2018 Report Card, a new conference was held by the working group to present updated findings on the 10 physical activity indicators.
Policy	Chile	Following the publication of their first Report Card in 2016, Chile's Report Card working group assisted with the establishment of new regulations aiming to ensure that all children attending public schools are engaging in at least 1 h of physical activity outside of physical education classes.
Policy	Ghana	The Report Card working group was involved in the development of new policy guidelines for physical education and sport.
Research	Brazil	The 2018 Brazil Report Card working group developed and published in a Brazilian peer-review journal a systematic review for each physical activity indicator. The working group found enough evidence to grade all the Report Card indicators for the first time, illustrating the quality of the work of the team involved.

(continued)

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Table 5 ***(continued)***

Category	Country	Description and link
Research	Ukraine/Bulgaria	Independent development of Report Cards on the physical activity of children and youth by using a method similar to that used to develop the Global Matrix Report Cards.
Research	Ghana	The work from Ghana's Report Cards (2014, 2016, and 2018) supported the initiation of the study of barriers in implementing physical education in Ghanaian schools.
Research	International	The Global Matrix 3.0 main article is being used as a reference for academics citing recent data concerning the global state of physical activity and differences observed among countries.
Research and Policy	England, Scotland, Wales, and Northern Ireland (United Kingdom)	Findings from the previous Report Cards (2016 or 2018) that were developed in England, Scotland, Wales, and Northern Ireland were included in the surveillance and implementation documentation of the 2019 Updated UK Physical Activity Guidelines. An article highlighting the work of the AHKGA in this regard has been recently accepted for publication in the *British Journal of Sports Medicine*.[39]
Research, Policy, and Surveillance	Chile	Chile's Report Card working group has partnered with the Ministry of Health in order to collaborate on surveillance studies, national strategies for the promotion of physical activity, and the identification of multilevel factors affecting behaviors.
Surveillance	Botswana	In response to a lack of objective physical activity data revealed by Botswana's 2018 Report Card, a project is being developed to collect national data on the 10 indicators included in the Report Cards. The project is generating significant interest and support from numerous sectors of youth sport and health promotion, which will potentially result in partnership and funding opportunities.
Surveillance	Bulgaria	The Report Card is giving the Bulgarian Report Card working group the opportunity to advocate for the importance of quality and relevant data and for the development of a systematic surveillance system of physical activity. *BG Be Active* is a nongovernmental organization that is working in the field of health-enhancing physical activity promotion and that needs relevant information about target groups in order to develop strategies and secure funding for activities.
Surveillance	Chile	Based on advocacy and the results from Chile's 2018 Report Card, a national physical activity survey was developed to provide data on all of the physical activity indicators that are included in the Report Cards.
Surveillance	China	In response to Shanghai's (China) 2016 Report Card, the Chinese Report Card working group developed the Physical Activity and Fitness in China—The Youth Study (PAFCTYS) in 2016. PAFCTYS is a national surveillance protocol that is conducted on a yearly basis to collect physical activity data from a nationally representative group of school children across the country.
Surveillance	Colombia	The first 2 versions of the Report Card in Colombia helped to identify research gaps in the national surveillance of physical activity. This helped to advocate for the inclusion of new components to assess physical activity among children in the latest version National Survey of Nutrition (2015), which is the main source of data on physical activity at the national level.
Surveillance	Czech Republic	Following the release of its first Report Card, the Czech Republic Report Card working group is currently in discussion with the Ministry of Health about the possibility to launch a national physical activity surveillance system.
Surveillance	Scotland	Discussions with the government survey teams about how to extract and interpret data in the national surveys revealed that there were some data that researchers were not aware of, which were not reported in the national survey reports. In addition, the way in which data are operationalized in the national surveys is not always logical and can lead to overestimation of physical activity levels.

Abbreviation: AHKGA indicates Active Healthy Kids Global Alliance.

international cooperation, the exchange of good practices, and global networking (15%).

Similarly, in 2018, after the release of the Global Matrix 3.0, several Report Card leaders reported in the Global Matrix 3.0 post-launch survey that they expected their participation in the Global Matrix and Report Card processes to improve their capacity for advocacy. The Report Card leader of Chile stated that the Global Matrix 3.0 article was ". . . very useful for advocacy purposes and to identify/propose new ideas for policies." and added that Chile's Report Card was ". . . a relevant tool for practitioners and school professionals as they get a very updated state of the art of the current situation in Chile. Lot of them are using the Report Card to justify local proposals and programs along Chile." Most of the Report Card leaders (41, 84%) also declared that they expected their Report Card to have a positive influence on powering the movement to get kids moving in their country by raising awareness and 25 (51%) by creating policy and strategy development.

"I think the Global Matrix 3.0 demonstrates how 49 countries that are very different in many respects can work together as one team composed of individual country teams to raise awareness and

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propose solutions for a shared global health problem: physical inactivity. A similar organizational framework could be used for other global public health issues" reported the leader of the Lebanon Report Card.

Overall, an overwhelming compilation of positive messages and feedback were reported by the Report Card leaders relative to their participation in the Global Matrix 3.0. More materials and analysis related specifically to the Global Matrix 3.0 process, development, release, and impact will be available in a Global Matrix 3.0 evaluation article (Aubert et al, under review in the *Journal of Exercise Science & Fitness*).

Summary of Impact

Although it is still too early to observe a positive change in physical activity levels in children and youth, the Report Cards and Global Matrix initiative have had demonstrable impacts on powering the movement to get kids moving at both national and international levels. The evaluation of various sources of information shows an accumulation of evidence that the immediate and intermediate outcomes presented in the logic model of AHKGA (Figure 2) are already starting to be addressed. An impact on raising awareness and capacity building in the national and international scientific community, disseminating information to the general population and stakeholders, and finally on powering the movement to get kids moving has been observed. It is hoped that continuing to pursue the Global Matrix and Report Card activities will initiate a measurable shift in the physical activity levels of children and contribute to achieving the 4 strategic objectives of the World Health Organization Global Action Plan as follows: creating an active society, creating active environments, creating active lives, and creating active systems.[22]

Strengths and Limitations

This is the first article to summarize the international impact of the Global Matrices and Report Cards with a common goal to power the movement to get children and youth moving. This impact assessment was performed using a variety of both quantitative and qualitative sources of information, including surveys, peer-reviewed publications, e-mails, gray literature among other sources. The main limitation of this impact assessment is that it relies partly on the reports made by the Report Card leaders, the Report Card team members, the mentors, and the AHKGA Board members. Consequently, the results may be biased and/or incomplete, making countries that reported more detailed information to the AHKGA look more successful than others. However, the qualitative information collected from Report Card leaders provides insight into the experiences had by Report Card working groups and leaders.

Future Directions for the AHKGA Report Card and Global Matrices

The AHKGA will pursue its journey to power the movement to get kids moving through the development of future Global Matrices on physical activity for children and youth and parallel activities. Future goals of the AHKGA include the following:

(1) Based on the model used in Canada, boost the impact of Report Cards and Global Matrix in other participating country's media. More efforts will also be made to improve the dissemination of the Report Card and Global Matrix findings through social media outlets at national, regional, and global levels.

(2) Recruit more countries to participate in the Global Matrices to cover the missing and underrepresented geographic areas, including the South Pacific, Northern and Central Africa, and Northern Asia.

(3) Contribute to the development and international adoption of standardized methods of evaluation of the Report Card indicators that are suitable and adjustable to all cultural contexts and all children and youth.

(4) Following the example of The Netherlands Report Card+ initiative,[43] the AHKGA aims to include the evaluation of the physical activity indicator for children and youth with a disability or chronic disease.

(5) Following the examples of the Canadian and Polish Report Cards, where ParticipACTION and V4SPORT Foundation, respectively, are leading in the preparation of the Report Cards with working groups of national physical activity experts, the AHKGA wants to encourage Report Card leaders to create partnerships with local grassroots physical activity/sport organizations to bridge the gap between what the scientific world knows and what active-healthy lifestyle organizations do.

(6) Develop a new financial system, so the functioning of the organization and its activities will not rely solely on the registration fees of the countries participating in the Global Matrices through fundraising, partnerships, sponsorships, and parallel activities.

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Online supplementary File 1: Year, country and web link for each national Report Card produced since 2005.

Year	Country	Link to the Report
2005	Canada	https://www.participaction.com/sites/default/files/downloads/Participaction-2005FullReportCard-DroppingTheBall_0.pdf
2006	Canada	https://www.participaction.com/sites/default/files/downloads/Participaction-2006FullReportCard-KidsTVTime_0.pdf
2007	Canada	https://www.participaction.com/sites/default/files/downloads/Participaction-2007FullReportCard-Olderbutnotwiser_0.pdf
2007	South Africa	https://www.activehealthykids.org/wp-content/uploads/2017/03/south-africa-report-card-short-form-2007.pdf
2008	Canada	https://www.participaction.com/sites/default/files/downloads/Participaction-2008FullReportCard-UnplugourKids_0.pdf
2009	Canada	https://www.participaction.com/sites/default/files/downloads/Participaction-2009FullReportCard-ActiveKidsFittoLearn_0.pdf
2010	Canada	https://www.participaction.com/sites/default/files/downloads/Participaction-2010FullReportCard-HealthyHabitsStartEarly_0.pdf
2010	South Africa	https://www.activehealthykids.org/wp-content/uploads/2017/03/south-africa-report-card-long-form-2010.pdf
2011	Canada	https://www.participaction.com/sites/default/files/downloads/Participaction-2011FullReportCard-AfterSchoolActivity_0.pdf
2011	Kenya	http://dvqdas9jty7g6.cloudfront.net/resources/KenyanReportCardLongForm.pdf
2012	Canada	https://www.participaction.com/sites/default/files/downloads/Participaction-2012FullReportCard-ActivePlayExtinct_0.pdf
2012	Mexico	https://www.activehealthykids.org/wp-content/uploads/2017/03/mexico-report-card-long-form-2012.pdf
2013	Canada	https://www.participaction.com/sites/default/files/downloads/Participaction-2013FullReportCard-UnhealthyHabits_1.pdf
2013	Scotland	https://www.activehealthykids.org/wp-content/uploads/2016/11/scotland-report-card-long-form-2013.pdf
2014	Australia	https://www.activehealthykids.org/wp-content/uploads/2016/11/australia-report-card-long-form-2014.pdf
2014	Canada	https://www.participaction.com/sites/default/files/downloads/Participaction-2014FullReportCard-CanadaInTheRunning_0.pdf
2014	Colombia	https://www.activehealthykids.org/wp-content/uploads/2016/11/colombia-report-card-short-form-2014.pdf
2014	England	https://www.activehealthykids.org/wp-content/uploads/2016/11/england-report-card-short-form-2014.pdf
2014	Finland	https://www.activehealthykids.org/wp-content/uploads/2016/11/finland-report-card-short-form-2014.pdf
2014	Ghana	NA
2014	Ireland	https://www.activehealthykids.org/wp-content/uploads/2016/11/ireland-report-card-long-form-2014.pdf
2014	Kenya	https://www.activehealthykids.org/wp-content/uploads/2016/11/kenya-report-card-long-form-2014.pdf
2014	Mexico	https://www.activehealthykids.org/wp-content/uploads/2017/03/mexico-report-card-long-form-2014.pdf
2014	Mozambique	https://www.activehealthykids.org/wp-content/uploads/2018/08/mozambique-report-card-short-form-2014.pdf
2014	New Zealand	NA
2014	Nigeria	NA
2014	South Africa	https://www.activehealthykids.org/wp-content/uploads/2016/11/south-africa-report-card-long-form-2014.pdf
2014	United States	https://www.activehealthykids.org/wp-content/uploads/2016/11/united-states-report-card-long-form-2014.pdf
2014	Wales	https://www.activehealthykids.org/wp-content/uploads/2017/03/wales-report-card-long-form-2014.pdf
2015	Australia	https://www.activehealthykids.org/wp-content/uploads/2017/03/ahka_reportcard_2015_web.pdf
2015	Canada	https://www.participaction.com/sites/default/files/downloads/Participaction-2015ReportCard-FullReport_5.pdf
2016	Australia	https://www.activehealthykids.org/wp-content/uploads/2016/11/australia-report-card-long-form-2016.pdf
2016	Belgium	https://www.activehealthykids.org/wp-content/uploads/2016/11/belgium-report-card-long-form-2016-en.pdf
2016	Brazil	https://www.activehealthykids.org/wp-content/uploads/2016/11/brazil-report-card-long-form-2016.pdf

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Year	Country	Link to the Report
2016	Bulgaria	http://www.bgbeactive.org/wp-content/uploads/2018/05/Active-Healthy-Kids-6-15-BG-Report-English.pdf
2016	Canada	https://www.participaction.com/sites/default/files/downloads/2016%20ParticipACTION%20Report%20Card%20-%20Full%20Report.pdf
2016	Chile	https://www.activehealthykids.org/wp-content/uploads/2016/11/chile-report-card-long-form-2017.pdf
2016	China	https://www.activehealthykids.org/wp-content/uploads/2016/11/china-report-card-short-form-2016.pdf
2016	Colombia	https://www.activehealthykids.org/wp-content/uploads/2016/11/colombia-report-card-short-form-2016.pdf
2016	Denmark	https://www.activehealthykids.org/wp-content/uploads/2016/11/denmark-report-card-long-form-2017.pdf
2016	England	https://www.activehealthykids.org/wp-content/uploads/2016/11/england-report-card-short-form-2016.pdf
2016	Estonia	https://sisu.ut.ee/sites/default/files/liikumislabor/files/liikumise_hinnang_a5_final_peale_foorumit.pdf
2016	Finland	https://www.activehealthykids.org/wp-content/uploads/2016/11/finland-report-card-long-form-2016.pdf
2016	France	http://www.onaps.fr/data/documents/RC2016.pdf
2016	Ghana	NA
2016	Hong Kong	https://www.activehealthykids.org/wp-content/uploads/2016/11/hong-kong-long-form-report-card-2016.pdf
2016	India	https://www.activehealthykids.org/wp-content/uploads/2016/11/india-report-card-long-form-2016.pdf
2016	Ireland	https://www.activehealthykids.org/wp-content/uploads/2016/11/ireland-report-card-long-form-2016.pdf
2016	Japan	https://www.activehealthykids.org/wp-content/uploads/2016/11/japan-report-card-long-form-2016.pdf
2016	Kenya	https://www.activehealthykids.org/wp-content/uploads/2016/11/kenya-report-card-long-form-2016.pdf
2016	Malaysia	https://www.activehealthykids.org/wp-content/uploads/2016/11/malaysia-report-card-long-form-2017.pdf
2016	Mexico	https://www.activehealthykids.org/wp-content/uploads/2016/11/mexico-report-card-long-form-2017.pdf
2016	Mozambique	https://www.activehealthykids.org/wp-content/uploads/2016/11/mozambique-poster-2016.pdf
2016	Netherlands	https://www.activehealthykids.org/wp-content/uploads/2016/11/netherlands-report-card-long-form-2016.pdf
2016	New Zealand	http://www.nihi.auckland.ac.nz/Portals/2/Documents/2016%20PA%20Report%20Card/Final%20NZ%20PA%20Report%20Card.compressed.pdf?ver=2016-11-15-130228-183
2016	Nigeria	http://www.nigerianheart.org/images/2016%20Nigerian%20Report%20Card%20on%20Physical%20Activity%20for%20Children%20and%20Youth.pdf
2016	Poland	https://www.activehealthykids.org/wp-content/uploads/2016/11/poland-report-card-short-form-2016.pdf
2016	Portugal	https://www.activehealthykids.org/wp-content/uploads/2016/11/portugal-report-card-long-form-2017-en.pdf
2016	Qatar	https://www.activehealthykids.org/wp-content/uploads/2016/11/qatar-report-card-short-form-2016.pdf
2016	Scotland	https://www.activehealthykids.org/wp-content/uploads/2016/11/scotland-report-card-long-form-2016.pdf
2016	Slovenia	https://www.activehealthykids.org/wp-content/uploads/2016/11/slovenia-report-card-long-form-2016.pdf
2016	South Africa	https://www.activehealthykids.org/wp-content/uploads/2016/11/south-africa-report-card-long-form-2017.pdf
2016	South Korea	https://www.activehealthykids.org/wp-content/uploads/2016/11/south-korea-report-card-long-form-2016.pdf
2016	Spain	https://www.activehealthykids.org/wp-content/uploads/2016/11/spain-report-card-long-form-2016.pdf
2016	Sweden	https://www.activehealthykids.org/wp-content/uploads/2016/11/sweden-report-card-long-form-2016.pdf
2016	Thailand	https://www.activehealthykids.org/wp-content/uploads/2016/11/thailand-report-card-long-form-2016.pdf
2016	United Arab Emirates	https://www.activehealthykids.org/wp-content/uploads/2016/11/united-arab-emirates-report-card-short-form-2016.pdf
2016	United States	https://www.activehealthykids.org/wp-content/uploads/2016/11/united-states-of-america-report-card-long-form-2016.pdf
2016	Venezuela	https://www.activehealthykids.org/wp-content/uploads/2016/11/venezuela-report-card-long-form-2016.pdf

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Year	Country	Link to the Report
2016	Wales	https://www.activehealthykids.org/wp-content/uploads/2016/11/wales-report-card-long-form-2016.pdf
2016	Zimbabwe	https://www.activehealthykids.org/wp-content/uploads/2016/11/zimbabwe-report-card-long-form-2016.pdf
2017	Japan	NA
2017	Netherlands	https://www.activehealthykids.org/wp-content/uploads/2017/05/Report_Card_14052017.pdf
2018	Australia	https://www.activehealthykids.org/wp-content/uploads/2018/11/australia-report-card-long-form-2018.pdf
2018	Bangladesh	https://www.activehealthykids.org/wp-content/uploads/2018/11/bangladesh-report-card-short-form-2018.pdf
2018	Belgium (Flanders)	https://www.activehealthykids.org/wp-content/uploads/2018/11/belgium-report-card-short-form-2018.pdf
2018	Botswana	https://www.activehealthykids.org/wp-content/uploads/2018/11/botswana-report-card-short-form-2018.pdf
2018	Brazil	https://www.activehealthykids.org/wp-content/uploads/2018/11/brazil-report-card-long-form-2018.pdf
2018	Bulgaria	NA
2018	Canada	https://www.participaction.com/en-ca/thought-leadership/report-card/2018
2018	Chile	http://www.activehealthykidschile.com/resultados2016-2-2/
2018	China	https://www.activehealthykids.org/wp-content/uploads/2018/11/china-report-card-short-form-2018.pdf
2018	Colombia	https://www.activehealthykids.org/wp-content/uploads/2019/07/colombia-report-card-long-form-2018.pdf
2018	Czech Republic	https://www.activehealthykids.org/wp-content/uploads/2019/01/czech-republic-report-card-long-form-2018.pdf
2018	Denmark	https://www.activehealthykids.org/wp-content/uploads/2019/03/denmark-report-card-long-form-2018.pdf
2018	Ecuador	https://www.activehealthykids.org/wp-content/uploads/2019/01/ecuador-report-card-short-form-2018.pdf
2018	England	https://www.activehealthykids.org/wp-content/uploads/2018/11/england-report-card-short-form-2018.pdf
2018	Estonia	https://www.activehealthykids.org/wp-content/uploads/2018/11/estonia-report-card-long-form-2018.pdf
2018	Ethiopia	https://www.activehealthykids.org/wp-content/uploads/2018/12/ethiopia-report-card-short-form-2018.pdf
2018	Finland	https://www.activehealthykids.org/wp-content/uploads/2018/11/finland-report-card-long-form-2018.pdf
2018	France	NA
2018	Germany	https://www.activehealthykids.org/wp-content/uploads/2018/11/germany-report-card-short-form-2018.pdf
2018	Ghana	http://alwag.org/grc2018/
2018	Guernsey	https://www.activehealthykids.org/wp-content/uploads/2018/11/guernsey-report-card-short-form-2018.pdf
2018	Hong Kong	https://www.activehealthykids.org/wp-content/uploads/2018/11/hong-kong-report-card-long-form-2018.pdf
2018	India	https://www.activehealthykids.org/wp-content/uploads/2018/11/india-report-card-long-form-2018.pdf
2018	Japan	https://www.activehealthykids.org/wp-content/uploads/2018/12/japan-report-card-long-form-2018.pdf
2018	Jersey	NA
2018	Lebanon	https://www.activehealthykids.org/wp-content/uploads/2018/11/lebanon-report-card-short-form-2018-1.pdf
2018	Lithuania	https://www.activehealthykids.org/wp-content/uploads/2018/11/lithuania-report-card-long-form-2018.pdf
2018	Mexico	https://www.activehealthykids.org/wp-content/uploads/2018/11/mexico-report-card-long-form-2018.pdf
2018	Nepal	https://www.activehealthykids.org/wp-content/uploads/2018/11/nepal-report-card-short-form-2018.pdf
2018	Netherlands	https://www.activehealthykids.org/wp-content/uploads/2018/11/netherlands-report-card-short-form-2018.pdf
2018	New Zealand	https://www.activehealthykids.org/wp-content/uploads/2018/11/new-zealand-report-card-long-form-2018.pdf

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Year	Country	Link to the Report
2018	Nigeria	https://www.activehealthykids.org/wp-content/uploads/2018/11/nigeria-report-card-long-form-2018.pdf
2018	Poland	https://www.activehealthykids.org/wp-content/uploads/2018/11/poland-report-card-short-form-2018.pdf
2018	Portugal	NA
2018	Qatar	https://www.activehealthykids.org/wp-content/uploads/2018/11/qatar-report-card-short-form-2018.pdf
2018	Scotland	https://www.activehealthykids.org/wp-content/uploads/2018/11/scotland-report-card-short-form-2018.pdf
2018	Slovenia	https://www.activehealthykids.org/wp-content/uploads/2018/11/slovenia-report-card-long-form-2018.pdf
2018	South Africa	https://www.activehealthykids.org/wp-content/uploads/2018/11/south-africa-report-card-short-form-2018.pdf
2018	South Korea	https://www.activehealthykids.org/wp-content/uploads/2018/11/south-korea-report-card-short-form-2018.pdf
2018	Spain	NA
2018	Sweden	https://www.activehealthykids.org/wp-content/uploads/2018/11/sweden-report-card-short-form-2018.pdf
2018	Thailand	https://www.activehealthykids.org/wp-content/uploads/2018/11/thailand-report-card-long-form-2018.pdf
2018	Taiwan	https://www.activehealthykids.org/wp-content/uploads/2018/11/chinese-taipei-report-card-short-form-2018.pdf
2018	United Arab Emirates	https://www.activehealthykids.org/wp-content/uploads/2018/11/united-arab-emirates-short-form-2018.pdf
2018	United States	https://www.activehealthykids.org/wp-content/uploads/2018/11/united-states-report-card-long-form-2018.pdf
2018	Uruguay	https://www.activehealthykids.org/wp-content/uploads/2018/11/uruguay-report-card-long-form-2018.pdf
2018	Venezuela	https://www.activehealthykids.org/wp-content/uploads/2018/11/venezuela-report-card-short-form-2018.pdf
2018	Wales	https://www.activehealthykids.org/wp-content/uploads/2018/11/wales-report-card-long-form-2018.pdf
2018	Zimbabwe	https://www.activehealthykids.org/wp-content/uploads/2018/11/zimbabwe-report-card-long-form-2018.pdf

Note: NA = Not Available.

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Online Supplementary File 2: Articles related to the Report Cards or Global Matrices published in a scientific journal, corresponding country, and corresponding citation count, ordered by year and country name.

Year	Country	Reference of Articles related	Citation count
2011	Canada	Barnes JD, Colley RC, Tremblay MS. Results from the Active Healthy Kids Canada 2011 Report Card on Physical Activity for Children and Youth. *Appl Physiol Nutr Metab*. 2012;37(4):793-797.	26
2012	Canada	Colley RC, Brownrigg M, Tremblay MS. A model of knowledge translation in health: the Active Healthy Kids Canada Report Card on physical activity for children and youth. *Health Promot Pract*. 2012;13(3):320-30.	89
2012	Canada	Barnes JD, Colley RC, Borghese M, et al. Results from the active healthy kids Canada 2012 report card on physical activity for children and youth. *Paediatr Child Health*. 2013;18(6):301-4.	13
2013	Canada	Gray C, Larouche R, Barnes J, et al. Are We Driving Our Kids to Unhealthy Habits? Results of the Active Healthy Kids Canada 2013 Report Card on Physical Activity for Children and Youth. *Int J Environ Res Public Health*. 2014;11(6):6009-6020.	36
2013	Scotland	Reilly JJ, Dick S, McNeill G, et al. Results from Scotland's 2013 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal*. 2014;11(s1):S93-S97.	21
2014	Australia	Schranz N, Olds T, Cliff D, et al. Results from Australia's 2014 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal*. 2014;11(s1):S21-S25.	29
2014	Australia	Straker L, Howie EK, Cliff DP, et al. Australia and other nations are failing to meet sedentary behaviour guidelines for children: implications and a way forward. *J Phys Act Heal*. 2016;13(2):177-188.	7
2014	Australia	Vella SA, Schranz NK, Davern M, et al. The contribution of organised sports to physical activity in Australia: Results and directions from the Active Healthy Kids Australia 2014 Report Card on physical activity for children and young people. *J Sci Med Sport*. 2016;19(5):407-12.	21
2014	Canada	Gray CE, Barnes JD, Bonne JC, et al. Results from Canada's 2014 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal*. 2014;11(s1):S26-S32.	36
2014	Canada	Tremblay MS, Barnes JD, Cowie Bonne J. Impact of the Active Healthy Kids Canada report card: a 10-year analysis. *J Phys Act Heal*. 2014;11(s1):S3-S20.	40
2014	Canada	Janssen I. Active play: An important physical activity strategy in the fight against childhood obesity. *Can J Pub Heal*. 2014;105(1):e22-e27.	36
2014	Colombia	González SA, Sarmiento OL, Cohen DD, et al. Results from Colombia's 2014 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal*. 2014;11(s1):S33-S44.	43
2014	England	Standage M, Wilkie HJ, Jago R, et al. Results from England's 2014 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal*. 2014;11(s1):S45-S50.	13
2014	Finland	Liukkonen J, Jaakkola T, Kokko S, et al. Results from Finland's 2014 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal*. 2014;11(s1):S51-S57.	31
2014	Ghana	Ocansey R, Aryeetey R, Sofo S, et al. Results from Ghana's 2014 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal*. 2014;11(s1):S58-S62.	9

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Year	Country	Reference of Articles related	Citation count
2014	Global	Tremblay MS, Gray CE, Akinroye K, et al. Physical Activity of Children: A Global Matrix of Grades Comparing 15 Countries. *J Phys Act Heal.* 2014;11(s1):S113-S125.	257
2014	Global	Tremblay MS. 2014 Global Summit on the Physical Activity of Children. *J Phys Act Heal.* 2014;11(s1):S1-S2.	22
2014	Ireland	Harrington DM, Belton S, Coppinger T, et al. Results from Ireland's 2014 Report Card on Physical Activity in Children and Youth. *J Phys Act Heal.* 2014;11(s1):S63-S68.	19
2014	Kenya	Wachira L-JM, Muthuri SK, Tremblay MS, et al. Results from Kenya's 2014 Report Card on the Physical Activity and Body Weight of Children and Youth. *J Phys Act Heal.* 2014;11(s1):S69-S73.	12
2014	Mexico	Martinez M del PR, Galaviz KI, Ulloa EJ, et al. Results from Mexico's 2014 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal.* 2014;11(s1):S74-S78.	12
2014	Mozambique	Prista A, Picardo S, Ribeiro E, et al. Results from Mozambique's 2014 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal.* 2014;11(s1):S79-S82.	5
2014	New Zealand	Maddison R, Dale LP, Marsh S, et al. Results from New Zealand's 2014 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal.* 2014;11(s1):S83-S87.	16
2014	Nigeria	Akinroye KK, Oyeyemi AL, Odukoya OO, et al. Results from Nigeria's 2013 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal.* 2014;11(s1):S88-S92.	5
2014	South Africa	Draper C, Basset S, de Villiers A, et al. Results from South Africa's 2014 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal.* 2014;11(s1):S98-S104.	38
2014	United States of America	Dentro KN, Beals K, Crouter SE, et al. Results from the United States' 2014 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal.* 2014;11(s1):S105-S112.	69
2016	Australia	Schranz NK, Olds T, Boyd R, et al. Results From Australia's 2016 Report Card on Physical Activity for Children and Youth. *J Phys Act Health.* 2016;13(11 Suppl 2):S87-S94.	7
2016	Belgium	Wijtzes AI, Verloigne M, Mouton A, et al. Results From Belgium's 2016 Report Card on Physical Activity for Children and Youth. *J Phys Act Health.* 2016;13(11 Suppl 2):S95-S103.	9
2016	Brazil	Nardo N, Silva DAS, de Moraes Ferrari GL, et al. Results From Brazil's 2016 Report Card on Physical Activity for Children and Youth. *J Phys Act Health.* 2016;13(11 Suppl 2):S104-S109.	9
2016	Canada	Barnes JD, Cameron C, Carson V, et al. Results From Canada's 2016 ParticipACTION Report Card on Physical Activity for Children and Youth. *J Phys Act Health.* 2016;13(11 Suppl 2):S110-S116.	29
2016	Canada	Barnes JD, Tremblay MS. Changes in indicators of child and youth physical activity in Canada, 2005-2016. *Can J Pub Heal.* 2017;107(6):e586-e589.	5
2016	Chile	Aguilar-Farías N, Cortínez A, Leppe-Zamora J, et al. [Chile's report card on physical activity: contributing to a global initiative for more active children and adolescents]. *Rev Med Chil.* 2016;144(2):267-8.	1
2016	Chile	Aguilar-Farias N, Cortinez-O'Ryan A, Sadarangani KP, et al. Results From Chile's 2016 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal.* 2016;13(11 Suppl 2):S117-S123.	16
2016	China	Liu Y, Tang Y, Cao Z-B, et al. Results From Shanghai's (China) 2016 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal.* 2016;13(11 Suppl 2):S124-S128.	25

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Year	Country	Reference of Articles related	Citation count
2016	Colombia	González SA, Castiblanco MA, Arias-Gómez LF, et al. Results From Colombia's 2016 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal*. 2016;13(11 Suppl 2):S129-S136.	20
2016	Denmark	Larsen LR, Troelsen J, Kirkegaard KL, et al. Results From Denmark's 2016 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal*. 2016;13(11 Suppl 2):S137-S142.	6
2016	England	Wilkie H, Standage M, Sherar L, et al. Results From England's 2016 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal*. 2016;13(11 Suppl 2):S143-S149.	6
2016	Estonia	Kruusamäe H, Kull M, Mooses K, et al. Results From Estonia's 2016 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal*. 2016;13(11 Suppl 2):S150-S156.	5
2016	Finland	Tammelin TH, Aira A, Hakamäki M, et al. Results From Finland's 2016 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal*. 2016;13(11 Suppl 2):S157-S164.	20
2016	France	Aucouturier J, Ganière C, Aubert S, et al. Results From the First French Report Card on Physical Activity for Children and Adolescents (2016). *J Phys Act Heal*. April 2017:1-14.	2
2016	Ghana	Ocansey R, Aryeetey R, Sofo S, et al. Results From Ghana's 2016 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal*. 2016;13(11 Suppl 2):S165-S168.	3
2016	Global	Tremblay MS, Barnes JD, González SA, et al. Global Matrix 2.0: Report Card Grades on the Physical Activity of Children and Youth Comparing 38 Countries. *J Phys Act Heal*. 2016;13(11 Suppl 2):S343-S366.	144
2016	Global	Tremblay MS, Gonzalez SA, Katzmarzyk PT, et al. Physical activity report cards: Active Healthy Kids Global Alliance and The Lancet Physical Activity Observatory. *J Phys Act Heal*. 2015;12(3):297-8.	9
2016	Global	Tremblay MS, Gonzalez SA, Katzmarzyk PT, et al. Introduction to the Global Matrix 2.0: Report Card Grades on the Physical Activity of Children and Youth Comparing 38 Countries. *J Phys Act Heal*. 2016;13(11 Suppl 2):S85-S86.	8
2016	Hong Kong	Huang WY, Wong SH-S, Wong MC-S, et al. Results From Hong Kong's 2016 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal*. 2016;13(11 Suppl 2):S169-S175.	9
2016	India	Katapally TR, Goenka S, Bhawra J, et al. Results From India's 2016 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal*. 2016;13(11 Suppl 2):S176-S182.	13
2016	Ireland	Harrington DM, Murphy M, Carlin A, et al. Results From Ireland North and South's 2016 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal*. 2016;13(11 Suppl 2):S183-S188.	5
2016	Japan	Tanaka C, Tanaka S, Inoue S, et al. Results From Japan's 2016 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal*. 2016;13(11 Suppl 2):S189-S194.	11
2016	Kenya	Onywera VO, Muthuri SK, Hayker S, et al. Results From Kenya's 2016 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal*. 2016;13(11 Suppl 2):S195-S200.	9
2016	Malaysia	Sharif R, Chong KH, Zakaria NH, et al. Results From Malaysia's 2016 Report Card on Physical Activity for Children and Adolescents. *J Phys Act Heal*. 2016;13(11 Suppl 2):S201-S205.	4
2016	Mexico	Galaviz KI, Arroyo MA, González-Casanova I, et al. Results From Mexico's 2016 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal*. 2016;13(11 Suppl 2):S206-S212.	8

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Year	Country	Reference of Articles related	Citation count
2016	Mozambique	Prista A, Daca T, Tchonga F, et al. Results From the Mozambique 2016 Report Card on Physical Activity for Children and Adolescents. *J Phys Act Heal.* 2016;13(11 Suppl 2):S213-S217.	5
2016	Netherlands	Burghard M, Knitel K, van Oost I, et al. Dutch Physical Activity Report Card Study Group. Is our Youth Cycling to Health? Results From the Netherlands' 2016 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal.* 2016;13(11 Suppl 2):S218-S224.	14
2016	New Zealand	Maddison R, Marsh S, Hinckson E, et al. Results From New Zealand's 2016 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal.* 2016;13(11 Suppl 2):S225-S230.	12
2016	Nigeria	Adeniyi AF, Odukoya OO, Oyeyemi AL, et al. Results From Nigeria's 2016 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal.* 2016;13(11 Suppl 2):S231-S236.	7
2016	Poland	Zembura P, Goldys A, Nalecz H. Results From Poland's 2016 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal.* 2016;13(11 Suppl 2):S237-S241.	6
2016	Portugal	Mota J, E Silva MJC, Raimundo AM, et al. Results From Portugal's 2016 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal.* 2016;13(11 Suppl 2):S242-S245.	12
2016	Qatar	Al-Kuwari MG, Ibrahim IA, Hammadi EM Al, et al. Results From Qatar's 2016 Active Healthy Kids Report Card on Physical Activity for Children and Youth. *J Phys Act Heal.* 2016;13(11 Suppl 2):S246-S250.	5
2016	Scotland	Reilly JJ, Johnstone A, McNeill G, et al. Results From Scotland's 2016 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal.* 2016;13(11 Suppl 2):S251-S255.	7
2016	Slovenia	Sember V, Starc G, Jurak G, et al. Results From the Republic of Slovenia's 2016 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal.* 2016;13(11 Suppl 2):S256-S264.	10
2016	South Africa	Uys M, Bassett S, Draper CE, et al. Results From South Africa's 2016 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal.* 2016;13(11 Suppl 2):S265-S273.	19
2016	South Korea	Song Y, Yang HI, Lee E-Y, et al. Results From South Korea's 2016 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal.* 2016;13(11 Suppl 2):S274-S278.	16
2016	Spain	Roman-Viñas B, Marin J, Sánchez-López M, et al. Results From Spain's 2016 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal.* 2016;13(11 Suppl 2):S279-S283.	9
2016	Sweden	Nyström CD, Larsson C, Ehrenblad B, et al. Results From Sweden's 2016 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal.* 2016;13(11 Suppl 2):S284-S290.	10
2016	Thailand	Amornsriwatanakul A, Nakornkhet K, Katewongsa P, et al. Results From Thailand's 2016 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal.* 2016;13(11 Suppl 2):S291-S298.	10
2016	United Arab Emirates	Zaabi MA, Shah SM, Sheek-Hussein M, et al. Results From the United Arab Emirates' 2016 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal.* 2016;13(11 Suppl 2):S299-S306.	7
2016	United States of America	Katzmarzyk PT, Denstel KD, Beals K, et al. Results From the United States of America's 2016 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal.* 2016;13(11 Suppl 2):S307-S313.	52
2016	Venezuela	Herrera-Cuenca M, Méndez-Perez B, Morales VC, et al. Results From Venezuela's 2016 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal.* 2016;13(11 Suppl 2):S314-S329.	9

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Year	Country	Reference of Articles related	Citation count
2016	Wales	Tyler R, Mannello M, Mattingley R, et al. Results From Wales' 2016 Report Card on Physical Activity for Children and Youth: Is Wales Turning the Tide on Children's Inactivity? *J Phys Act Heal.* 2016;13(11 Suppl 2):S330-S336.	7
2016	Zimbabwe	Manyanga T, Makaza D, Mahachi C, et al. Results From Zimbabwe's 2016 Report Card on Physical Activity for Children and Youth. *J Phys Act Heal.* 2016;13(11 Suppl 2):S337-S342.	6
2017	Japan	Tanaka C, Abe T, Okada S, et al. Comparison of Indicators for Physical Activity in Primary School and Junior High School Students in 47 Prefectures – According to International Indicators Based on "REPORT CARD ON PHYSICAL ACTIVITY FOR CHILDREN AND YOUTH". *Res Exerc Epidemiol.* 2018;20(1):37-48.	0
2017	Netherlands	Burghard M, de Jong NB, Vliegers S, et al. 2017 Dutch Report Card^{+} : Results From the First Physical Activity Report Card Plus for Dutch Youth With a Chronic Disease of Disability. *Front Pediatr. 2018*;6:122.	0
2018	Australia	Schranz N, Glennon V, Evans J, et al. Results from Australia's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S315-S317 Aguilar-Farias N, Miranda-Marquez S, Sadarangani KP, et al. Results from Chile's 2018 Report	1
2018	Bangladesh	Khan A, Kadir MA, Choudhury SR, et al. Results from Bangladesh's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S318-S319.	1
2018	Belgium	Seghers J, De Baere S, Verloigne M, et al. Results from Flanders' 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S357-S359.	1
2018	Botswana	Tladi DM, Monnaatsie M, Shaibu S, et al. Results from Botswana's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S320-S322.	2
2018	Brazil	Silva DAS, Christofaro DGD, Ferrari GL de M, et al. Results from Brazil's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S323-S325.	3
2018	Brazil	Silva DA, Tremblay MS.It's time to take care of Brazilian children and adolescents. *Rev. Bras. Cineantropom. Desempenho Hum.* 2018;20(4):363-366.	0
2018	Brazil	Filho VC, da Costa RM, Knebel MT, et al. The prevalence of global physical activity among young people: a systematic review for the Report Card Brazil 2018. *Rev. Bras. Cineantropom. Desempenho Hum.*. 2018;20(4):367-387.	0
2018	Brazil	Maillane-Vanegas S, Codogno JS, Turi BC, et al. Prevalence of sports participation among Brazilian adolescents: a systematic review. *Rev. Bras. Cineantropom. Desempenho Hum.* 2018;20(4):388-394.	0
2018	Brazil	Ferrari GL, de Victo ER, Ferrari TK, et al. Active transportation to school for children and adolescents from Brazil: a systematic review. *Rev. Bras. Cineantropom. Desempenho Hum.* 2018;20(4):406-414.	0
2018	Brazil	da Silva KS, Bandeira AS, dos Santos PC, et al. Systematic review of childhood and adolescence sedentary behaviour: analysis of the Report Card Brazil 2018. *Rev. Bras. Cineantropom. Desempenho Hum.* 2018;20(4):415-445.	0
2018	Brazil	Gonçalves EC, Bandeira AS, dos Santos PC, et al. Prevalence of Brazilian children and youth who meet health criteria for cardiorespiratory fitness: systematic review. *Rev. Bras. Cineantropom. Desempenho Hum.* 2018;20(4):446-471.	0

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Year	Country	Reference of Articles related	Citation count
2018	Brazil	Batista KR, Couto JO, de Oliveira MG, et al. Flexibility in Brazilian children and adolescents: a systematic review. *Rev. Bras. Cineantropom. Desempenho Hum.* 2018;20(4):472-482.	0
2018	Brazil	Davoli GB, Lima LR, Silva DA. Abdominal muscular endurance in Brazilian childrena dn adolescents: a systematic review of cross-sectional studies. *Rev. Bras. Cineantropom. Desempenho Hum.* 2018;20(4):483-496.	0
2018	Brazil	De Lima TR, Moraes MS, Martins PC, et al. Diversity of parameters in the muscle strength evaluation of Brazilian school children and adolescents: a systematic review. *Rev. Bras. Cineantropom. Desempenho Hum.* 2018;20(4):497-516.	0
2018	Brazil	Simões CF, Lopes WA, Remor JM, et al. Prevalence of weight excess in Brazilian children and adolescents: a systematic review. *Rev. Bras. Cineantropom. Desempenho Hum.* 2018;20(4):517-531.	0
2018	Brazil	Tebar WR, Oliveira CB, Gil FC, et al. Physical activity of parents and of their children: a systematic review of Brazilian sample studies – Report Card Brazil. *Rev. Bras. Cineantropom. Desempenho Hum.* 2018;20(4):532-542.	0
2018	Brazil	Manta SW, da Silva KS, Minatto G, et al. Community and environment for physical activity among young people: a systematic review of the Report Card Brazil 2018. *Rev. Bras. Cineantropom. Desempenho Hum.* 2018;20(4):543-562.	0
2018	Brazil	Mendes AA, Lopes WA, Locateli JC, et al. The prevalence of Active Play in Brazilian children and adolescents: a systematic review. *Rev. Bras. Cineantropom. Desempenho Hum.* 2018;20(4):395-405.	0
2018	Bulgaria	Mileva B. Results from Bulgaria's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S326-S327.	2
2018	Canada	Barnes JD, Cameron C, Carson V, et al. Results from Canada's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S328-S330.	2
2018	Chile	Aguilar-Farias N, Miranda-Marquez S, Sadarangani KP, et al. Results from Chile's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S274-S283.	1
2018	China	Liu Y, Tang Y, Cao Z-B, et al. Results from China's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S331-S332.	2
2018	Colombia	González SA, Triana CA, Abaunza C, et al. Results from Colombia's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S333-S334.	2
2018	Czech Republic	Gába A, Rubín L, Badura P, et al. Results from the Czech Republic's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S338-S340.	3
2018	Denmark	Nørager Johansen DL, Neerfeldt Christensen BF, Fester M, et al. Results from Denmark's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S341-S343.	1
2018	Ecuador	Andrade S, Ochoa-Aviles A, Freire W, et al. Results from Ecuador's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S344-S346.	1
2018	England	Standage M, Sherar L, Curran T, et al. Results from England's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S347-S349.	1

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Year	Country	Reference of Articles related	Citation count
2018	Estonia	Mäestu E, Kull M, Mooses K, et al. Results from Estonia's 2018 Report Card on Physical Activity for Children and Youth. J Phys Act Health. 2018;15(S2):S350-S352.	2
2018	Ethiopia	Abdeta C, Teklemariam Z, Deksisa A, et al. Results from Ethiopia's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S353-S354.	2
2018	Finland	Kämppi K, Aira A, Halme N, et al. Results from Finland's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health. 2018*;15(S2):S355-S356.	2
2018	France	Aubert S, Aucouturier J, Ganière C, et al. Results from France's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S360-S362.	2
2018	Germany	Demetriou Y, Hebestreit A, Reimers AK, et al. Results from Germany's 2018 Report Card on Physical Activity for Children and Youth. I. 2018;15(S2):S363-S365.	2
2018	Ghana	Nyawornota VK, Luguterah A, Sofo S, et al. Results from Ghana's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S366-S367.	2
2018	Global	Aubert S, Barnes JD, Abdeta C, et al. Global Matrix 3.0 Physical Activity Report Card Grades for Children and Youth: Results and Analysis from 49 Countries. *J Phys Act Health*. 2018;15(S2):S251-S273.	10
2018	Global	Aubert S, Barnes JD, Forse M, et al. International Impact of the Report Cards and Global Matrices of Physical Activity Grades for Children and Youth. *J Phys Act Health*. 2018;(this issue).	N/A
2018	Guernsey	Williams A, Whitman L, Le Page Y, et al. Results from the Bailiwick of Guernsey's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S368-S369.	1
2018	High HDI countries	González SA, Barnes JD, Abi Nader P, et al. Report Card Grades on the Physical Activity of Children and Youth from 10 Countries with High Human Development Index – Global Matrix 3.0. *J Phys Act Health*. 2018;15(S2):S284-S297.	2
2018	Hong Kong	Huang WY, Wong SHS, Sit CHP, et al. Results from Hong Kong's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S370-S372.	2
2018	India	Bhawra J, Chopra P, Harish R, et al. Results from India's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S373-S374.	2
2018	Japan	Tanaka C, Tanaka S, Inoue S, et al. Results From Japan's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S375-S376.	1
2018	Jersey	Scriven J, Cabot J, Mitchell D, et al. Results from Jersey's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S377-S378.	1
2018	Lebanon	Abi Nader P, Majed L, Sayegh S, et al. Results from Lebanon's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S379-S381.	1
2018	Lithuania	Emeljanovas A, Mieziene B, Gruodyte-Raciene R, et al. Results from Lithuania's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S382-S383.	0
2018	Mexico	Galaviz KI, Argumedo Garcia G, Gaytán-González A, et al. Results from Mexico's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S384-S385.	1

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Year	Country	Reference of Articles related	Citation count
2018	Mid and Low HDI countries	Manyanga T, Barnes JD, Abdeta C, et al. The Indicators of Physical Activity among Children and Youth in Nine Countries with Low and Medium Human Development Indices: A Global Matrix 3.0 Paper. *J Phys Act Health* 2018;15(S2):S274-S283.	3
2018	Nepal	Subedi N, Paudel S, Nepal S, et al. Results from Nepal's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S386-S387.	2
2018	Netherlands	Takken T, de Jong N. Results from the Netherlands's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S388-S389.	2
2018	New Zealand	Smith M, Ikeda E, Hinckson E, et al.Results from New Zealand's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S390-S392.	2
2018	Nigeria	Akinroye KK, Adeniyi AF. Results from Nigeria's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S393-S394.	2
2018	Poland	Zembura P, Korcz A, Cieśla E, et al. Results from Poland's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S395-S397.	1
2018	Portugal	Mota J, Santos R, Coelho-e-Silva MJ, et al. Results from Portugal's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S398-S399.	1
2018	Qatar	Ibrahim I, Al Hammadi E, Sayegh S, et al. Results from Qatar's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S400-S401.	2
2018	Scotland	Hughes AR, Johnstone A, Bardid F, et al. Results from Scotland's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S402-S403.	1
2018	Slovenia	Sember V, Morrison SA, Jurak G, et al. Results from Slovenia's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S404-S405.	2
2018	South Africa	Draper CE, Tomaz SA, Bassett SH, et al. Results from South Africa's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S406-S408. Manyanga T, Munambah NE, Mahachi CB, Makaza D, Mlalazi TF. Results from Zimbabwe's 2018 Report Card on Physical Activity for Children and Youth. J Phys Act Health. 2018;(this issue).	3
2018	South Korea	Oh J-WJ-W, Lee E, Lim J, et al. Results from South Korea's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S409-S410.	2
2018	Spain	Roman-Viñas B, Zazo F, Martínez-Martínez J, et al. Results from Spain's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S411-S412.	3
2018	Sweden	Delisle Nyström C, Larsson C, Alexandrou C, et al. Results from Sweden's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S413-S414.	1
2018	Taiwan	Chang C-K, Wu C-L. Results from Chinese Taipei (Taiwan)'s 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S415-S416.	1
2018	Thailand	Saonuam P, Rasri N, Pongpradit K, et al. Results from Thailand's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S417-S418.	2

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Year	Country	Reference of Articles related	Citation count
2018	Ukraine	Mandiuk A. Levels of involvement of children and adolescents in various forms of motor activity in Ukraine and member countries Active Healthy Kids Global Alliance. *Slobozhanskyi Herald of Science and Sport.* 2018;3(65):40-44.	0
2018	United Arab Emirates	Paulo MS, Nauman J, Abdulle A, et al. Results from the United Arab Emirates' 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S419-S421.	2
2018	United States	Katzmarzyk PT, Denstel KD, Beals K, et al. Results from the United States 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S422-S424.	4
2018	Uruguay	Brazo-Sayavera J, Del Campo C, Rodriguez MJ et al. Results from Uruguay's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2018;15(S2):S425-S426.	2
2018	Venezuela	Herrera-Cuenca M, Méndez-Pérez B, Landaeta-Jiménez M, et al. Results from Venezuela's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health.* 2018;15(S2):S427-S429.	2
2018	Very High HDI countries	Aubert S, Barnes JD, Aguilar-Farias N, et al. Report Card Grades on the Physical Activity of Children and Youth Comparing 30 Very High Human Development Index Countries. *J Phys Act Health*. 2018;15(S2):S298-S314.	2
2018	Wales	Edwards LC, Tyler R, Blain D, et al. Results from Wales' 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health.* 2018.15(S2):S430-S432.	2
2018	Zimbabwe	Manyanga T, Munambah NE, Mahachi CB, et al. Results from Zimbabwe's 2018 Report Card on Physical Activity for Children and Youth. *J Phys Act Health.* 2018;15(S2):S433-S435.	2
2019	Asia	Tomkinson GR, Wong SH. Global Matrix 3.0 – An introduction to the report cards on the physical activity for children and youth from five Asian countries and regions. *J Exerc Sci Fit.* 2019;17(1):3-7.	0
2019	China	Liu Y, Tang Y, Cao ZB, et al. Results from China's 2018 Report Card on physical activity for children and youth. *J Exerc Sci Fit*. 2019;17(1):3-7.	1
2019	Czech Republic	Gába A, Rubín L, Sigmund E, et al. Executive summary of the Czech Republic's 2018 Report Card on Physical Activity for Children and Youth. *Acta Gymnica*. Published Online: May 26, 2019 (DOI: 10.5507/ag.2019.007)	0
2019	Germany	Demetriou Y, Bucksch J, Hebestreit A, et al. Germany's 2018 report card on physical activity for children and youth. *Ger J Exerc Sport Res*. 2019;49(188):1-14.	0
2019	Hong Kong	Huang WY, Wong SH, Sit CHP, et al. Results from the Hong Kong's 2018 Report Card on physical activity for children and youth. *J Exerc Sci Fit*. 2019;17(1):14-19.	1
2019	Japan	Tanaka C, Tanaka S, Inoue S, et al. Results from Japan's 2018 Report Card on physical activity for children and youth. *J Exerc Sci Fit.* 2019;17(1):20-25.	1
2019	Lebanon	Abi Nader P, Majed L, Sayegh S, et al. First Physical Activity Report Card for Children and Youth in Lebanon. *J Phys Act Health*. 2019;16(6): 385-396.	0
2019	South Korea	Oh JW, Lee E-Y, Lim JJ, et al. Results from South Korea's 2018 Report Card on physical activity for children and youth. *J Exerc Sci Fit*. 2019;17(1):26-33.	1
2019	Taiwan	Wu CL, Chang CK. Results from the Chinese Taipei (Taiwan) 2018 Report Card on physical activity for children and youth. *J Exerc Sci Fit*. 2019;17(1):8-13	1

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Online Supplementary File 3: Conference presentations related to the Report Cards or Global Matrices, ordered by year and country name.

Type of presentation	Country/ Region	Lead Author	Year	Event	Title
Oral (presentation)	Scotland	Reilly JJ.	2013	Children in Scotland Conference	Seminar on the 2013 Scottish Card
Oral (presentation)	Scotland	Reilly JJ.	2013	Inspiring Scotland/The Robertson Trust Workshop on Physical Activity and Active Play	Seminar on the 2013 Scottish Card
Oral (presentation)	Scotland	Reilly JJ.	2013	Scottish Government CPD Series	Seminar on the 2013 Scottish Card
Poster	Australia	Tomkinson G.	2014	Global Summit on the Physical Activity of Children	Is Sport Enough?
Oral (presentation)	Canada	Tremblay MS.	2014	Global Summit on the Physical Activity of Children	The Active Healthy Kids Canada Report Card on the Physical Activity of Children and Youth: Results and learnings from 10 years of powering the movement to get kids moving
Poster	Canada	Tremblay MS.	2014	Global Summit on the Physical Activity of Children	Is Canada in the Running?
Poster	Colombia	González SA.	2014	Global Summit on the Physical Activity of Children	Report Card on Physical Activity for Children and Youth, Colombia 2014
Oral (presentation)	Colombia	González S.	2014	National Obesity Conference - Colombian Obesity Foundation	First Report Card on Physical Activity for Children and Youth in Colombia
Oral (presentation)	Colombia	González S.	2014	Physical Activity Policy Course - Administrative Department of Sports - Coldeportes	The Report Card on Physical Activity as an advocacy tool
Poster	England	Wilkie HJ.	2014	Global Summit on the Physical Activity of Children	Results from England's 2014 Report Card on Physical Activity for Children and Youth
Poster	Finland	Liukkonen J.	2014	Global Summit on the Physical Activity of Children	Finnish Report Card 2014 on Physical Activity for Children and Youth
Poster	Ghana	Ocansey R.	2014	Global Summit on the Physical Activity of Children	Ghanian 2014 Report Card on Physical Activity for Children and Youth
Oral (keynote)	International	Tremblay MS.	2014	III Encontro Brazil Canada and I Congresso International de Tratamento da Obesidade	Making movement a movement: A contemporary imperative
Oral (presentation)	International	Tremblay MS.	2014	III Encontro Brazil Canada and I Congresso International de Tratamento da Obesidade	Lessons learned from around the world for promoting healthy active living: What, when, where and how?

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Type of presentation	Country/ Region	Lead Author	Year	Event	Title
Oral (presentation)	International	Tremblay MS.	2014	25th Congress of the Nutrition Society of South Africa and 13th Congress of the Association for Dietetics in South Africa	Active Healthy Kids Kenya and the KIDS-CAN Alliance: What Africa can teach the world
Oral (keynote)	International	Tremblay MS.	2014	Global Summit on the Physical Activity of Children	Unveiling the Global Matrix: A comparison of childhood physical activity across 15 countries
Panel Discussion	International	Tomkinson G., Reilly J., Onywera V., Katzmarzyk P., González SA.	2014	Global Summit on the Physical Activity of Children	Leading or Lagging? Global insights for "improving the grade"
Oral (presentation)	International	Tremblay MS.	2014	JOINDAF Conference	A comparison of childhood physical activity across 15 countries
Poster	Ireland	Belton S., Murphy M.	2014	Global Summit on the Physical Activity of Children	Results from Ireland's 2014 Report Card on Physical Activity in Children and Youth
Poster	Kenya	Onywera V.	2014	Global Summit on the Physical Activity of Children	Results from Kenya's 2014 Report Card on the Physical Activity and Body Weight of Children and Youth
Poster	Mexico	Galaviz KI.	2014	Global Summit on the Physical Activity of Children	The 2014 Mexican Report Card on Physical Activity for Children and Youth
Poster	Mozambique	Prista A.	2014	Global Summit on the Physical Activity of Children	Report Card for Healthy Active Children - Mozambique
Poster	New Zealand	Maddison R.	2014	Global Summit on the Physical Activity of Children	Results from the New Zealand 2014 Report Card on Physical Activity for Children and Youth
Poster	Nigeria	Akinroye K.	2014	Global Summit on the Physical Activity of Children	Nigerian 2013 Report Card on Physical Activity for Children and Youth
Poster	Scotland	Reilly JJ.	2014	Global Summit on the Physical Activity of Children	Results from the Scottish Report Card on Physical Activity for Children and Youth
Oral (presentation)	Scotland	Reilly JJ.	2014	Scottish Teachers CPD Day	Seminar on the 2013 Card
Poster	South Africa	Lambert EV.	2014	Global Summit on the Physical Activity of Children	Healthy Active Kids South Africa Report Card 2014
Poster	United States	Katzmarzyk PT.	2014	Global Summit on the Physical Activity of Children	The 2014 United States Report Card on Physical Activity for Children and Youth
Oral (presentation)	Australia	Schranz N.	2015	Pediatric Work Physiology Meeting	2014 Australian Report Card Findings

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Poster	Australia	Schranz N.	2015	Pediatric Work Physiology Meeting	Focused on just the Sport indicator of the Report Card
Poster	Canada	Barnes JD.	2015	American College of Sports Medicine Annual Meeting	Assessing change in indicators of child and youth physical activity in Canada, 2005-2015.
Oral (presentation)	Colombia	González SA.	2015	Research Symposium on the promotion of fitness, lifestyles and cardiometabolic risks control among school aged children	Results of the first Report Card on Physical Activity and Health for Colombian Children
Oral (presentation)	International	Tremblay MS.	2015	XXIX Pediatric Work Physiology Meeting	Stand-up and take the next step in child health and exercise research: Journeying into unfamiliar territory
Oral (presentation)	International	Tremblay MS.	2015	XXIX Pediatric Work Physiology Meeting	Active Healthy Kids Report Cards
Poster	Australia	Schranz N., Tomkinson G.	2016	6th ISPAH Congress	2016 Report Card on Physical Activity for Children and Young People, Physical Literacy: Do our kids have all the tools?
Poster	Belgium	Wijtzes AI.	2016	6th ISPAH Congress	The 2016 Flemish Report Card on Physical Activity for Children and Youth
Poster	Brazil	Nardo N.	2016	6th ISPAH Congress	Results from Brazil's 2016 Report Card on the Physical Activity of Children and Youth
Poster	Canada	Tremblay MS.	2016	6th ISPAH Congress	Are Canadian Kids Too Tired to Move?
Oral (presentation)	Canada	Tremblay MS.	2016	Active Living Research Conference 2016	"The biggest risk is keeping kids indoors": 2015 ParticipACTION report card on physical activity for children and youth
Oral (presentation)	Canada	Barnes JD.	2016	Canadian Society for Exercise Physiology Annual Scientific Conference	Assessing change in indicators of child and youth physical activity in Canada, 2005-2016.
Oral (presentation)	Canada	LeBlanc AG.	2016	Ever Active Schools Conference	2015 ParticipACTION Report Card on Physical Activity for Children and Youth
Poster	Chile	Aguilar-Farias N.	2016	6th ISPAH Congress	Results from Chile's Report Card on the Physical Activity of Children and Youth
Poster	China	Liu Y.	2016	6th ISPAH Congress	Results from the 2016 Shanghai (China) Report Card on Physical Activity for Children and Youth

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Type of presentation	Country/ Region	Lead Author	Year	Event	Title
Oral (presentation)	Colombia	González SA.	2016	6th ISPAH Congress	Physical activity among Colombian Children: Moving from Policy to Action - As part of the symposium: Childhood Physical Activity: An exploration across countries at different stages of development.
Poster	Colombia	González SA.	2016	6th ISPAH Congress	Results from Colombia's 2016 Report Card on Physical Activity for Children and Youth
Oral (presentation)	Colombia	González SA.	2016	Colombian Obesity Congress	Results of the Second Report Card on the Physical Activity of Colombian Children and Youth. Physical activity and Sports as a path for peace.
Oral (presentation)	Colombia	González SA.	2016	First Summit on Physical Activity Governmental Programs in the Americas	Results of the Second Report Card on the Physical Activity of Colombian Children and Youth. Physical activity and Sports as a path for peace.
Poster	Colombia	González SA.	2016	Research Day School of Medicine, Universidad de los Andes	Results of the Second Report Card on the Physical Activity of Colombian Children and Youth. Physical activity and Sports as a path for peace.
Oral (presentation)	Colombia	González SA.	2016	Research Symposium on the promotion of fitness, lifestyles and cardiometabolic risks control among school aged children	Results of the Second Report Card on the Physical Activity of Colombian Children and Youth. Physical activity and Sports as a path for peace.
Poster	Denmark	Larsen LR.	2016	6th ISPAH Congress	Results from the Danish 2016 Report Card on Physical Activity for Children and Youth
Poster	England	Wilkie HJ.	2016	6th ISPAH Congress	The 2016 Active Healthy Kids England Report Card of Physical Activity for Children and Young People
Poster	Estonia	Jürimäe J.	2016	6th ISPAH Congress	Results from Estonia's 2016 Report Card on Physical Activity of Children and Youth
Poster	Finland	Tammelin T.	2016	6th ISPAH Congress	Finland's Report Card 2016, Physical Activity for Children and Youth
Poster	Ghana	Ocansey R.	2016	6th ISPAH Congress	Results from Ghana's 2016 Report Card on Physical Activity of Children and Youth

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Poster	Hong Kong	Wong S.	2016	6th ISPAH Congress	Results from the Hong Kong's 2016 Report Card on Physical Activity for Children and Youth
Oral (presentation)	Hong Kong	Wong S.	2016	Summer School for Physical Education Teachers Conference 2016	Report Card – Its Relation to Assessment Literacy for PE Teachers
Poster	India	Katapally TR.	2016	6th ISPAH Congress	Results from the India 2016 Report Card on Physical Activity for Children and Youth
Oral (keynote)	International	Tremblay MS.	2016	2nd International Conference on Physical Activity and Sports for Health and Development in Africa	Physical activity for health and development: Lessons Africa can give and take from the developed world
Oral (keynote)	International	Tremblay MS.	2016	6th ISPAH Congress	Global Matrix 2.0: International Results from 38 Countries
Oral (invited presentation)	International	Tremblay MS.	2016	Invited seminar presentation at the Physical Activity for Health Department, University of Strathclyde	Global Matrix 2.0: International results on childhood active transportation from 38 countries
Oral (invited presentation)	International	Tremblay MS.	2016	Invited presentation at the University of Stirling Visiting Lecturer Seminar Series	Making movement a movement: efforts from Canada to enhance childhood physical activity worldwide
Oral (invited presentation)	International	Tremblay MS.	2016	Invited presentation to the Thailand Report Card Research Committee	The Global Matrix 2.0, an initiative combining 38 country report card findings
Oral (invited presentation)	International	Tremblay MS.	2016	Invited presentation to the Thailand Report Card Research Committee	Strategies for optimizing advocacy and impact of the Thailand Report Card on Physical Activity for Children and Youth
Poster	Ireland	Belton S	2016	6th ISPAH Congress	The 2016 Ireland North and South Report Card on Physical Activity for Children and Youth
Poster	Japan	Tanaka C.	2016	6th ISPAH Congress	Results from the Japan 2016 Report Card on Physical Activity for Children and Youth
Oral (presentation)	Japan	Tanaka C.	2016	18th Scientific Meeting in Japanese Association of Exercise Epidemiology	The Active Healthy Kids Report Card for promoting physical activity in children and youth

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Oral (presentation)	Japan	Tanaka C.	2016	67th Conference of the Japanese Society of Physical Education, Health and Sports Sciences	Overview of The Japan 2016 Report Card on Physical Activity for Children and Youth
Poster	Kenya	Onywera V.	2016	6th ISPAH Congress	Results from Kenya's 2016 Report Card on Physical Activity of Children and Youth
Poster	Korea, Republic of	Jeon J.	2016	6th ISPAH Congress	2016 South Korea's Report Card on Physical Activity for Children and Youth
Poster	Malaysia	Sharif R.	2016	6th ISPAH Congress	Results from Malaysia's 2016 Report Card on Physical Activity of Children and Youth
Poster	Mozambique	Prista A.	2016	6th ISPAH Congress	Results from the Mozambique 2016 Report Card on Physical Activity for Children and Adolescents
Poster	Netherlands	Takken T.	2016	6th ISPAH Congress	Results from The Netherland's 2016 Report Card on Physical Activity of Children and Youth
Poster	New Zealand	Maddison R.	2016	6th ISPAH Congress	2016 New Zealand Physical Activity Report Card for Children and Youth
Poster	Nigeria	Adeniyi AF.	2016	6th ISPAH Congress	2016 Nigerian Report Card on Physical Activity for Children and Youth
Poster	Poland	Zembura P.	2016	6th ISPAH Congress	Results from Poland's 2016 Report Card on Physical Activity for Children and Youth
Poster	Portugal	Mota J.	2016	6th ISPAH Congress	Move for Fun-Be Active-Be Healthy
Poster	Qatar	Ibrahim I.	2016	6th ISPAH Congress	Development of Qatar Active Healthy Kids Report Card
Poster	Scotland	Reilly JJ.	2016	6th ISPAH Congress	Results from Scotland's 2016 Report Card on Physical Activity of Children and Youth
Oral (presentation)	Scotland	Reilly JJ.	2016	Annual Play Scotland Conference	Seminar on active play from the 2016 Scottish Card
Oral (presentation)	Scotland	Reilly JJ.	2016	Scottish Parliament Information Centre Annual Knowledge Exchange Day	Seminar on the 2016 Scottish Card
Oral (presentation)	Scotland	Hughes A.	2016	Scottish Physical Activity Research Connections National Conference	Seminar on the 2016 Scottish Card

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Poster	Slovenia	Sember V.	2016	6th ISPAH Congress	2016 Report Card on Physical Activity in Slovenia
Poster	South Africa	Lambert EV.	2016	6th ISPAH Congress	Results from South Africa's 2016 Report Card on Physical Activity of Children and Youth
Poster	Spain	Roman-Viñas B.	2016	6th ISPAH Congress	Results from the Spanish 2016 Report Card on Physical Activity for Children and Youth
Poster	Sweden	Eriksson U.	2016	6th ISPAH Congress	The Sweden Report Card on Physical Activity for Children and Youth 2016
Poster	Thailand	Amornsriwatanakul A.	2016	6th ISPAH Congress	Thailand 2016 Report Card on Physical Activity for Children and Youth (2016 TRC)
Poster	United Arab Emirates	Al Zaabi M.	2016	6th ISPAH Congress	Results from the Active Healthy Kids, United Arab Emirates 2016 Report Card on Physical Activity for Children and Youth
Poster	United States	Katzmarzyk PT.	2016	6th ISPAH Congress	Results from United States 2016 Report Card on Physical Activity of Children and Youth
Poster	Venezuela	Herrera M.	2016	6th ISPAH Congress	Results from Venezuela's 2016 Report Card on Physical Activity of Children and Youth
Poster	Wales	Stratton G.	2016	6th ISPAH Congress	Is Wales Turning the Tide on Children's Inactivity? Active Healthy Kids Wales Report Card 2016
Oral (presentation)	Zimbabwe	Manyanga T.	2016	6th ISPAH Congress	Zimbabwe Physical Activity Report Card for Children and Youth: Challenges, Opportunities, and Lessons Learned from the Global Matrix 2.0
Poster	Zimbabwe	Manyanga T., Makaza D.	2016	6th ISPAH Congress	Results from Zimbabwe's 2016 Report Card on the Physical Activity for Children and Youth
Oral (presentation)	Australia	Schranz N.	2017	Health and Physical Education Curriculum Leaders Forum	Physical Activity of Children and Youth in Australia: Do Our Kids Have All the Tools?
Oral (presentation)	Australia	Schranz N.	2017	Recreation SA and Sport and Leisure Conference	2016 Australian Report Card findings

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Poster	Belgium	Cloes M.	2017	12th European Congress of The Fédération Internationale d'Éducation Physique	Active Healthy Kids Belgium 2016 Report Card on Physical Activity for Children and Youth
Poster	Belgium	Cloes M.	2017	22nd Annual congress of the European College of Sport Science ECSS MetropolisRuhr	Active Healthy Kids Belgium 2016 Report Card on Physical Activity for Children and Youth
Poster	Belgium	Cloes M.	2017	2017 AIESEP International Conference	Active Healthy Kids Belgium 2016 Report Card on Physical Activity for Children and Youth
Oral (presentation)	Belgium	Cardon G.	2017	CIAPSE 2 - Children's Physical Activity and Sport	Active Healthy Kids Belgium 2016 Report Card on Physical Activity for Children and Youth
Oral (presentation)	Belgium	Cardon G.	2017	International Obesity Conference	Active Healthy Kids Belgium 2016 Report Card on Physical Activity for Children and Youth
Oral (presentation)	Belgium	Cardon G.	2017	International Obesity Conference	The promotion of more PA and less SB in Children: Why and how? Belgian PA Report Cards
Oral (presentation)	Denmark	Larsen LR.	2017	Children, Youth and Movement: From Policy to Practice	The international Active Healthy Kids Global Alliance network
Oral (presentation)	Denmark	Skovgaard T.	2017	Children, Youth and Movement: From Policy to Practice	Children, youth and physical activity: Political priorities and investments
Oral (presentation)	Denmark	Troelsen J.	2017	Children, Youth and Movement: From Policy to Practice	Environmental surroundings: School, family, friends and the physical surroundings
Oral (presentation)	Denmark	Kristensen PL.	2017	Children, Youth and Movement: From Policy to Practice	Physical activity and sedentary behaviour
Oral (presentation)	Denmark	Østergaard L.	2017	Children, Youth and Movement: From Policy to Practice	Active transportation
Oral (presentation)	Denmark	Lyck L.	2017	Children, Youth and Movement: From Policy to Practice	Organized sports participation
Poster	Estonia	Kull M.	2017	CIAPSE 2 - Children's Physical Activity and Sport	Results from the Estonian 2016 Report Card on Physical Activity for Children and Youth.
Poster	Finland	Tammelin T.	2017	CIAPSE2 – Children's physical activity and sport	Finland's 2016 Report Card on Physical Activity for Children and Youth
Oral (presentation)	Hong Kong	Wong S.	2017	2017 Chulalongkorn Asian Heritage Forum: Culture of Leisure – Balance of Life	Leisure-time Physical Activity and Sedentary Behaviour in Schoolchildren

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Type of presentation	Country/ Region	Lead Author	Year	Event	Title
Oral (presentation)	Hong Kong	Wong S.	2017	2017 International Conference on Physical Activity and Exercise Science	2016 Hong Kong Report Card on Physical Activity for Children
Oral (presentation)	International	Tremblay MS.	2017	10th Anniversary Pennington Biomedical Research Center Childhood Obesity and Public Health Conference: Making the Grade – impact of public health report cards on physical activity and obesity	Active Healthy Kids Global Alliance: Global Matrix Initiative
Poster	International	Aubert S.	2017	Canadian Global Health Student and Young Professional Summit	Evidence of Impact of Active Healthy Kids Global Alliance Report Cards
Oral (keynote)	International	Tremblay MS.	2017	German Association of Sports Science Conference: Innovation & Technology in Sport	Innovation, technology and childhood healthy active living: moving forward by looking back
Oral (presentation)	International	Tremblay MS.	2017	Il Foro Universitatrio en Actividad Fisca y Salud: Movilidad urbana no motorizada / ciciovias	Global Matrix 2.0: International results on childhood active transportation from 38 countries
Oral (symposium)	International	Manyanga T	2017	ISBNPA 2017 Annual Meeting	Highlights of report card grades on the physical activity of children and youth in low-income countries
Oral (symposium)	International	Katapally TR	2017	ISBNPA 2017 Annual Meeting	Highlights of report card grades on the physical activity of children and youth in middle-income countries
Oral (symposium)	International	Seghers J	2017	ISBNPA 2017 Annual Meeting	Highlights of report card grades on the physical activity of children and youth in high-income countries
Oral (invited presentation)	International	Tremblay MS.	2017	Invited presentation at the release of the Mexican Report Card on the Physical Activity of Children and Youth	Global Matrix 2.0: International results from 38 countries
Oral (invited presentation)	International	Tremblay MS.	2017	Invited presentation at the Universidade Pedagogica	Global Matrix 2.0: International Results on Childhood Physical Activity from 38 Countries
Oral (invited presentation)	International	Tremblay MS.	2017	Invited presentation to the United States Report Card on Physical Activity for Children and Youth Research Advisory Committee	History of the Report Card Project and the Active Healthy Kids Global Alliance

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Type of presentation	Country/ Region	Lead Author	Year	Event	Title
Oral (keynote)	International	Tremblay MS.	2017	Jersey Sport Foundation Conference 2017	Making Movement and Movement: A contemporary imperative
Oral (presentation)	Japan	Tanaka C.	2017	25th Annual Meeting of Japan Society of Exercise and Sports Physiology	Current status and issues of physical activity of Japanese children and youth from The Report Card on Physical Activity for Children and Youth
Oral (presentation)	Scotland	Reilly JJ.	2017	Annual Scottish Public Health Conference	Keynote on the 2016 Scottish Card
Oral (presentation)	Scotland	Reilly JJ.	2017	Scottish Government CPD Seminars	Presentation of the 2016 Scottish Card
Oral (presentation)	Wales	Tyler R., Edwards L.	2017	Public Health Wales Conference	Is Wales Turning the Tide on Children's Inactivity? Active Healthy Kids Wales Report Card 2016
Oral (presentation)	Africa	Tremblay MS.	2018	IC-PASHDA 2018	Physical activity, economic development and obesity in Africa: Insights from the Global Matrix 2.0
Poster	Australia	Schranz N.	2018	2018 ACHPER (SA) Health and PE Conference	Children and HPE: What the data say and what the children tell us
Oral (presentation)	Australia	Schranz N.	2018	2018 PDHPE K-10 Conference: *The State of Play in PDHPE K-10*	Children, Physical Activity and HPE: Data, Children's Voice, and Connection with Curriculum
Oral (presentation)	Australia	Stylianou M.	2018	Association of Independent Schools NSW: Heads of Sport Conference	Physical Activity & Sport: Data and Children and Young People's Voice
Oral (presentation)	Australia	Schranz N.	2018	Movement to Move	Launch of Active Healthy Kids Australia Report Card on Physical Activity for Children and Young People
Poster	Australia	Schranz N.	2018	Movement to Move	Results from the 2018 Active Healthy Kids Australia Report Card on Physical Activity for Children and Young People
Poster	Bangladesh	Khan A.	2018	Movement to Move	Results from the 2018 Active Healthy Kids Bangladesh Report Card on Physical Activity for Children and Youth
Poster	Belgium	Seghers J.	2018	Movement to Move	Results from Flanders' 2018 Report Card on Physical Activity for Children and Youth
Oral (presentation)	Belgium	Cardon G.	2018	Symposium Shanghai University of Sports	Results from Belgium's report cards on PA in children and youth

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Type of presentation	Country/ Region	Lead Author	Year	Event	Title
Poster	Botswana	Tladi D.	2018	Movement to Move	Results from Botswana's 2018 Report Card on Physical Activity for Children and Youth
Poster	Brazil	Silva DA.	2018	Movement to Move	Results from Brazil's 2018 Report Card on Physical Activity for Children and Youth
Poster	Bulgaria	Mileva B.	2018	Movement to Move	Results from Bulgaria's 2018 Report Card on Physical Activity for Children and Youth
Poster	Canada	Aubert S.	2018	4th Annual Canadian Global Health Students and Young Professionals Summit	International Impact of the Report Cards and Global Matrices of Physical Activity Grades for children and youth
Poster	Canada	Aubert S.	2018	Active Living Research Conference 2018	Evidence of Impact of Active Healthy Kids Global Alliance Report Cards (international)
Poster	Canada	Tremblay MS.	2018	Annual Scientific Conference of the Canadian Society of Exercise Physiology	Results from Canada's 2018 Report Card on Physical Activity for Children and Youth
Poster	Canada	Barnes JD.	2018	Movement to Move	Results from Canada's 2018 Report Card on Physical Activity for Children and Youth
Poster	Chile	Aguilar-Farias N.	2018	Movement to Move	Results from Chile's 2018 Report Card on Physical Activity for Children and Youth
Oral (symposium)	China	Liu Y.	2018	ISBNPA 2018 Annual Meeting	Results from China Report Card on Physical Activity for Children and Youth
Poster	China	Liu Y.	2018	Movement to Move	Results from China's 2018 Report Card on Physical Activity for Children and Youth
Poster	Chinese Taipei	Chang CK.	2018	Movement to Move	Results from Chinese Taipei (Taiwan)'s 2018 Report Card on Physical Activity for Children and Youth
Poster	Colombia	González SA.	2018	Movement to Move	Results from Colombia's 2018 Report Card on Physical Activity for Children and Youth
Poster	Czech Republic	Gába A.	2018	Movement to Move	Results from the Czech Republic's 2018 Report Card on Physical Activity for Children and Youth

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Type of presentation	Country/ Region	Lead Author	Year	Event	Title
Poster	Denmark	Skovgaard T.	2018	Movement to Move	The Danish 2018 Report Card on Physical Activity for Children and Youth
Poster	Ecuador	Andrade S.	2018	Movement to Move	Results from Ecuador's 2018 Report Card on Physical Activity for children and youth
Poster	England	Standage M.	2018	Movement to Move	Results from England's 2018 Report Card on Physical Activity for Children and Youth
Poster	Estonia	Jürimäe J.	2018	Movement to Move	Results from Estonia's 2018 Report Card on Physical Activity for Children and Youth
Poster	Ethiopia	Abdeta C.	2018	Movement to Move	Ethiopia 2018 Report Card on Physical Activity for Children and Youth
Poster	Finland	Kämppi K.	2018	Movement to Move	Finland's 2018 Report Card on Physical Activity for Children and Youth
Poster	France	Aubert S.	2018	Movement to Move	Results from France's 2018 Report Card on Physical Activity for Children and Youth
Poster	Germany	Demetriou Y.	2018	Movement to Move	Results from Germany's 2018 Report Card on Physical Activity for Children and Youth
Oral (presentation)	Ghana	Nyawornota VK.	2018	College of Education, University of Ghana 70th Anniversary Colloquium	2016 Report Card of Physical Activity Levels of Children and Youth in Canada
Oral (presentation)	Ghana	Nyawornota VK.	2018	IC-PASHDA 2018	Report Card of Physical Activity Levels of Children and Youth in Ghana
Oral (presentation)	Ghana	Ocansey RT.	2018	Launching of the 2018 RC on PA levels of children and youth in Ghana	Childhood physical inactivity reaches crisis levels around the globe: The Ghana RC says 70% of children and youth have failing PA grades
Poster	Ghana	Nyawornota VK.	2018	Movement to Move	Results from Ghana's 2018 Report Card on Physical Activity for Children and Youth
Poster	Guernsey	Williams A.	2018	Movement to Move	A Golden Opportunity: The Bailiwick of Guernsey Report Card 2018
Oral (presentation)	High HDI	González SA.	2018	Movement to Move	Report Card Grades on the Physical Activity of Children and Youth From 10 Countries with High Human Development Index: Global Matrix 3.0

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Type of presentation	Country/ Region	Lead Author	Year	Event	Title
Oral (presentation)	Hong Kong	Wong S.	2018	The 2nd International Summit Forum on "Exercise and Healthy China 2030"	From Sitting to Moving: Research Evidence on Children and Young Adults
Poster	Hong Kong	Wong S.	2018	Movement to Move	Results of Hong Kong's 2018 Report Card on Physical Activity for Children and Youth
Poster	India	Bhawra J.	2018	Movement to Move	Results from India's 2018 Report Card on Physical Activity for Children and Youth
Oral (presentation)	International	Tremblay MS.	2018	ISPAH 2018	Policy lessons learned through the Active Healthy Kids Global Alliance Report Cards
Oral (presentation)	International	Tremblay MS.	2018	Movement to Move	Launch of Global Matrix 3.0
Poster	Japan	Tanaka C.	2018	Movement to Move	Results from Japan's 2018 Report Card on Physical Activity for Children and Youth
Poster	Jersey	Scriven J.	2018	Movement to Move	Results from Jersey's 2018 Report Card on Physical Activity for Children and Youth
Poster	Korea, Republic of	Oh JW.	2018	Movement to Move	Results from South Korea's 2018 Report Card on Physical Activity for Children and Youth
Poster	Lebanon	Abi Nader P.	2018	Movement to Move	Results from the First Lebanon's Physical Activity Report Card for Children and Youth (2018)
Poster	Lithuania	Emeljanovas A.	2018	Movement to Move	Lithuania's 2018 Report Card on Physical Activity for Children and Youth
Oral (presentation)	Medium and Low HDI	Manyanga T.	2018	Movement to Move	Indicators of Physical Activity among Children and Youth in Nine Countries with Low and Medium Human Development Indices: A Global Matrix 3.0 Paper
Poster	Mexico	Galaviz KI.	2018	Movement to Move	Results from Mexico's 2018 Report Card on Physical Activity for Children and Youth
Poster	Nepal	Subedi N.	2018	Movement to Move	Nepal's 2018 Report Card on Physical Activity for Children and Youth

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Type of presentation	Country/ Region	Lead Author	Year	Event	Title
Poster	Netherlands	Takken T.	2018	Movement to Move	Results from the Netherlands' 2018 Report Card on Physical Activity for Children and Youth
Poster	New Zealand	Mandic S.	2018	Movement to Move	New Zealand Physical Activity Card for Children and Adolescents 2018
Poster	Nigeria	Adeniyi AF.	2018	Movement to Move	2018 Nigerian Report Card on Physical Activity for Children and Youth
Poster	Poland	Zembura P.	2018	Movement to Move	Results from Poland's 2018 Report Card on Physical Activity for Children and Youth
Poster	Portugal	Mota J.	2018	Movement to Move	Results from Portugal's 2018 Report Card on Physical Activity for Children and Youth
Poster	Qatar	Ibrahim I.	2018	Movement to Move	Results from Qatar's 2018 Report Card on Physical Activity for Children and Youth
Poster	Scotland	Hughes AR.	2018	Movement to Move	Results from Scotland's 2018 Report Card on Physical Activity for Children and Youth
Poster	Slovenia	Starc G.	2018	Movement to Move	Results from Slovenia's 2018 Report Card on Physical Activity for Children and Youth
Poster	South Africa	Draper CE.	2018	Movement to Move	Healthy Active Kids South Africa Report Card
Oral (symposium)	South Korea	Lee EL.	2018	ISBNPA 2018 Annual Meeting	Experience from Global Matrix 2.0 and progress of the 2018 South Korea's Report Card on Physical Activity for Children and Youth
Poster	Spain	Roman-Viñas B.	2018	Movement to Move	Results from Spain's 2018 Report Card on Physical Activity for Children and Youth
Poster	Sweden	Löf M.	2018	Movement to Move	Results from Sweden's 2018 Report Card on Physical Activity for Children and Youth
Oral (presentation)	Sweden	Löf M.	2018	Pep Forum 2018	Results from Sweden's 2018 Report Card on Physical Activity for Children and Youth

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Type of presentation	Country/ Region	Lead Author	Year	Event	Title
Oral (symposium)	Taiwan	Chang CK.	2018	ISBNPA 2018 Annual Meeting	Active Healthy Kids Report Card on Physical Activity for Children and Youth in Asian: The Preliminary Results of Chinese Taipei (Taiwan)
Poster	Thailand	Saonuam P.	2018	Movement to Move	Results from Thailand's 2018 Report Card on Physical Activity for Children and Youth
Poster	United Arab Emirates	Paulo MS.	2018	Movement to Move	Results from the United Arab Emirates 2018 Report Card on Physical Activity for Children and Youth
Poster	United States	Katzmarzyk PT.	2018	Movement to Move	The 2018 U.S. Report Card on Physical Activity for Children and Youth
Oral (presentation)	Uruguay	Brazo-Sayavera J.	2018	XVII Encuentro Nacional XII Internacional de Investigadores en Educación Física	Reporte de actividad física en niños y adolescentes uruguayos 2018
Oral (presentation)	Uruguay	Brazo-Sayavera J.	2018	Encuentro de Investigadores de la Región Noreste	Global Matrix 3.0: Actividad física en niños y adolescentes uruguayos
Poster	Uruguay	Brazo-Sayavera J.	2018	Movement to Move	Report Card on Physical Activity for Children and Youth in Uruguay
Poster	Venezuela	Herrera-Cuenca M.	2018	Movement to Move	Results from Venezuela's 2018 Report Card on Physical Activity for Children and Youth
Oral (presentation)	Very High HDI	Aubert S.	2018	Movement to Move	Report Card grades on the physical activity of children and youth Comparing 30 very high human development index countries
Poster	Wales	Stratton G., Edwards L.	2018	Movement to Move	Results from Wales' 2018 Report Card on Physical Activity for Children and Young People
Oral (keynote)	Zimbabwe	Makaza D.	2018	1st Zimbabwe Physical Education and Sport Teachers Association (ZIPESTA) Annual Conference	Results from Zimbabwe's 2018 Report Card on Physical Activity for Children and Youth
Poster	Zimbabwe	Manyanga T.	2018	Movement to Move	Results from Zimbabwe's 2018 Report Card on Physical Activity for Children and Youth
Oral (presentation)	Africa	Manyanga T.	2019	Annual Research Day School of Epidemiology and Public Health	Highlights of Report Card grades from six African countries that participated in the Global Matrix 3.0

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Type of presentation	Country/ Region	Lead Author	Year	Event	Title
Oral (symposium)	Africa	Manyanga T.	2019	ISBNPA 2019	Highlights of Report Card Grades from six African Countries that participated in the Global Matrix 3.0.
Oral (symposium)	Asia	Lee EY.	2019	ISBNPA 2109	Highlights of Report Card grades from 12 Asian countries that participated in the Global Matrix 3.0.
Oral (symposium)	Asia	Chang CK.	2019	Taiwan International Conference on Physical Activity and Exercise Sciences	Special Symposium on Kids and Youth Physical Activity in Asia Region I: Current Situation and Future
Oral (symposium)	Asia	Wong S.	2019	Taiwan International Conference on Physical Activity and Exercise Sciences	Special Symposium on Kids and Youth Physical Activity in Asia Region I: Current Situation and Future
Oral (symposium)	Asia	Liu Y.	2019	Taiwan International Conference on Physical Activity and Exercise Sciences	Special Symposium on Kids and Youth Physical Activity in Asia Region I: Current Situation and Future
Oral (symposium)	Asia	Lee EY.	2019	Taiwan International Conference on Physical Activity and Exercise Sciences	Special Symposium on Kids and Youth Physical Activity in Asia Region I: Current Situation and Future
Oral (symposium)	Asia	Saonuam P.	2019	Taiwan International Conference on Physical Activity and Exercise Sciences	Special Symposium on Kids and Youth Physical Activity in Asia Region I: Current Situation and Future
Oral (symposium)	Asia	Khan A.	2019	Taiwan International Conference on Physical Activity and Exercise Sciences	Special Symposium on Kids and Youth Physical Activity in Asia Region I: Current Situation and Future
Oral (symposium)	Asia	Chang CK.	2019	Taiwan International Conference on Physical Activity and Exercise Sciences	Special Symposium on Kids and Youth Physical Activity in Asia Region II: Policy, Strategy and Future Development
Oral (symposium)	Asia	Wong S.	2019	Taiwan International Conference on Physical Activity and Exercise Sciences	Special Symposium on Kids and Youth Physical Activity in Asia Region II: Policy, Strategy and Future Development
Oral (symposium)	Asia	Liu Y.	2019	Taiwan International Conference on Physical Activity and Exercise Sciences	Special Symposium on Kids and Youth Physical Activity in Asia Region II: Policy, Strategy and Future Development
Oral (symposium)	Asia	Lee EY.	2019	Taiwan International Conference on Physical Activity and Exercise Sciences	Special Symposium on Kids and Youth Physical Activity in Asia Region II: Policy, Strategy and Future Development

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Type of presentation	Country/ Region	Lead Author	Year	Event	Title
Oral (symposium)	Asia	Saonuam P.	2019	Taiwan International Conference on Physical Activity and Exercise Sciences	Special Symposium on Kids and Youth Physical Activity in Asia Region II: Policy, Strategy and Future Development
Oral (symposium)	Asia	Khan A.	2019	Taiwan International Conference on Physical Activity and Exercise Sciences	Special Symposium on Kids and Youth Physical Activity in Asia Region II: Policy, Strategy and Future Development
Poster	Canada	Barnes JB.	2019	ISBNPA 2019	Canada's 2018 Report Card on Physical Activity of Children and Youth: Leading or Lagging in Comparison to the Global Matrix 3.0 Findings?
Poster	Czech Republic	Gaba A.	2019	ISBNPA 2019	Results from the Czech Republic's 2018 Report Card on Physical Activity for Children and Youth
Oral (presentation)	China	Liu Y.	2019	Conference on Physical Activity and Health – More active people for healthy China	China 2018 Report Card on PA for children and youth
Oral (presentation)	Denmark	Skovgaard T.	2019	Denmark 2019 National Active Healthy Kids Conference	Moving children and youth – national and international tendencies
Oral (presentation)	Denmark	Troelsen J.	2019	Denmark 2019 National Active Healthy Kids Conference	Community and environment and the influence on children's physical activity possibilities
Oral (presentation)	Denmark	Tomassen CB.	2019	Denmark 2019 National Active Healthy Kids Conference	Children's access to organized sports
Oral (presentation)	Denmark	Neerfeldt BF.	2019	Denmark 2019 National Active Healthy Kids Conference	The school as an arena for children and youth's physical activities
Oral (presentation)	Denmark	Pilgaard M.	2019	Denmark 2019 National Active Healthy Kids Conference	The meaning of family and peers in relation to children and youth's physical activity level
Oral (presentation)	Denmark	Johansen DN.	2019	HEPA Europe conference 2019	The Danish 2018 Report Card on Physical Activity for Children and Youth
Poster	Denmark	Johansen DN.	2019	ISBNPA 2019	The Danish 2018 Report Card on Physical Activity for Children and Youth
Oral (presentation)	Europe	Aubert S.	2019	Annual Research Day School of Epidemiology and Public Health	Highlights of Report Card grades from 20 European countries that participated in the Global Matrix 3.0

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Type of presentation	Country/ Region	Lead Author	Year	Event	Title
Oral (presentation)	India	Bhawra J.	2019	ISBNPA 2019	State of the evidence of Active Living among Children and Youth in India: a Scoping Review informing the 2018 India Report Card on Physical Activity for Children and Youth
Oral (symposium)	International	Aubert S.	2019	ISBNPA 2019	Global Matrix 3.0 on Physical Activity for Children and Youth: Insights from Report Card Grades from European, African, Latin-American, and Asian Countries
Oral (presentation)	International	Tremblay MS.	2019	Conference on Physical Activity and Health – More active people for healthy China	Global Physical Activity Report Card Grades for Children and Youth
Oral (presentation)	International	Tremblay MS.	2019	ISBNPA 2019	Prevalence of children and youth meeting physical activity guidelines: a 49-country comparison.
Oral (presentation)	International	Aubert S.	2019	ISBNPA 2019	Prevalence of children and youth meeting sedentary behaviour guidelines: a 49-country comparison.
Poster	International	Gonzalez SA.	2019	ISBNPA 2019	Active transportation among children and youth: a 49-country comparison.
Oral (presentation)	International	Tremblay MS.	2019	School of Epidemiology and Public Health, University of Ottawa, Graduate Seminar	Active Healthy Kids Global Alliance: Powering the movement to get kids moving
Oral (invited presentation)	International and Hong Kong	Tremblay MS.	2019	Invited presentation at the 2018 Active Healthy Kids Hong Kong Report Card on Physical Activity for Children and Youth release press conference	Active Healthy Kids Global Alliance: Global Matrix 3.0 findings.
Oral (invited presentation)	International and Lithuania	Tremblay MS.	2019	Invited presentation at the Lithuania Sports University	Active Healthy Kids Global Alliance: Global Matrix 3.0
Oral (presentation)	Latin America	González SA.	2019	Annual Research Day School of Epidemiology and Public Health	Highlights of Report Card grades from Latin-American countries that participated in the Global Matrix 3.0
Oral (symposium)	Latin America	González SA.	2019	ISBNPA 2019	Highlights of Report Card grades from Latin-American countries that participated in the Global Matrix 3.0.

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Type of presentation	Country/ Region	Lead Author	Year	Event	Title
Poster	Lebanon	Hadla R., Mattar L.	2019	XIth International Lebanese Epidemiological Association Eastern Mediterranean Regional Scientific Meeting	Results from the First Lebanon's Physical Activity Report Card for Children and Youth (2018)
Poster	Nepal	Subedi N.	2019	ISBNPA 2019	Result of Nepal's 2018 Report Card on Physical Activity for Children and Youth
Oral (presentation)	Spain	Roman-Viñas B.	2019	Congress of the Spanish Society of Obesity	Obesity and Physical Activity in Spanish children

Note: CPD = Continuing Professional Development; JOINDAF = Jornadas de Investigação e Desenvolvimento do Desporto e Actividade Física; ISPAH = International Society for Physical Activity and Health; ISBNPA = International Society of Behavioral Nutrition and Physical Activity.

Chapter 9: Manuscript 6

This manuscript has been written and formatted following the submission standards of the *Journal of Exercise Sciences and Fitness*. It appears in its submitted format.

Title:

Evaluation of the process and outcomes of the Global Matrix 3.0 of Physical Activity Grades for Children and Youth

Citation:

Aubert S, Barnes JD, Tremblay MS. Evaluation of the process and outcomes of the Global Matrix 3.0 of Physical Activity Grades for Children and Youth. Submitted to: *Journal of Exercise Sciences and Fitness*. 2019.

This article summarizes the results from the evaluation of the process and finding indicators of the Global Matrix 3.0 and presents recommendations for improvement. I am the primary (first) author on this article. I wrote the draft manuscript, and the co-authors edited the manuscript and approved the final version of the manuscript before it was submitted for peer review. All co-authors contributed significantly and met the International Committee of Medical Journal Editors guidelines for authorship. I handled the minor revisions suggested by the reviewers and resubmitted this article. The title page and the submitted manuscript are presented in this chapter.

Full length articles/Research papers

Evaluation of the process and outcomes of the Global Matrix 3.0 of Physical Activity Grades for Children and Youth

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Conflicts of interest

The authors want to disclose that they were members of the AHKGA Board of Directors during the development of the Global Matrix 3.0.

Acknowledgements

The authors want to thank the current and previous AHKGA Board of Director's members, the Report Card leaders, and their working group members who contributed actively to the successful development of the Global Matrix 3.0 and its evaluation. We are also grateful to Evan Turner for the support he provided during the audit of the short Report Card articles, the writing of the integrated articles, and the evaluation of the international impact of the Report Cards.

Evaluation of the process and outcomes of the Global Matrix 3.0 of Physical Activity Grades for Children and Youth

Abstract

Background/Objective

Participation in the Active Healthy Kids Global Alliance (AHKGA) Global Matrix initiative represents a significant work and resource investment for Report Card teams. The objective of this paper was to evaluate the process and findings of the Global Matrix 3.0 and formulate recommendations for improvement.

Methods

The evaluation of the Global Matrix 3.0 was planned prior to its development and a list of potential process, impact, and outcome indicators were pre-identified. These indicators were informed by online surveys, direct reports, *MailChimp*'s statistics, *Google Analytics* of the AHKGA website, and emails sent to the AHKGA Board of Directors.

Results

Five online surveys were completed by 88%-100% of the targeted respondents. High satisfaction ratings were observed for most of the Global Matrix 3.0 methods, key steps, concepts, and the resources (e-blasts and website) provided by the AHKGA. A total of 496 open-ended comments were provided in the five surveys, including 199 comments reporting issue(s), and 38 reporting both positive feedback and issue(s). The participating Report Card teams successfully assigned a grade to each physical activity indicator, produced a Report Card document, and wrote a short Report Card article.

Conclusion

This evaluation process allowed for the identification of needed improvements and the formulation of recommendations for future Global Matrix initiatives. This work highlighted the need for the development of physical activity behavior assessment tools that would be internationally adopted and

culturally adaptable to varying contexts to improve the standardization of physical activity surveillance at the global scale.

Key words

Adolescent; child; international cooperation; outcome assessment; process assessment; youth sport

Introduction

The Global Matrix on physical activity for children and youth[1–3] is an international initiative where multidisciplinary teams of experts from numerous countries concurrently develop national Report Cards[4] with physical activity grades following a harmonized development process. This initiative is led by the *Active Healthy Kids Global Alliance* (AHKGA), an incorporated not-for-profit organization dedicated to improving the physical activity of children and youth from around the world.[5] In 2018, the AHKGA released the Global Matrix 3.0, compiling Report Card grades from 49 countries for 10 physical activity indicators: five behavioral indicators (overall physical activity, organized sport and physical activity, active play, active transportation, sedentary behavior), one individual characteristic indicator (physical fitness), and four sources of influence indicators (family and peers, school, community and environment, government).[3] Forty-nine short Report Card articles summarizing the main findings from each participating country,[6] three articles discussing results from the Report Cards by predetermined Human Development Index (HDI)[7–9] categories (low and medium HDI, high HDI, and very high HDI),[10–12] an article integrating the findings from all HDI papers, and an article reporting the international impact of the Global Matrix and Report Card initiative[13] were published in a special issue of the Journal of Physical Activity and Health (JPAH).

Participation in the Global Matrix represents a significant investment in both human and financial resources for all the involved researchers and stakeholders. Report Card teams have to pay registration fees and follow a specific harmonized development method to develop their Report Card. Therefore, the AHKGA designed a method to evaluate the Global Matrix 3.0 process and outcomes to carefully reflect on opportunities to work more effectively and efficiently in the future. This evaluation process involved the collection of process and outcome indicators through online surveys and reports by email at different stages of the Global Matrix 3.0 development process. The objective of this paper was to

present the main findings of these evaluations and to formulate recommendations for the improvement of future Global Matrix initiatives.

Methods

Global Matrix 3.0 and harmonized Report Card development

The detailed methods for the development of the Global Matrix 3.0[3] and Report Card,[4] have been previously published. In each participating country, one to three Report Card leaders were officially designated to manage the national Report Card development, and to ensure effective communication between the AHKGA Executive Committee and the Report Card team. Report Card teams had to compile the best available published and unpublished evidence to assign letter grades to physical activity indicators following harmonized benchmarks and grading rubric.[3]

A mentoring system was developed for the Global Matrix 3.0: new Report Card leaders and teams were paired with an intermediate mentor who was an experienced Report Card leader from a country that participated in the Global Matrix 2.0. In addition, six regional mentors (Africa, Asia, Europe, North America, Oceania, and South America) were designated to provide help and guidance to the countries when needed and to report their progress to the AHKGA Executive Committee. The AHKGA Board of Directors coordinated the Global Matrix 3.0 development and provided a variety of resources through e-blasts, a monthly newsletter sharing resources and deadlines, and mentorship to support the harmonized development of Report Cards. The Report Card leaders were also provided with individual access credentials for the "members only" section of the AHKGA website where information on the Report Card development process and resource documents were provided. The Report Card grades from each participating country were submitted with their rationale and were audited by selected AHKGA members. Finally, a short Report Card article was written by each Report Card team following a template provided by the AHKGA and audited by selected AHKGA members before being submitted for copy-editing in JPAH.

Evaluation indicators

An evaluation plan for the Global Matrix 3.0 was designed prior its development by members of the AHKGA Board of Directors. The aim of this plan was to gather data and information to strengthen and improve the Global Matrix development process and approach, and also to assess the international impact of the Global Matrices and Report Cards. The impact indicators monitored the progress of achieving the Global Matrix 3.0 objectives.[14] A study entirely dedicated to the international impact of the Report Cards and Global Matrices was recently published in JPAH.[13] The reader is invited to consult this open access publication reporting and discussing the Global Matrix 3.0 impact indicators. Process outcomes meeting the SMART framework criteria (Specific, Measurable, Appropriate, Reliable, Time-consistent)[15] were identified by reviewing the scientific and grey literature and adapted to the specificity of the Global Matrix. The evaluation plan included the possibility to collect unanticipated indicators by offering the opportunity to report any negative or positive side product of the Global Matrix process in open comments on evaluation surveys and by email to everyone involved at any stage of the development. In addition, specific outcome indicators for the expected Global Matrix 3.0 outputs were also pre-identified to assess if the objectives of the Global Matrix 3.0 were achieved.[14] The evaluation of these indicators was informed by online surveys, direct reports, *MailChimp*'s statistics, *Google Analytics* of the AHKGA website, and emails that were sent to the AHKGA Board of Directors. *MailChimp* (The Rocket Science Group, Atlanta) is an email marketing platform that provides analytics on the number of recipients who received the e-blasts, opened them, and clicked on relevant links. *Google Analytics* (Google, Mountain View) is a Google service that tracks AHKGA website traffic and usage.

Online surveys

Five online surveys were developed using REDCap Software, a secure, web-based application designed exclusively to support data capture for research studies,[16] for evaluation purposes and circulated by

AHKGA: three sequential Report Card Leader Surveys, and two sequential Mentoring Surveys. A web link to the online surveys was circulated to the Report Card leaders through the monthly AHKGA e-blasts. Regular reminders to complete the surveys were sent to the Report Card leader in subsequent e-blasts and by e-mail. Only one Report Card leader per participating country was allowed to complete the online surveys. The Report Card Leader Surveys were circulated at three time points of the Global Matrix 3.0 development process as seen in Figure 1, and their content evolved depending on the time point. Open- and close-ended data on satisfaction and potential issues concerning the Global Matrix 3.0 key steps, concepts and process were collected. The Mentoring Surveys were circulated at two time points (Figure 1). The two Mentoring Surveys were anonymized, identical, and aimed to evaluate the mentorship organization for the Global Matrix 3.0. In these surveys, Report Card leaders rated (from 1 to 10) the responsiveness, engagement, and overall organization of AHKGA, their intermediate mentor, their regional mentor, or their mentee(s) (in the case of mentors completing the surveys). In both types of surveys, satisfaction rates were evaluated using three-point Likert scales.

Ethics statement

This evaluation protocol was submitted to the Children's Hospital of Eastern Ontario Research Ethics Board (CHEO REB) (#18/08X). CHEO REB determined that this project did not meet the *Tri-Council Policy Statement Ethical Conduct for Research Involving Humans*[17] definition of research but corresponded instead to a quality assurance project "quality assurance/quality improvement/program evaluation".

Results

Process indicators

a. Global Matrix 3.0 country and participant information

Table 1 summarizes the information on countries that participated in the Global Matrix 3.0. While the AHKGA aimed for a maximum of 75 countries to participate in the Global Matrix 3.0, 51 countries

registered and had paid their registration fees by the end of January 2018. Over the development of the Global Matrix 3.0, two countries dropped out due to lack of time and lack of new data respectively. Table 2 presents descriptive statistics concerning the number of participants to the Global Matrix 3.0. Global Matrix 3.0 "participants" refers to all the people who have contributed to the development of the Global Matrix 3.0 (i.e. AHKGA Board of Directors, Report Card leaders and team members). Fourteen country Report Cards were led by one or several females, and six were co-led by at least one female. During the development of the Global Matrix 3.0, the AHKGA Board of Directors was composed of four females and six males. The Report Card leaders also reported the number of members who dropped-out their Report Card team, the number of new members who joined, and the reason(s) why in the Report Card leader survey 2 (Table 3).

b. Responsiveness, engagement and organization of the Global Matrix 3.0 Report Card leaders

The three Report Card Leader Surveys were completed by 100% of the targeted respondents (i.e. one Report Card leader per participating country, n = 49) and the Mentoring Surveys 1 and 2 were completed by 98% and 88% of the targeted respondents (i.e. one Report Card leader per participating country and an additional regional mentor, n = 50), respectively. The intermediate and regional mentors rated (from 0 to 10) the responsiveness, engagement and overall organization of the Global Matrix 3.0 participants using Likert scales in the Mentoring Surveys. A summary of these ratings is presented in Table 4. The statistics provided by *MailChimp* regarding the use of the e-blasts are presented in Table 5. Finally, the number of page views in the AHKGA website member only section over the year 2018 provided by *Google Analytics* is presented in Figure 2.

c. Responsiveness, engagement and organization of the intermediate and regional mentors

The Report Card leaders rated the responsiveness, engagement and overall organization of their intermediate mentors and/or the regional mentors using Likert scales (from 0 to 10) in the Mentoring

Surveys. A summary of these ratings is presented in Table 6. All intermediate and regional mentors reported that they spent ≤1 hour per week mentoring countries.

d. Responsiveness, engagement and organization of AHKGA Board of Directors

A total of 12 AHKGA Board of Director meetings took place between January and November 2018 (one per month in addition to a special three-day strategic planning meeting which occurred in January), for a total of 28 hours of face-to-face or teleconference meetings. For each of these meetings, an agenda was prepared and circulated by the President of AHKGA, and the attendance, discussions, and list of action items were recorded in the minutes. The President of AHKGA prepared and circulated an e-blast sent to all country leaders within a week following each of these meetings. In addition to these recurring activities, the AHKGA Board of Directors created the resource documents that guided the development of the Global Matrix 3.0; created and maintained the AHKGA website, led the audit of the Report Card grades and of the short Report Card articles; contributed to the writing of the integrated scientific articles; prepared workshops and scientific presentations for the release of the Global Matrix 3.0 at the Movement to Move event; and developed adaptable templates of a press release, key finding document, question and answer sheet, social media material, and infographics dedicated to help the Report Card leaders promote the dissemination of their findings. All Report Card leaders who were not members of the AHKGA Board of Directors were asked to rate the responsiveness, engagement and overall organization of the AHKGA using Likert scales in the Mentoring Surveys; a summary of these ratings is presented in Table 6.

e. Collateral Impact

A series of success stories related to the Report Card and/or Global Matrix activities was already published elsewhere.[13] One of these stories, classified in the “capacity building” category, is a relevant unexpected side effect that resulted from the Global Matrix 3.0 development process: the development of the 2018 Ghana’s Report Card facilitated the training of senior students in physical education and

sport in data monitoring and surveillance. The Report Card leader of Uruguay also reported recently that the development of their Report Card was a good training opportunity for the members of his research group and his senior undergrad students.

f. Satisfaction measures, challenges and issues

The satisfaction of the Report Card leaders concerning key steps and concepts of the Global Matrix 3.0 was assessed though the Report Card Leader Surveys 1, 2, and 3. A selection of satisfaction ratings organized by themes is presented in Figures 3A-H. The Report Card leaders also reported potential issue(s) through open-ended responses in several sections of the Report Card Leader Surveys and Mentoring Surveys. A total of 496 comments were provided in the five surveys, including 103 positive comments, 156 neutral or informative comments, 199 comments reporting a /several issue(s), and 38 reporting both positive feedback and some issue(s). The number of issues mentioned in the last two categories of comments is summarized in Table 7. Finally, the Report Card leaders were also asked in Report Card Leader Survey 3 to report if they (or someone else in their country) were planning on participating in the next Global Matrix (Global Matrix 4.0). Out of the 47 who replied, 85% replied “yes”, 15% replied “unsure”, and none replied “no”.

Outcome indicators

The expected outputs of the Global Matrix 3.0 included the compilation of physical activity grades,[6] the production of Report Card documents, the publication of short Report card articles[13] and peer-reviewed articles integrating and comparing the international findings.[3,10–12] The Report Card leaders were also invited to rate their confidence in each physical activity grade of their Report Card by entering a number from 1 to 10 in the Report Card Leader Survey 2. The descriptive statistics of their confidence ratings are presented in Table 8.

Discussion

The collective efforts from the Report Card leaders and team members, intermediate and regional mentors, and AHKGA Board of Directors allowed us to collect a variety of quantitative and qualitative information to inform the evaluation of the process, impact, and outcomes of the Global Matrix 3.0.

Overall, high satisfaction ratings were observed concerning the majority of the Global Matrix 3.0 methods, key steps, and concepts identified in Figure 3. Table 5 and Figure 2 show that the resources (e-blasts and website) provided by AHKGA were used all year long by the majority of the Report Card leaders, and the Report Card leaders expressed high satisfaction with these supporting materials (Figure 3G). The general overview of the findings presented in this article shows that despite the challenges and issues encountered, the Global Matrix 3.0 process facilitated the success of all participating Report Card teams to submit their 10 physical activity grades, publish their short Report Card articles, and potentially have a positive impact nationally or internationally. However, several points of improvement were identified to inform recommendations for future Global Matrix initiatives.

Recommendations

Findings from the Mentoring Surveys showed that the mentorship organization created for the Global Matrix 3.0 was too complex and confusing for the participants. Several participants failed to even identify their mentor or mentee country, and lack of support from the mentor was one of the main issues raised in the comments collected in the surveys (Table 7). In practice, most country leaders contacted AHKGA directly for guidance and mentoring. Consequently, it is recommended that central support should be provided by a smaller number of mentors selected by AHKGA that will guarantee their involvement and responsiveness to help guide and mentor new and requesting Report Card teams. It would also be interesting to take advantage of the expertise of all the future Report Card team members with the creation of a discussion/advice forum on the AHKGA website where anyone could

post a question and receive a quick answer from available experts or share advice or resources. It is recommended for AHKGA to pursue providing additional support and resources for the development of the Report Cards through e-blasts, the "members only" section of the AHKGA website and the audit process of the grades and their rationale. In addition, the AHKGA has also provided support for the dissemination of the Report Cards through the AHKGA website and Twitter account, and with the provision of a detailed dissemination package described elsewhere.[13] Findings presented in Figure 3G show that Report Card leaders found these resources useful; therefore, AHKGA is encouraged to continue these efforts.

As reported by several Report Card leaders in the surveys (Table 5), the anticipated deadlines for the submission of the final physical activity grades that were provided at the beginning of the Global Matrix 3.0 development stage were very challenging. Once the registration period was closed, the Report Card teams ended with a strict four-month deadline to complete their grade assignment and a six-month deadline to write their short Report Card article. It is recommended that AHKGA aim to provide more lead time in future Global Matrices, allowing more anticipation and flexibility to the Report Card leaders in the planning of their Report Cards development.

Comments collected in the surveys (Table 5) highlighted the challenge faced by AHKGA in the choice, definition and descriptions of the indicators and their associated benchmarks. More detailed and strict criteria for the benchmarks to evaluate the indicators was requested; however, several Report Card leaders complained as well about the lack of good quality data in their country, in particular of data that fits with the benchmarks that were provided by AHKGA. It was also raised that some of the indicators or benchmarks may be too specific and more adapted to very high HDI countries, and not always relevant for the others. Some Report Card leaders suggested that AHKGA should take the leadership on the development of standardized tools dedicated to the collection of physical activity behavior data, or

provide a clear recommendation of tools to use for the Report Card teams willing to collect their own data or contributing to the development of new national physical activity surveillance systems. As several Report Card leaders expressed their interest in contributing to the development of more detailed or clear benchmarks or even specific AHKGA tools to assess and analyze the public policies, a feasible approach in the first instance would be for AHKGA to lead an interactive discussion involving all interested Global Matrix participants to update physical activity indicators, their definitions and associated benchmarks. The development of physical activity behavior assessment tools that would be internationally adapted and adopted could become a parallel project to the Global Matrix initiative if adequate resources permit.

With the increasing number of countries participating in the Global Matrix initiative comes a growing need for human, material and financial resources to successfully coordinate its development. Before the initiation of Global Matrix 3.0, AHKGA decided to adopt a registration fee system that increased with the level of HDI of the countries in order to facilitate the participation of the developing countries.[3] The lowest satisfaction ratings reported by the Report Card leaders were related to the registration fees and the availability of funding for the design of the Report Cards (Figure 3A). And Report Card leaders from countries belonging to each category of HDI reported difficulty to find funding in the open spaces for comments of the surveys (Table 7). However, the difficulty to find funding is not a problem that is uniquely tied to the Global Matrix initiative but widespread in scientific research and knowledge translation globally. The Global Matrix 3.0 registration fees were used to pay for the overall management of the Global Matrix 3.0 initiative, to finance the publication of the Global Matrix 3.0 articles in a special issue in JPAH, develop and maintain the AHKGA website, and assist with expenses related to the release at the Movement to Move event in Adelaide Australia. It is recommended that the benefits and supports provided for the registration fee be clearly presented. It is also recommended that the AHKGA explore strategic partnerships in order to obtain financial support and reduce the

registration fees for future Global Matrices and/or offer more support to low- and medium-HDI countries. Meanwhile, Report Card leaders and teams need to be creative, persistent, and support each other in their quest to secure funding to support report card developments, releases and promotions.

Despite the generally good confidence ratings concerning the Report Card grades that were reported by the Report Card leaders (Table 8), the lack of good quality data was the issue most leaders noted (Table 4). It is an important recommendation to highlight to all the future participating countries that a lack of good quality data or lack of new data since a previous Report Card has been published is still a relevant and meaningful finding to report. This is particularly true concerning some of the sources of influence indicators (school, community and environment, government). The main message of a Report Card can be to highlight the efforts or the absence of efforts that have been accomplished to tackle the population health issue of children and youth physical inactivity or to improve the surveillance within a country. Regardless of the availability of good quality data, the Report Card remains a potentially powerful tool for advocacy.[13]

There are still parts of the world missing in the Global Matrix initiative, and the low- and medium-HDI countries and the high HDI countries are also underrepresented in comparison with the very high HDI countries.[3] However, the AHKGA is an active network of interconnected researchers and physical activity experts from various fields, distributed across six continents.[13] Therefore, to have more participating countries in the next Global Matrices, in particular from the low- and medium-HDI countries, it is recommended that the international network of the AHKGA keep promoting this project through publications, social media, e-mails, conferences and mouth to mouth interactions to connect with new experts and teams from missing countries, in particular the with the low- and medium-HDI countries and the high HDI countries.

Finally, it is recommended that this evaluation process be continuous. Keeping ongoing records of media impact, publications, presentations, success stories, and issues that arise will need to be proactively pursued in order to facilitate the improvement and optimize the impact of this global initiative.

Strengths and limitations

The main limitation of this evaluation was that it relied essentially on responses to surveys and on reports made by the Report Card leaders, the Report Card team members, the mentors, and the AHKGA Board members. Consequently, the results may be biased and/or incomplete, potentially making the opinion of individual who replied more consistently and reported more information weighting more than others. This evaluation plan was also designed and led by members of the AHKGA Board of Directors, constituting a potential source of personal bias. On the other side, a complete understanding of the Global Matrix and Report Card harmonized development process was essential to the design and understanding of this evaluation process. In addition, this evaluation plan allowed to collect feedback from the Report Card team at all the stages of development of the Global Matrix 3.0, allowing to identify potential issues that were still addressable at the moment they were raised.

Conclusion

A variety of quantitative and qualitative information was collected to inform the evaluation of the process and outcomes of the Global Matrix 3.0. From these evaluations the Global Matrix 3.0 was a successful international initiative in terms of delivery of the expected outcomes - the physical activity grades for each participating country - despite several identified issues that challenged the Report Card teams. This evaluation process allowed for the identification of several improvements and the formulation of recommendations for future Global Matrix initiatives and highlighted the need for the development of physical activity behavior assessment tools that would be internationally adopted and

culturally adaptable for all contexts to improve the standardization of physical activity surveillance at the global scale.

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Tables

Table 1: Global Matrix 3.0 country participation information.

Indicator	Total	Low and Medium HDI countries	High HDI countries	Very High HDI countries
Number of participating countries[a]	49	9	10	30
Country dropout	2	1	1	0
New participating countries	15	4	4	7
Global Matrix 2.0 returning countries	34	5	6	23

Notes: HDI = Human Development Index, NA = not applicable. [a]A total of 51 counties registered and paid their registration fees by January 2018, but two countries dropped out and 49 fully participated in the Global Matrix 3.0 process.

Table 2: Global Matrix 3.0 participants' characteristics.

Indicator	Total	Mean number of members (range) per Report Card team
Total number of Global Matrix 3.0 participants	513	10 (3-23)
Number of males	258 (50%)	5 (0-17)
Number of females	255 (50%)	5 (0-16)
Number affiliated with a university (%)	NA	68% (0%-100%)
Number affiliated with a governmental institution (%)	NA	10% (0%-67%)
Number of institutions affiliated with the Global Matrix 3.0 participants	283	6 (1-15)

Note: NA = not applicable.

Table 3: Number and reasons of dropped-out Report Card team members and new Report Card team members reported in the Report Card Leader Survey 2.

Report Card team members who dropped out n (%)	13 (2%)
Report Card team members drop-out reasons	Lack of time (n = 7) Moved to another position/ city/ country or to retirement (n = 4) Removed/quitted due to lack of participation (n = 2)
Number of new Report Card team members	9 (1.7%)
New Report Card team members reasons	Expertise needed for the Report Card (n = 4) Replacement of Report Card team member who dropped out (n = 2) Help needed due to large amount of workload (n = 2) Recommended by AHKGA (n = 1)

Table 4: Mean responsiveness, engagement and overall organization ratings of the Report Card leaders evaluated in the Mentoring Survey 1 and 2.

Indicators	Mentoring Survey 1	Mentoring Survey 2
Number of Report Card leaders rated by intermediate mentors	13	9
Number of Report Card leaders rated by regional mentors	17	34
Mean responsiveness rating (out of 10)	8.0	8.2
Mean engagement rating (out of 10)	8.0	8.1
Mean overall organization rating (out of 10)	8.1	8.4

Table 5: *Mailchimp* statistics concerning the use of the e-blasts circulated monthly by AHKGA.

Title of the e-blast	Send Date	Total Recipients	Open Rate	Total Opens	Click Rate	Total Clicks
Global Matrix 3.0 - January 2018 E-Blast	2018-01-26 16:23	68	75%	373	51%	106
Global Matrix 3.0 - February 2018 E-Blast	2018-02-26 12:59	70	73%	940	40%	81
Global Matrix 3.0 - March 2018 E-Blast	2018-03-29 15:39	69	75%	637	59%	157
Global Matrix 3.0 - April 2018 E-Blast	2018-04-24 10:25	67	84%	629	57%	188
Global Matrix 3.0 - May 2018 E-Blast	2018-05-14 12:03	67	82%	1448	60%	190
Global Matrix 3.0 - June 2018 E-Blast	2018-06-22 15:18	77	77%	1343	57%	181
Global Matrix 3.0 - July 2018 E-Blast	2018-07-17 13:47	77	79%	728	42%	186
Global Matrix 3.0 - August 2018 E-Blast	2018-08-27 13:39	76	72%	623	42%	132
Global Matrix 3.0 - September 2018 E-Blast	2018-09-19 8:18	76	76%	734	11%	20
Global Matrix 3.0 - October 2018 E-Blast	2018-10-14 21:30	78	73%	925	11%	16
Global Matrix 3.0 - November 2018 E-Blast #1	2018-10-31 17:05	78	74%	792	53%	142
Global Matrix 3.0 Materials Needed Reminder	2018-11-07 11:17	77	74%	744	52%	65
Global Matrix 3.0 Materials Needed Reminder #2	2018-11-13 13:57	76	78%	340	60%	80
Global Matrix 3.0 - November 2018 E-Blast #2 - FINAL ONE BEFORE LAUNCH!	2018-11-17 15:08	123	63%	635	38%	324

Table 6: Mean Responsiveness, engagement and overall organization scores of the intermediate mentors, the regional mentors, and AHKGA evaluated in the Mentoring Survey 1 and 2.

Indicators	Mentoring Survey 1	Mentoring Survey 2
Number of Report Card leaders rating intermediate mentors	23 (47%)	17 (35%)
Mean intermediate mentors responsiveness score	7.9	7.9
Mean Intermediate mentors engagement score	7.7	7.7
Mean intermediate mentors overall organization score	7.5	7.5
Number of Report Card leaders rating regional mentors	31 (63%)	31 (63%)
Mean regional mentors responsiveness score	8.0	8.4
Mean regional mentors engagement score	8.0	8.3
Mean regional mentors overall organization score	8.1	8.4
Number of Report Card leaders rating AHKGA	36 (73%)	36 (73%)
Mean AHKGA responsiveness score	9.4	8.5
Mean AHKGA engagement score	9.4	8.8
Mean AHKGA overall organization score	9.1	8.8

Table 7: Summary of the challenges/issues reported in the Report Card Leader Surveys 1, 2, and 3, and in the Mentoring Surveys 1 and 2.

	Mentoring Survey 1	Mentoring Survey 2	Report Card Leader Survey 1	Report Card Leader Survey 2	Report Card Leader Survey 3	Total
Lack of new data/ good quality representative data			13	48	14	75
Difficulty to find funding			7	15	26	48
Benchmarks /indicators are unclear /not detailed enough	1		3	12	12	28
Lack of support from the mentor	7	6	1	2	1	17
Difficulty to recruit Report Card team members /to have a complete Report Card team			4	6	1	11
All the Report Card team members were not responsive/ contributing at the same level				5	4	9
Registration fees (for the Global Matrix or Movement to Move event) were too expensive			4	1	2	7
The short Report Card articles were too restrictive					7	7
Difficulty to reach a target audience/ have an impact in the media					6	6
Mentored Report Card leader was not responsive/ cooperative	1	1	1		2	5
Challenging deadline/ complain about deadline change/ unclear deadline	1		3	1		5
Benchmarks and indicator are not relevant and adapted to all context (low and medium HDI countries)			2	1	2	5

Note: This table presents the count of how many times each issue or challenge was *mentioned*. Several comments contained more than one mention of issue or challenge. Only the issues that were raised a minimum of five times are presented. As there were several open spaces in each survey, the same issue could potentially be mentioned several times by the same Report Card leader.

Table 8: Descriptive statistics of the confidence ratings for the physical activity grades reported in the Report Card Leader Survey 2.

	PA	SP	AP	AT	SB	PF	FAM	SCH	COM	GOV
Number of replies	46	46	45	46	46	44	45	45	46	46
Mean (out of 10)	8.1	7.8	6.4	8.0	7.4	6.8	6.4	7.7	7.3	7.1
Ratings >6	85%	80%	64%	83%	80%	68%	60%	84%	74%	67%
Max	10	10	10	10	10	10	10	10	10	10
Min	4	2	0	2	2	0	0	0	0	0

Notes: PA = Physical Activity; SP = Organized Sport and Physical Activity; AP = Active Play; AT = Active Transportation; SB = Sedentary Behaviors; PF = Physical Fitness; SCH = School; COM = Community and Environment; FAM = Family and Peers; GOV = Government. Some Report Card leaders specified in comments that that they decided to rate their confidence level "0" for the incomplete grades of their Report Card while some others specified that they rated them "10".

Figures

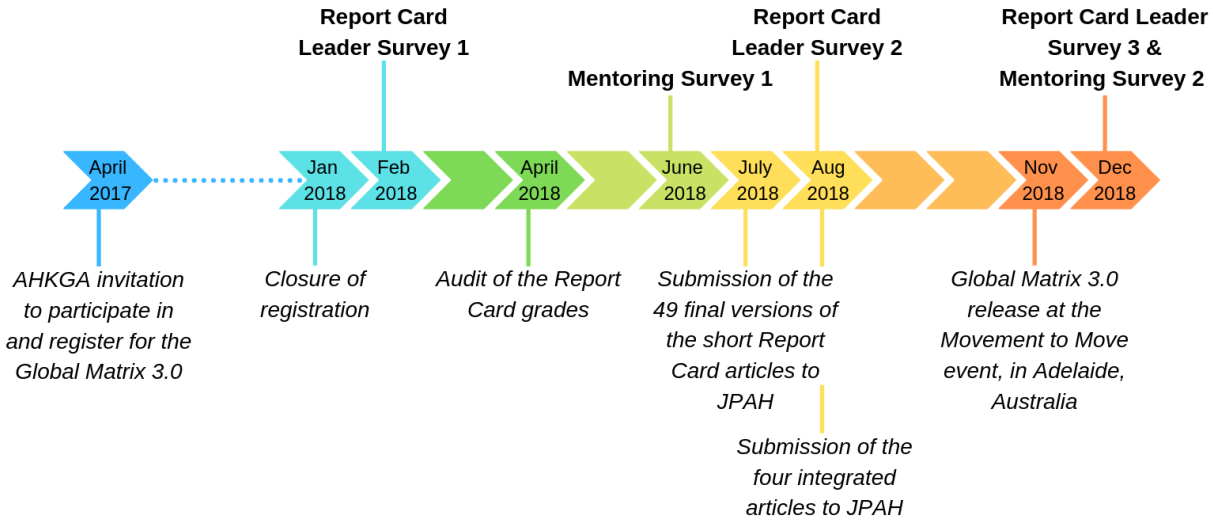


Figure 1: Timeline presenting the key steps of the Global Matrix 3.0 development and the time of the evaluation surveys. AHKGA = Active Healthy Kids Global Alliance; JPAH= Journal of Physical Activity and Health.

Figure 2: Number of page views in the AHKGA website member only section over the year 2018 provided by Google Analytics.

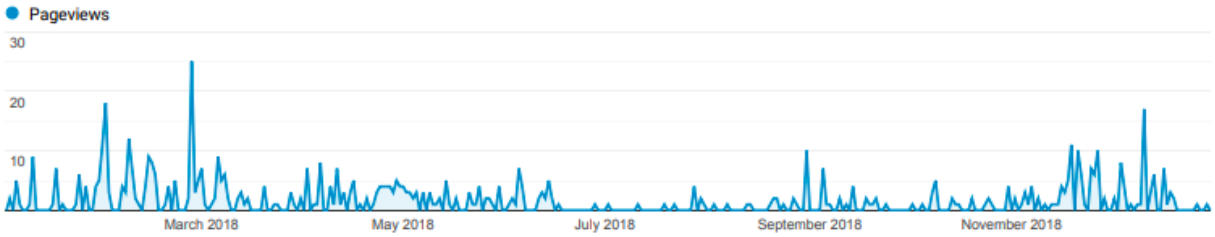
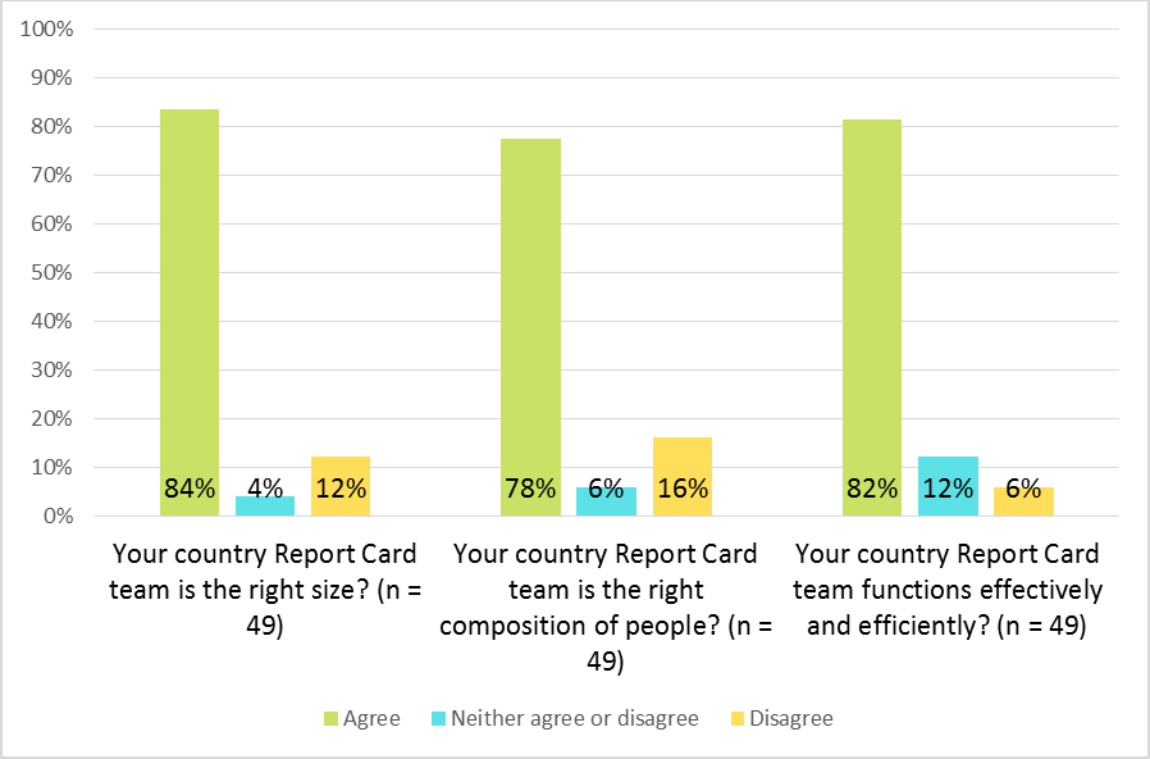


Figure 3: Satisfaction rates of the Report Card leaders collected in the Report Card Leader Surveys 1, 2, and 3 concerning the registration process (A), the Report Card team (B), the Report Card process (C), the final Report Card documents (D), the short Report Card articles and the integrated articles (E), the release of the Report Cards and of the Global Matrix 3.0 (F), the supportive resources provided by AHKGA (G), and the general satisfaction concerning the Global Matrix 3.0 (H).

A

B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78%
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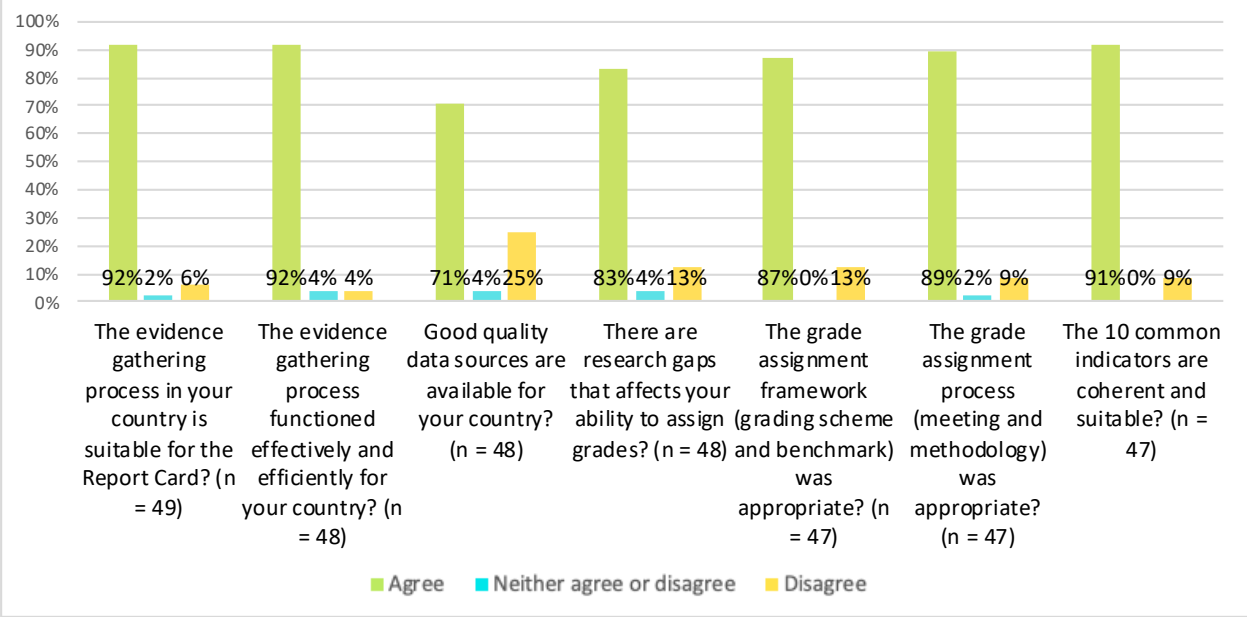
16%
82%
12%
6%
Your country Report Card team is the right size? (n = 49)
Your country Report Card team is the right composition of people? (n = 49)
Your country Report Card team functions effectively and efficiently? (n = 49)
Agree
Neither agree or disagree
Disagree

C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92% 2% 6%
92% 4% 4%
71% 4% 25%
83% 4% 13%
87% 0% 13%
89% 2% 9%
91% 0% 9%
The evidence gathering process in your country is suitable for the Report Card? (n = 49)
The evidence gathering process functioned effectively and efficiently for your country? (n = 48)
Good quality data sources are available for your country? (n = 48)
There are research gaps that affects your ability to assign grades? (n = 48)
The grade assignment framework (grading scheme and benchmark) was appropriate? (n = 47)
The grade assignment process (meeting and methodology) was appropriate? (n = 47)
The 10 common indicators are coherent and suitable? (n = 47)
Agree
Neither agree or disagree
Disagree

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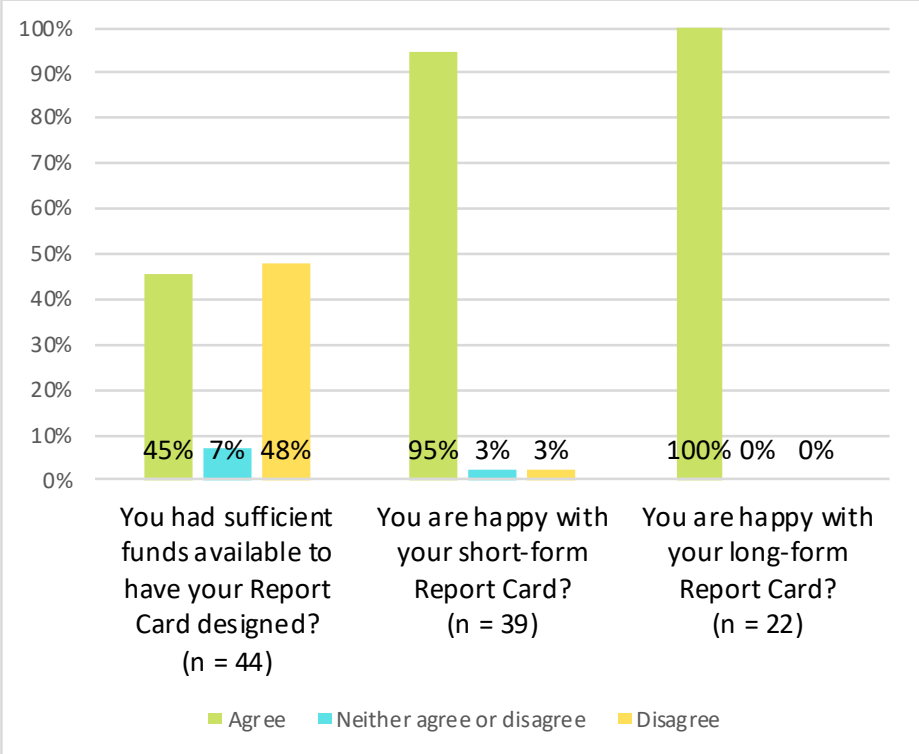
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You had sufficient funds available to have your Report Card designed? (n = 44)
You are happy with your short-form Report Card? (n = 39)
You are happy with your long-form Report Card? (n = 22)
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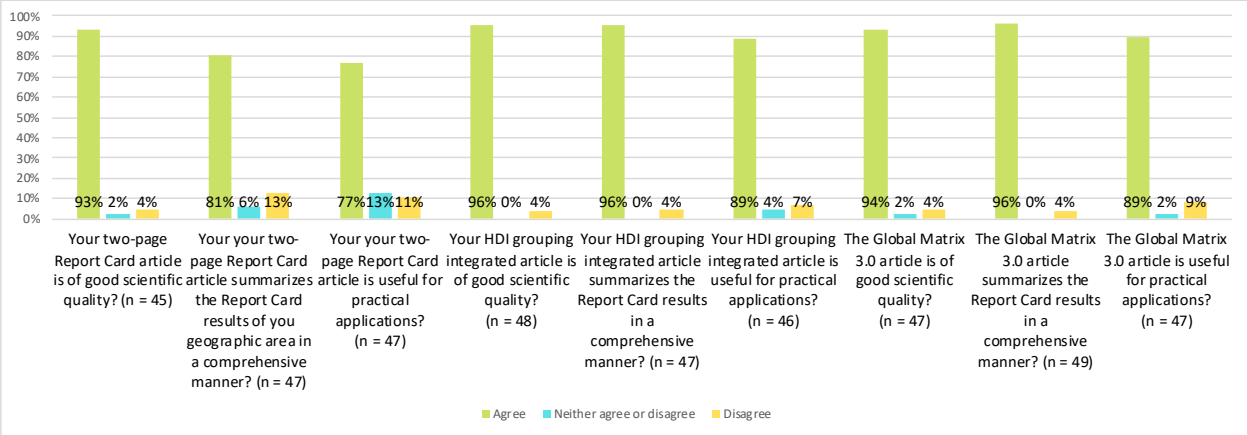
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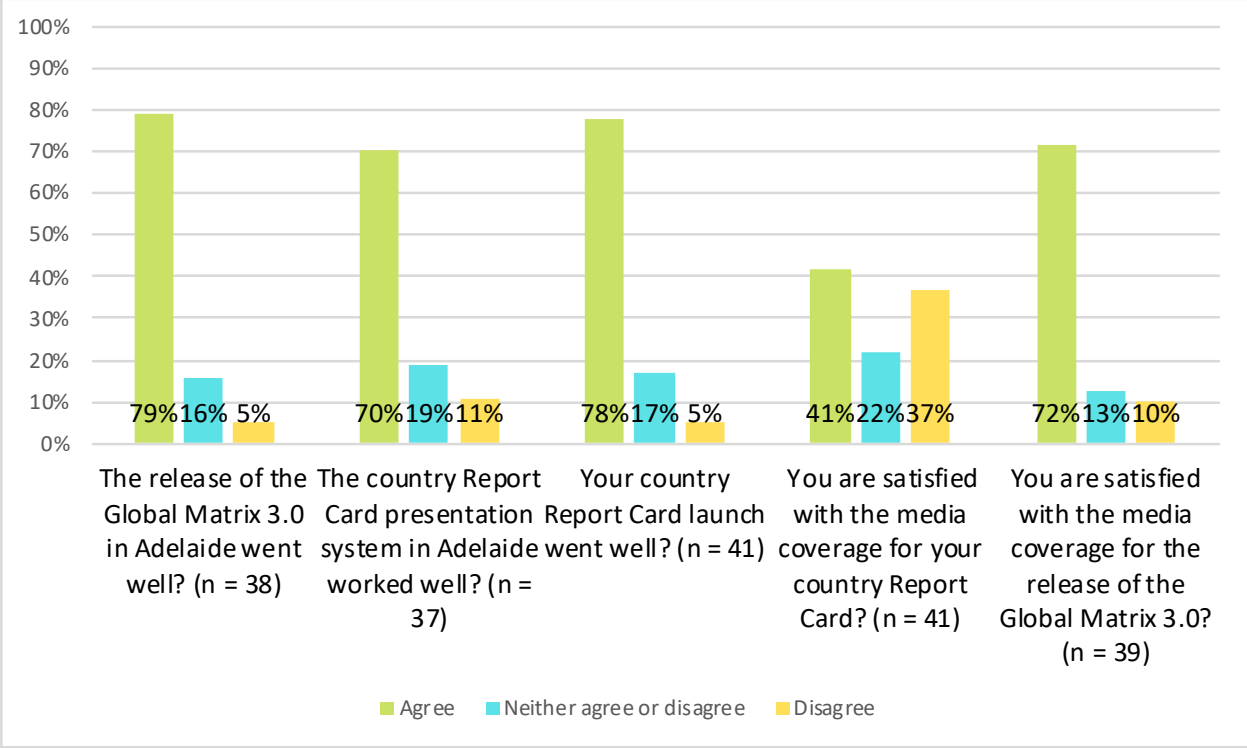
Your two-page Report Card article is of good scientific quality? (n = 45)
Your your two-page Report Card article summarizes the Report Card results of you geographic area in a comprehensive manner? (n = 47)
Your your two-page Report Card article is useful for practical applications? (n = 47)
Your HDI grouping integrated article is of good scientific quality? (n = 48)
Your HDI grouping integrated article summarizes the Report Card results in a comprehensive manner? (n = 47)
Your HDI grouping integrated article is useful for practical applications? (n = 46)
The Global Matrix 3.0 article is of good scientific quality? (n = 47)
The Global Matrix 3.0 article summarizes the Report Card results in a comprehensive manner? (n = 49)
The Global Matrix 3.0 article is useful for practical applications? (n = 47)
Agree
Neither agree or disagree
Disagree

F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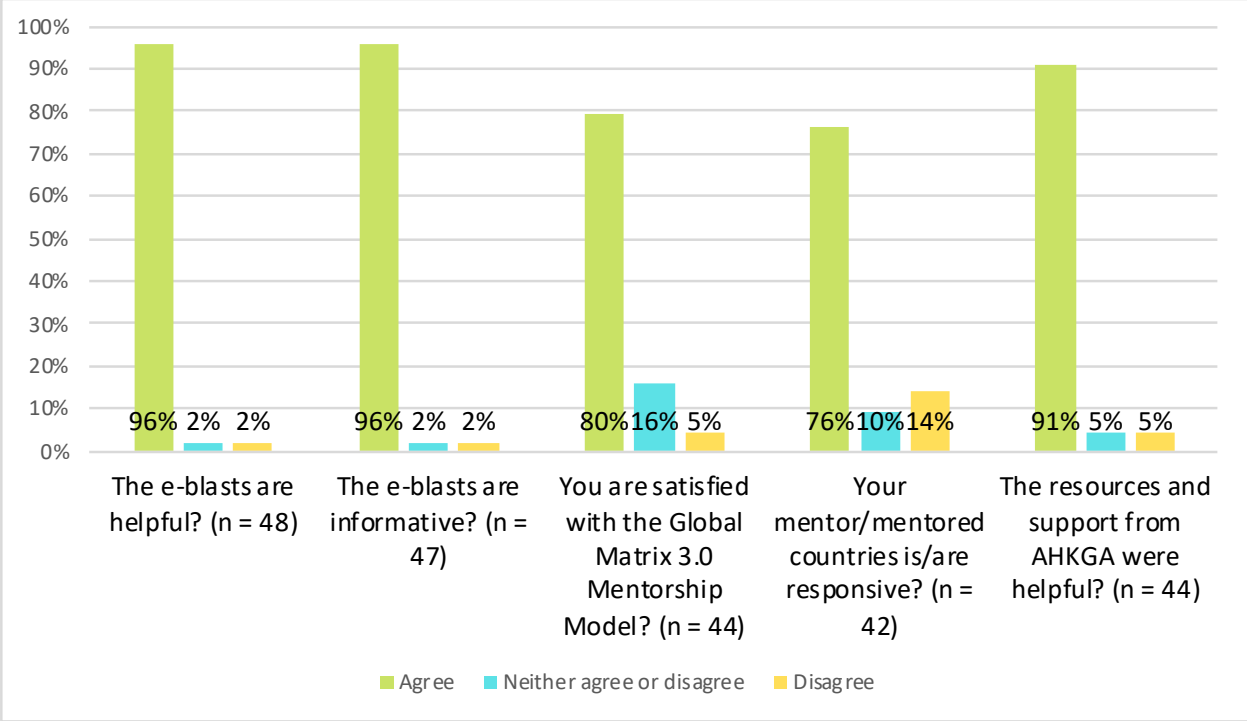
The release of the Global Matrix 3.0 in Adelaide went well? (n = 38)
The country Report Card presentation system in Adelaide worked well? (n = 37)
Your country Report Card launch went well? (n = 41)
You are satisfied with the media coverage for your country Report Card? (n = 41)
You are satisfied with the media coverage for the release of the Global Matrix 3.0? (n = 39)
Agree
Neither agree or disagree
Disagree

G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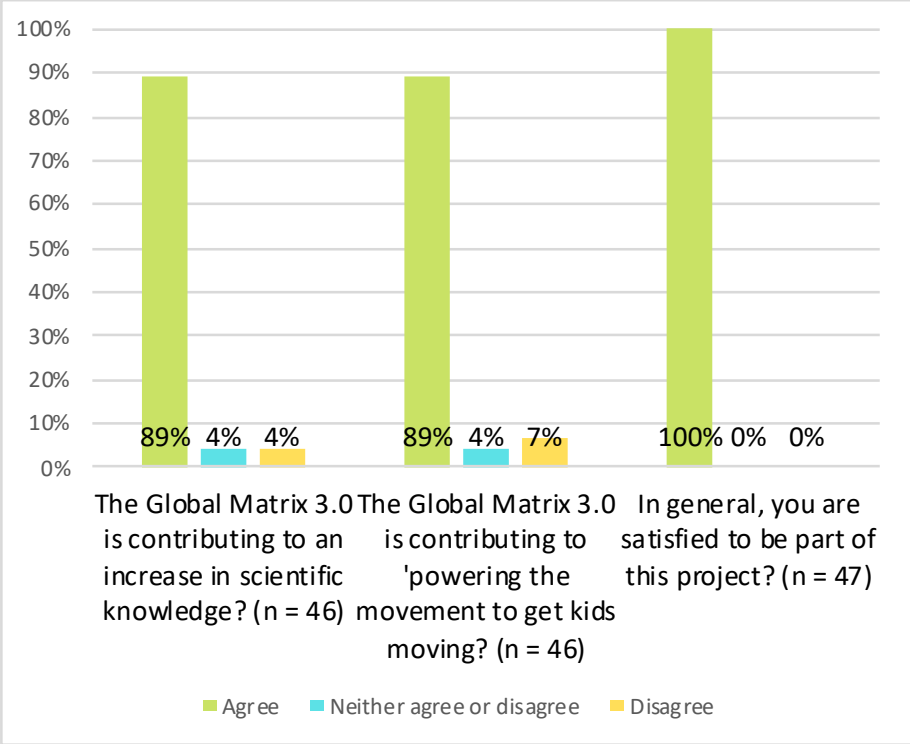
91% 5% 5%
The e-blasts are helpful? (n = 48)
The e-blasts are informative? (n = 47)
You are satisfied with the Global Matrix 3.0 Mentorship Model? (n = 44)
Your mentor/mentored countries is/are responsive? (n = 42)
The resources and support from AHKGA were helpful? (n = 44)
Agree
Neither agree or disagree
Disagree

H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The Global Matrix 3.0 is contributing to an increase in scientific knowledge? (n = 46)
The Global Matrix 3.0 is contributing to 'powering the movement to get kids moving? (n = 46)
In general, you are satisfied to be part of this project? (n = 47)
Agree
Neither agree or disagree
Disagree

Chapter 10: General Discussion

1. Summary of results

a. How has the development process from Global Matrix 1.0 evolved to today?

Between the early conceptualisation of the Global Matrix 1.0 in 2012 and launch of the Global Matrix 3.0 in 2018, the Global Matrix initiative has evolved from a spontaneous idea to a very anticipated and planned international research project. The information presented in Chapter 3 showed that in this short period of time, the Global Matrix initiative went through a remarkable evolution in terms of leadership, participating countries, registration, development operations, organizational management, and deliverables; while its core concept, the concurrent development of Report Cards of physical activity grades following an harmonised development process, remained the same.

AHKC innovated with the idea of the Global Matrix concept and the possibility of realizing international comparisons of physical activity grades, leading to the development of Global Matrix 1.0. The success of this first Global Matrix resulted in the creation of the AHKGA, who as an international network of researchers and stakeholders led the development of Global Matrix 2.0. In 2018, AHKGA became an officially incorporated not-for-profit organization that led the development of the Global Matrix 3.0. The growth and recognition of AHKGA as a leadership entity in the field of global surveillance and research in physical activity and health occurred in parallel with the evolution the Global Matrix initiative.

The great expansion of the Global Matrix initiative has also been observed in terms of participating countries. With 15 countries participating in the Global Matrix 1.0, 38 in the Global Matrix 2.0 (+153%), and 49 in the Global Matrix 3.0 (+29% in comparison with Global Matrix 2.0, +227% in comparison with Global Matrix 1.0), the number of participating countries has more than tripled in six years. The AHKGA was forced to innovate to adapt to this rapid increase of Report Card working groups to guide, and this impacted the registration fees and the management of the Global Matrix development. While it was

originally free to join the Global Matrix 1.0, Report Card working groups had to pay $500 USD registration fees to participate in the Global Matrix 2.0, and $500 USD to $1,500 USD to participate in the Global Matrix 3.0. The AHKGA Board of Directors also had to decentralize several tasks over time (e.g., mentoring new participating countries, quality control of Report Card physical activity grades) to reduce the burden of leading the development of the Global Matrix initiative on the AHKGA Board of Directors members. In addition, supporting the writing and funding the publication of one peer-review article for each country Report Card became unrealistic with the increasing number of participating countries and the AHKGA Board of Directors innovated new Global Matrix publication strategies (described in Chapter 3). The increased number of participating countries also provided better global representation and more statistical power for the Global Matrix initiative, allowing for more complex analyses.

Despite the aforementioned changes in the Global Matrix development process, the production of country Report Cards and the compilation and comparison of country physical activity grades remained the unchanged products of this initiative. Nevertheless, the specific harmonized process for the development of the Report Cards (target population, indicators, benchmarks, grading rubric) has and will continue to evolve, based on the feedback of the Global Matrix participants and on the scientific literature.

b. How do the report card grades vary across countries and why?

The Global Matrix 3.0 results presented in Chapter 6 showed that a total of 29 INC grades were assigned to the nine low to medium HDI countries, 25 INC grades were assigned to the 10 high HDI countries, and 67 INC grades were assigned to the 30 very high HDI countries. The average number of INC grades for the low and medium HDI, high HDI, and very high HDI countries were 3.2, 2.5, and 2.2, respectively. This result shows that it was generally more challenging for Report Card working groups from developing countries to find enough evidence to grade the Report Card indicators.

As shown in Chapter 6, the average physical activity grades obtained for each indicator in the Global Matrix 3.0 were low, with a small variation within the 10 indicators ("D" to "C"). More diversity was observed between the 3 HDI groupings (low and medium HDI countries, high HDI countries, and very high HDI countries), between the countries, and within each country. Higher behavioural grades and lower source of influence grades were generally observed in the low and medium HDI countries while the opposite was observed for the very high HDI countries, and generally low average grades were reported for each indicator in the high HDI countries.

More specifically, the participation of 49 countries in the Global Matrix 3.0 allowed studying the potential associations between child physical activity grades and some country sociodemographic indicators. The significant positive and negative correlations that were highlighted in Chapter 6 are briefly reviewed in this paragraph. Overall Physical Activity was negatively correlated with country HDI and growth national income per capita. Low to moderate positive associations were observed between Organized Sport and Physical Activity and numerous sociodemographic indicators (HDI, life expectancy at birth, mean years of schooling, growth national income per capita, public health expenditure, global food security index, improved drinking water coverage, and summer Olympic medal count) while small negative associations between Organized Sport and Physical Activity and the two inequality indices (Gini index and gender inequality index) were observed. Sedentary Behaviour was positively related to the mean years of schooling and negatively related to the summer Olympic medal count. Moderate positive associations between the School indicator and four sociodemographic indicators were observed (HDI, mean years of schooling, global food security index, and distance to equator) and moderate negative associations between the School indicator and the two inequality indices were observed (Gini index and gender inequality index). Positive moderate to strong associations between the Community and Environment indicator and HDI, life expectancy at birth, mean years of schooling, growth national income per capita, public health expenditure, global food security index, urban population percentage, improved drinking water coverage, and distance to equator were observed; and moderate to strong

negative associations were found between the Community and Environment indicator and the two inequality indices (Gini index and gender inequality index). Finally, the correlation analysis found moderate positive associations between the Government indicator and growth national income per capita, public health expenditure, improved water coverage, and distance to the equator, and moderate negative associations between the Government indicator and the two inequality indices (Gini index and gender inequality index). Collectively, these correlation analyses suggest that the source of influence indicators and the engagement of children and youth in organised sports are positively associated with favourable country sociodemographic indicators and negatively associated with country inequality indices; but Overall Physical Activity was negatively associated with favorable country sociodemographic indicators. This result aligns with the general observation of high sources of influence grades and low behavioural grades among the very high HDI countries. Efforts to provide environments and policies that are anticipated to be favourable for the engagement of children and youth in active behaviours are not reflected in an increase in the prevalence of physical activity, suggesting that there is a gap between the strategy level (source of influence indicators) and individual level (behavioral indicators), that government might be supporting the development of inefficient policies, and/or that we are still missing something in this equation.

Chapter 7 also provided insights on how the report card grades vary specifically within the 30 very high HDI countries. Again, the majority of very high HDI countries had better grades on the sources of influence levels, but this was not translated in positive outcomes concerning child physical activity and sedentary behaviour, indicating a gap between the policy intention and targeted individual behaviour. Chapter 5 also presented comparisons of the physical activity grades, between France and the other Global Matrix 3.0 participating countries. The only indicators standing-out in comparison with the 48 other countries participating in Global Matrix 3.0 were Physical Fitness and School. A “B-” was assigned to France for Physical Fitness, placing France among the top 10% of the countries for this indicator, and a “B” put France among the top third for the School indicator. However, when compared with Global

Matrix 3.0 European countries, France was less successful than the majority. France's grades were below the average for four of the indicators (Organized Sport and Physical Activity, Active Transportation, Sedentary Behaviour, and Government), equal to the average for Physical Activity, and above the average for two indicators (Physical Fitness and School). France got INC grades for the three remaining indicators (Active Play, Family and Peers, and Community and Environment). These findings showed that targeting an increased engagement in organized sports and active transportation among children and youth in France should be targeted with well-planned strategies. The successful policies promoting participation in organized sports and/or active transportation among children and youth implemented in Denmark, Finland, and Sweden should be studied to facilitate their adaptation to the French context.

Finally, Chapter 8 also provided results concerning the variations of the physical activity grades over time. The proportion of INC grades per Global Matrix was stable over time. However, half of the countries that participated in Global Matrix 1.0, Global Matrix 2.0 and Global Matrix 3.0 reported fewer INC grades in subsequent Report Cards, suggesting improvements in the surveillance of physical activity indicators in these countries, which could potentially be a positive effect of their participation in the Global Matrix initiative. The average grades per indicator were stable between the Global Matrix 1.0 Global Matrix 2.0, and Global Matrix 3.0, despite the participation of additional countries and modifications to the benchmarks and grading rubric. Overall, an average grade of "C," "C," and "C–" was observed for the Global Matrix 1.0, Global Matrix 2.0, and Global Matrix 3.0, respectively. As four years is likely not a long enough period to observe a significant letter grade change among the physical activity indicators, the stability of the grades between the Global Matrices may be an indicator of reliability of the Report Cards' standardized development process. When studying the evolution of the grades over time, several factors should be considered. The grades for the source of influence indicators are more likely to change within a shorter period than the behavioural indicator grades. Governmental institutions can develop and implement a new physical activity promotion policy/program in a relatively short time, but a longer period will be necessary for this policy/program to significantly affect physical

activity behaviours at the population level. In addition, the time necessary to observe a change also depends on which level the change is evaluated (e.g., local, national, international, global). Furthermore, standardized data collection and compilation is needed to be able to detect significant changes of grades over time. Hence, a 10 to 15 year window is likely needed to observe significant behavioural grade changes at the global level.

c. What has been the international impact of the Global Matrices and country Report Cards?

While caution is required for the interpretation of findings from the impact evaluation due to its limitations, Chapter 8 showed that the international impact of the Global Matrices and country Report Cards have had some demonstrable impact on powering the movement to get kids moving at both national and international levels. There is an accumulation of evidence and/or examples showing that the Global Matrix and Report Card initiative had a positive impact on generating capacity building in the national and international scientific community (e.g., several Report Card leaders reported that participating to the development of their national Report Card was a good training opportunity for their graduate students), on decreasing gaps in physical activity surveillance and research (e.g., after the publication of the first Chinese Report Card in 2016 focusing only on data from Shanghai, the Chinese Report Card team obtained support from public institutions and developed a national survey to evaluate the physical activity indicators annually), on increasing awareness and disseminating information to the general population and stakeholders (a compilation of the media hits related to the Report Cards and Global Matrices were presented in Chapter 8), and on powering the movement to get kids moving has been observed (e.g., following the publication of their first Report Card in 2016, showing that Chilean children and youth were among the least active in the world, Chile's Report Card working group assisted the government with the establishment of new regulations aiming to ensure that all children attending public schools are engaging in at least one hour of physical activity outside of physical education classes).

However, these positive impacts were not consistently observed in all countries that participated in the Report Card and Global Matrix initiative.

d. What can we learn from the Global Matrix 3.0 evaluation to further advance global childhood physical activity promotion efforts in the future?

The collective efforts of the Global Matrix 3.0 participants allowed for the collection of a variety of quantitative and qualitative information to evaluate the process, impact, and outcomes of the Global Matrix 3.0. Results from the evaluation of the process and findings indicators of the Global Matrix 3.0 are presented in Chapter 9. High Report Card leader satisfaction ratings were observed concerning the majority of the Global Matrix 3.0 harmonized development process, key steps, and concepts. The general overview of the Global Matrix 3.0 evaluation findings shows that despite the challenges and issues encountered, the Global Matrix 3.0 process facilitated the success of all participating Report Card working groups to submit their 10 Report Card grades, publish their short Report Card articles, and potentially have a positive impact nationally or internationally. However, several points of improvement were identified and a series of recommendations for future Global Matrix initiatives was provided in Chapter 9.

2. Summary of limitations and strengths

A number of limitations and strengths of this dissertation were detailed in the manuscripts presented in this thesis. They are summarized in this part.

a. Limitations

A major limitation to the Global Matrix 3.0 study was the amount of missing data to inform the physical activity grades. Including countries with a significantly large number of "INC" grades in the Global Matrix 3.0 is a limitation as it limited the comparisons. In addition, a great variability of the data was observed among the countries for each indicator in terms of benchmarks with data, measurement instrument, age range, sample size, data quality, and quantity of data. This is why the comparisons,

calculations of behavioural and sources of influence scores, correlations, and interpretations involving the grades are limited and should be interpreted with caution. Two identical grades for the same indicator can potentially capture very different contexts from one country to another. Additionally, a loss of information potentially occurred when translating original data to a letter grade, as letter grades provide less information than continuous variables. Another limitation of the Global Matrix 3.0 was the lack of representativeness of some areas of the world and some specific child and youth populations. For instance, the South Pacific islands, where the average body mass indices for child and youth were recently estimated to be the highest of the world[1] are missing, as well as countries from Central Asia and North Africa. Furthermore, national physical activity surveillance data almost exclusively focuses on adolescents, hence, 6-10 year-old children were under-represented in our analysis. In addition, children and youth with disabilities were excluded from the analysis, and the disparities and inequities across gender, socioeconomic status, or urban versus rural dwelling were mentioned in only a handful of Report Card articles; thus, they were not analyzed or discussed in the manuscripts presented in Chapter 6 and Chapter 7.

The evaluation of the impact of the Report Card and Global Matrices (presented in Chapter 8) faced several limitations including methodological challenges (e.g., evaluation relied partly on individual reports and survey responses; evaluation was designed by members of the AHKGA Board of Directors which may have introduced bias), unaccounted sources of cofounding (e.g., political climate in each country; baseline capacity for physical activity research; competing priorities), missing data, and data quality issues. As this evaluation process relied on individual reports and survey responses the results may be biased and/or incomplete, making countries that reported more detailed information to the AHKGA look more successful than others. Furthermore, findings presented in Table 2 of Chapter 9 showed that on average, only 10% of the Report Card team members were affiliated with a governmental institution. This could be limiting the impact of the Report Card development process as a greater

involvement of governmental institutions could potentially increase the policy response to this initiative for the promotion of physical activity.

The evaluation of the Global Matrix 3.0 process and outcomes (presented in Chapter 9) was limited by similar challenges. It relied essentially on responses to surveys and on reports made by the Report Card leaders, the Report Card team members, the mentors, and the AHKGA Board members. Consequently, the results could be biased and/or incomplete, potentially making the opinion of individuals who replied more consistently and reported more information weighting more than others. In addition, this evaluation plan was also designed and led by members of the AHKGA Board of Directors.

b. Strengths

With the 49 countries participating and the 10 common indicators being graded by each participating country, the Global Matrix 3.0 represents the most comprehensive and meaningful global comparison of the physical activity of children and youth. In addition, the identification and discussion of major trends concerning the characteristics of the physical activity of children and youth among the three HDI groupings were realized for the first time. The work presented in this dissertation shows that despite the great variability of the data informing the physical activity grades across countries and the potential loss of information associated with the translation of data into grades, the Global Matrix harmonized development process is a strategic and efficient way to synthetize the best available physical activity evidence and to perform international comparisons and analyses.

A similar initiative was developed to estimate the global prevalence of physical inactivity among adults: the Global Observatory for Physical Activity (GoPA!).[2] In contrast with the Global Matrix approach, estimates of the prevalence of physical inactivity were obtained using data from the WHO Repository. WHO data were replaced with a country's independent national estimate if a country contact suggested the change, if the prevalence was estimated using a standardized self-report instrument covering all-domains of physical activity (i.e., leisure-time, occupation, housework, and transport), and if the updated

WHO guidelines for physical activity were used to define the prevalence of physical inactivity.[2] In theory, this approach potentially enhanced comparability of estimates across countries; however, the questionnaires used to collect the physical activity information compiled in the WHO Repository were not validated against objective measurements of physical activity in all the languages and countries they were used. This limitation affects the comparability of the national physical activity estimates from GoPA! as the potential effect of cultural and language variability on the use of these physical activity questionnaires is unknown.

While the Global Matrix initiative included a greater variety of data, specific precautions were taken to improve the comparability of the grades between countries despite the variability of the data informing the grades. First, the best available published and unpublished evidence were identified and interpreted by teams of local/national experts (as opposed to having the national Report Cards developed externally by researchers not related to the noted countries). This was a strength of the Global Matrix approach for two reasons: 1. local/national experts are more informed and aware of the quality and limits of the available data, so more likely to perform a better selection and interpretation of the available evidence; 2. the mentoring of local/national experts for the development of their national Report Card is more likely to generate capacity building. An audit process (described in chapter 6) was also developed by the AHKGA Board of Directors to ensure that the grades were assigned respecting the harmonized grading framework. Furthermore, excluding the countries with insufficient data and/or imposing rules to assign "INC" grades when the data did not fit with the benchmarks for each indicator would have significantly reduced the number of countries and grades included and the relevance of conducting international comparisons. The Global Matrix 3.0 was possible as a result of the inclusive strategy adopted by the AHKGA.

In addition, even if most of the countries in the world are still not part of this international initiative, the Global Matrix and Report Card initiative brought a great network of researchers, health professionals, and stakeholder from most geographical regions together. The participation in the development of the Report Cards and the Global Matrices created networking opportunities for all participants involved. This close

collaboration of researchers at various stages of career, health professionals, and stakeholders generates several partnerships among researchers, and between researchers and relevant organizations, and allowed the mentoring of early career researchers in the field of physical activity and health. The AHKGA network forms a community with family-type relationship and information-sharing potential, resulting in capacity building and facilitating the identification of opportunities of further international research collaborations for the promotion of physical activity among children.

Efforts were made to identify and highlight major research and surveillance gaps in the peer-reviewed manuscripts presenting findings from the Global Matrix 3.0 and France's 2018 Report Cards. A transparent critique of the French national survey data collection and analysis methods was also provided. In addition, recommendations to improve the French grades were formulated in Chapter 5 and calls for actions to increase physical activity opportunities for all children and youth and decrease their sedentary behaviours were mentioned in the manuscripts presented in Chapter 6 and Chapter 7.

Finally, the manuscripts presented in Chapters 8 and 9 evaluating the international impact of the Global Matrices and Report Cards and the Global Matrix 3.0 process and findings indicators, were also the first of their kind. The anticipated design of this evaluation process allowed it to be informed prospectively by a rich variety of both quantitative and qualitative sources of information, including surveys, peer-reviewed publications, e-mails, and grey literature, among other sources. This evaluation process was led by physical activity experts that were involved in all the stages and levels (i.e. Report Card working groups and the AHKGA Board of Directors) of the Global Matrix development. Despite being a potential source of bias, as mentioned in the previous limitations part, a complete understanding of the Global Matrix and Report Card harmonized development process was essential to the design and understanding of this evaluation process. In addition, this evaluation plan allowed collecting feedback from the Report Card team at all the stages of development of the Global Matrix 3.0, allowing for the identification of potential issues that were still addressable at the moment they were raised.

3. Summary of Important Future Directions

There is a need to pursue the development, improvement, and expansion of the Global Matrix and Report Card initiative to power the movement to get kids moving. The AHKGA should aim to recruit more countries to participate in future Global Matrices to cover missing and underrepresented geographic areas, including the South Pacific, Northern and Central Africa, and Northern Asia. Findings presented in Chapter 5 (manuscript 2) highlighted the disparities across genders in terms of physical activity of children and youth in France, and a recent publication by Guthold and colleagues emphasized the physical activity disparity across gender at the global level.[3] Future Global Matrices should also include evaluation of the disparities and inequities across genders, socioeconomic status, and urban versus rural dwelling as well as the evaluation of the physical activity indicators for children and youth with a disability or chronic disease. More efforts also have to be made to improve the dissemination of all the Report Cards and Global Matrix findings through social media outlets at national, regional, and global levels. In addition, it would be of interest to develop a statistical method to attribute more weight to data with better quality included in the Global Matrix before performing comparisons and assessing how this approach would affect the findings.

Evaluation of the short, medium, and long term impact of the Report Card and Global Matrix initiative also needs to be expended. Similarly to the approach that was adopted by Ramirez and colleagues,[4] it would be interesting to develop a cross-sectional online survey to evaluate the use of the Report Cards and Global Matrix products across the Report Card's working group members. In addition, to evaluate the reach of the Report Cards beyond the academic sector, it would be interesting to complete this work with interviews of policy makers to assess their knowledge and opinion on the Report Cards. Finally it could be interesting to use the Health Enhancing Physical Activity Policy Analysis Tool (HEPA PAT)[5] on a regular basis to evaluate the evolution of the physical activity promotion policies and actions within the countries participating in the Global Matrix. Interviews or surveys addressed to the Report Card leaders

could be used to complete the HEPA PAT findings and identify potential policies or actions that were generated by the Report Card and Global Matrix activities.

The work presented in this thesis also highlighted the need for the development of globally accepted, adapted, and standardized physical activity data collection methods that all countries can follow in order to improve global surveillance, comparability and promotion of physical activity among children and youth of all ages, and abilities. More specifically, the development of measurement methods of the frequency, duration, and intensity of physical activity associated with the practice of sports or organized physical activities, the engagement in active transportation, and the engagement in active play is desirable to improve the comparability of data and provide a better representation of the current situation of physical activity among children at the global level. Consensus definitions and standardized measurement methods are also still needed for the assessment of the influence of the family and peers, school, community, built environment and policy environment on the physical activity of children and youth. In addition, the creation of specific programs is needed to provide additional support to the development of national physical activity surveillance systems in developing countries.

Finally, the findings presented in this dissertation highlighted the need to advocate for increasing physical activity opportunities for children and youth of all ages and abilities. The development and implementation of effective interventions within families, communities, and schools to promote physical activity and reduce sedentary behaviour are urgently needed, in particular in high and very high HDI countries.

4. Conclusion

The comprehensive summary of the Global Matrix 3.0 grades provided in this dissertation represents the richest source of child and youth physical activity information compiled to date. The Global Matrix harmonized development process is a strategic and efficient way to synthesize the best available physical activity evidence and to perform international comparisons and analyses despite inevitable variability of

physical activity data informing grades across countries. The Global Matrix and Report Card initiative had a positive impact on generating capacity building in the national and international scientific community, on decreasing gaps in physical activity surveillance and research, and on increasing awareness and disseminating information to the general population and stakeholders. This dissertation highlights the urgent need for international collaboration, collective efforts for the development of globally accepted, adapted, and standardized physical activity data collection methods, and emphasizes the emergency to address the persisting trend of low physical activity and high sedentary behaviour among children and youth worldwide. I hope that the work presented in this dissertation will facilitate the expansion of the Global Matrix, optimize its international impact and quality, and power the movement to get kids moving to contribute to the effort to reach the global target of the Action Plan for the Global Strategy for the Prevention and Control of Noncommunicable Diseases: "a 10% relative reduction in prevalence of insufficient physical activity."[6]

5. References

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Appendix A: Research Ethics Boards Approval – CHEO

02 February 2018

Dr. Mark Tremblay
HALO\HALO

Romeo# 20180024
REB# 18/08X
Title: Evaluation plan of the Development Process for the Global Matrix 3.0

Dear Dr. Tremblay,

The CHEO Research Ethics Board overseas all human research conducted at or through the hospital. In defining its scope, the REB adheres to Tri-Council definition of research as an undertaking intended to extend knowledge through a disciplined inquiry or systematic investigation. This is distinct from quality assurance/quality improvement/program evaluation activities that are intended to assess the performance of an organization/program or its staff, within the mandate of the organization/program.

The Interagency Advisory Panel on Research Ethics PRE has provided guidance on the distinction between quality assurance and research. The Panel states that quality assurance studies may share characteristics with research and in fact, may use scientific methods. In quality assurance, however, the data are used to advance the needs and functioning of the organization/program. By contrast, in research, data are used to answer a scientific question. The primary distinction between research and quality assurance is therefore, in their respective objectives, rather than the methods used. PRE released guidance regarding quality assurance, indicating that "publishing or otherwise disseminating the results of an activity is not a factor that determines whether the activity is research or not" (PRE guidance).

The REB determined that this project did not meet the TCPS 2 definition of research, as the objective of this project is to evaluate the general development process of Global Matrix 3.0, which is developed from version 2.0 and 1.0. The Global Matrix program, consisting of the Report Card on Physical Activity for Children and Youth, which is *a public-facing document* reporting letter grades, updated scientific information, research gaps, and recommendations for improvement on a number of physical activity indicators for children and youth, was developed and run in 14 countries in 2014 (Global Matrix 1.0), and in 37 additional countries in 2016 (Global Matrix 2.0).

Although the project is exempt from REB review and approval, please note that engagement in quality assurance/improvement requires the design of a measurement plan that is reasonable while protecting the confidentiality of participant data.

The application will be marked as withdrawn in ROMEO.

Should you have any questions or wish to discuss this further, please contact the office of the REB at extension 2128 or 3350.

Regards,

[redacted]

Richard Carpentier, Ph.D.
Chair, CHEO Research Ethics Board

Please note as well that personal health information (PHI) used in research should be stored securely.

- *Subject ID codes based on date of birth, ethnicity, hospital record number, and residency should be avoided. Variables that can be identifying of the person either alone or in combination must similarly be avoided. Instead, subjects should be coded with a study number that*

is not identifying of the individual. If needed, the hospital unique number can be linked to the study subject number in a separate password-protected and encrypted document.

- *Mobile/portable devices (e.g., laptops, USB keys, PDAs) that store research data should be password-protected, encrypted and stored in a secure manner.*

A final notice of approval will be issued when the Board has been provided with acceptable responses to the questions raised and evidence of the requested modifications to ***the study documentation (clean and tracked change copies). Please ensure that your response to this review includes an itemized response letter signed by the Principal Investigator that address all of the feedback noted above.*** *Please respond via ROMEO using an Investigators Response Event report.*

Please note that investigators must respond to REB feedback within ***90 days*** *from the date of the letter.*

Feedback from the CHEO REB may be shared as appropriate and required with other REBs that are also governed by TCPS.

Appendix B: Research Ethics Boards Approval – uOttawa

Aubert, Salome

From: Catherine Paquet [redacted]
Sent: mardi 15 mai 2018 16:32
To: Aubert, Salome; Ethics
Subject: RE: Need for a REB submission?

Hello Salomé,

Sorry for not responding to your request sooner.

Thank you for providing the documents. I can confirm that uOttawa agrees with the CHEO REB determination that the project does not require ethics review.

Please let me know if this email is not sufficient for your purposes.

Best regards,

Catherine

Catherine Paquet
Directrice, Bureau d'éthique et d'intégrité de la recherche | Director, Office of Research Ethics and Integrity
Université d'Ottawa | University of Ottawa
550 Cumberland (155) Ottawa ON K1N 6N5 Canada
Tél : [redacted]
Fax : [redacted]
http://www.recherche.uottawa.ca/deontologie/index.html

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Appendix C: Global Matrix 3.0 – Evaluation Plan (with survey questionnaires)

Global Matrix 3.0

EVALUATION PLAN

ACTIVE HEALTHY KIDS
GLOBAL ALLIANCE

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I. Background

In 2009, physical inactivity was identified as the fourth leading risk factor for non-communicable diseases (NCDs) (World Health Organization (WHO), 2009, p.V) behind high blood pressure, tobacco use and high blood glucose, and ahead of overweight and obesity. In 2008, physical inactivity was estimated to be responsible for 9% of premature mortalities or more than 5.3 million deaths worldwide (Lee et al., 2012). Based on these results, physical inactivity has been described as one of "*the biggest public health problems of the 21st century*" (Blair, 2009; Trost et al., 2014). The global prevalence of physical inactivity was estimated to be 31.1% for adults from 105 countries in 2012, (Hallal et al., 2012) and 81% for adolescents (11-to-17 years) in 2010 (WHO, 2014,). In addition, some studies have shown that individuals who engaged in low levels of physical activity during childhood were more likely to continue these behaviours in their adulthood, and thus, more likely to be obese as adults (Telama et al., 2005; Yang et al., 2006). Moreover, there has been an overall diminution in physical fitness in children and adolescents since 1975 (Tomkinson & Olds, 2007), and an increase in the prevalence of overweight and obesity for this age group in developed and developing countries between 1980 (8.1%) and 2013 (23.8%) (Ng et al., 2014). These findings suggest that a significant increase in non-communicable disease and disability can be anticipated if the physical inactivity crisis is not addressed (Lobstein et al., 2004).

In response to this growing concern, the Report Card on Physical Activity for Children and Youth was created in Canada in 2005. A thought leadership initiative, the Report Card is a public-facing document reporting letter grades, updated scientific information, research gaps, and recommendations for improvement on a number of physical activity indicators for children and youth. Grades are available for nine common indicators grouped into two categories: five daily behaviours (i.e., Overall Physical Activity, Organized Sport & Physical Activity Participation, Active Play, Active Transportation, and Sedentary Behaviours), and four settings and sources of influence (i.e., Family & Peers, School, Community & Environment, and Government). Designed to serve as a knowledge translation tool, to increase and accelerate the dissemination of physical activity research and evidence-based practice through effective and strategic synthesis, the Report Card has successfully contributed to the movement to help get children moving by influencing priorities, policies, and practice in Canada (Tremblay et al, 2014a; Tremblay et al, 2014b).

As part of a global movement toward physical activity surveillance, the Global Matrix of physical activity grades from several countries has emerged as an international research project developed in parallel to these other international initiatives and directives. The Report Card process was replicated in 14 additional countries from 5 continents, constituting the Global Matrix 1.0 that was released at the world's first Global Summit on the Physical Activity of Children in Toronto in 2014 (Tremblay, 2014c). All Report Cards were generated through a harmonized development process using the nine common indicators and a standardized grading framework similar to that of the Canadian Report Card (i.e., "A" = excellent to "F" = failing) (Tremblay et al., 2014b). The Summit brought together researchers, practitioners, policy-makers, and funders from the physical activity, sport, recreation, education, fitness, transportation, early childhood development, public health, and medical sectors from across the globe (Tremblay, 2014c). The 2014 Global Matrix was a successful pilot project, opening the door to

standardized international comparisons and highlighting strengths, disparities, inequities, research and surveillance gaps, and showing that no participating country had all the solutions. It facilitated the cross-fertilization of innovative solutions for countries with low grades to learn from those with high grades in particular areas/indicators.

Following the success of the world's first Global Summit on the Physical Activity of Children in Toronto in 2014, the Active Healthy Kids Global Alliance (AHKGA) was established (2015). The AHKGA is a network of researchers, health professionals and stakeholders, working together to advance physical activity in children and youth from around the world through the hosting of the Global Matrix project, and the sharing of methods and tools to support the development of national Report Cards. In July 2015, the AHKGA distributed an open call through established networks for interested countries to participate in the Global Matrix 2.0 project; 38 countries from 6 continents fully participated, indicating a 153% rise from the countries involved in the Global Matrix 1.0. The AHKGA organized the concurrent preparation of 38 Report Cards on the physical activity of children and youth and their aggregation, creating the Global Matrix 2.0 on Physical Activity of Children and Youth which was released in Bangkok in November 2016.

In the Global Matrix 2.0, good representation of most areas of the world was achieved, allowing the richest and most diverse comparison of physical activity related indicators for children and youth assembled to date (Tremblay et al., 2016). While extending the learning gained from the Global Matrix 1.0, it provided a useful framework for consolidating and assessing the best available evidence aimed at understanding differences between and within countries, and lent itself to creative and innovative learning opportunities across countries and continents (Tremblay et al., 2016). Several research and surveillance gaps were identified in the Global Matrix 2.0 paper, such as: expanding the Global Matrix 3.0 to include even greater global representation (most particularly in Middle East, South America, Pacific Islands, Caribbean Islands, and Russia); developing further research and surveillance of marginalized groups including children and youth with disabilities, new immigrants and refugees, and rural and remote communities; and, adding physical fitness as an indicator in future Report Card comparisons.

The Global Matrix 3.0 is now under development, with 52 countries fully registered, and will be launched in Adelaide, Australia in November 2018. While great progress was made between the Global Matrix 1.0 and Global Matrix 2.0, there is still a room for improvement for the Global Matrix. Several improvements were already made for this edition of the Global Matrix: the addition of a new indicator, *physical fitness*, and the creation of a new mentorship organisation. Now, each new country Report Card team will be paired with an Intermediate Mentor from a returning country, while all returning Report Card teams will still have a Regional Mentor available to provide help and guidance if needed, and all the regional Mentors will be mentored themselves by the AHKGA. The mentorship model is displayed in figure 1.

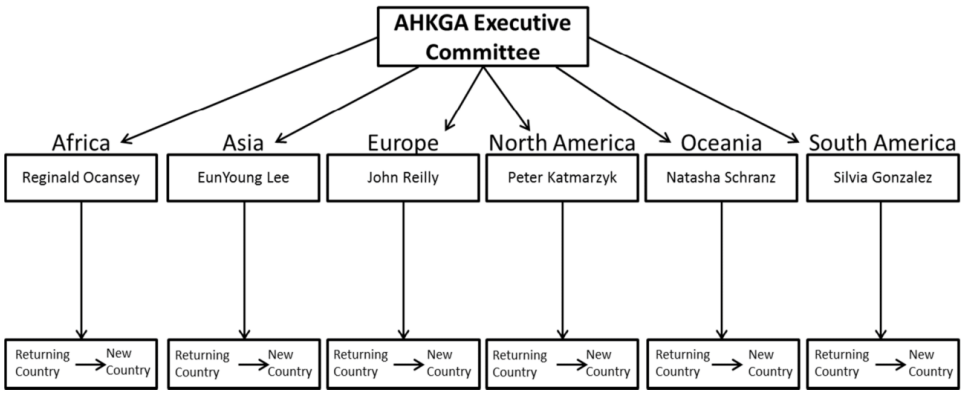

Figure 1: Global Matrix 3.0 mentorship structure

Based on experiences to date, further evaluation and optimization of the Global Matrix is essential. Participation in the Global Matrix represents a big investment in both work and financial terms for all the involved researchers and stakeholders so it is essential that we carefully reflect on opportunities to work more effectively and more efficiently in the future. The objective of this evaluation plan is to assess both positive and negative impacts of the Report Cards and Global Matrix 3.0 and to make adjustments during the current development process to optimize the success of this project.

II. Indicators to collect along the Global Matrix 3.0 Development Process

A. Process indicators

The process indicators measure progress at the different stages of project development or implementation. These indicators can be quantitative as well as qualitative and are based on the needs of the groups involved in implementing a program (Bloem et al., 2002). Process indicators being assessed include:

- **Participation**
    - Number of targeted countries
    - Number of participating countries
    - Number of returning countries
- **Country dropout**
    - Country dropout rate (%)

- Reasons for every drop out will be reported

This indicator relates to the participating countries fully registered in the Global Matrix 3.0 (i.e., who registered and paid the registrations fees) on time. Fifty-two countries from six continents met these criteria. The dropout rate (%) will be calculated after the launch of the Global Matrix 3.0 in November 2018. The reasons for dropout will be explored through by email questions and reported.

- **Number of participants (total Report Card team members)**

  - Total number of participants
  - Average participants per country
  - Variations in number of participants by country size, population, geographic location and Human Development Index
  - Dropout rate (%)
  - Reasons for every drop out will be reported

The country Report Card leaders will be asked to report the number of members involved in their Report Card Development Team/Committee at different stages of the Report Card development process (early development, late development, and post launch) through online surveys. They will also be asked to report if anyone has quit or join their team, and if yes to give the reason why.

- **Responsiveness, engagement and organization of participants**

  - **Responsiveness, engagement and organization of country Report Card leaders**

    - Rating on Likert scale though surveys

The intermediate and the regional mentors will be asked to rate the responsiveness, the engagement, and the organization of the country Report Card Leader(s)/team(s) they are mentoring on Likert scales through an online survey at different stages of the Report Card development process (late development and post launch).

    - Google Analytics: analytics of AHKGA website use

All country Report Card leaders were provided with individual access credentials for the "members only" section of the AHKGA website (www.activehealthykids.org/member-area) where guidance on the Report Card development process is provided. Google Analytics is web analytics software provided by Google that allows for the tracking of website traffic and usage such as the number of user visits (sessions), session duration and specific webpages accessed by users.

    - MailChimp: statistics of the proportion of Report Card leaders who are opening monthly e-blasts and clicking on any relevant links included in the e-blasts.

A newsletter including instructions, deadlines, and any other relevant information for the Report Card/ Global Matrix development process is sent monthly by Mark Tremblay on behalf of AHKGA. MailChimp

is email marketing software that provides users with a number of options when creating and sending emails. MailChimp also provides analytics on the number of recipients who received a given email, opened the email and clicked on any relevant links that were included in the email.

- **Responsiveness, engagement and organization of intermediate mentors**

  - Rating on Likert scale though surveys

The new Report Card leaders and the regional mentors will be asked to rate the responsiveness, the engagement and the organization of the intermediate mentors they are related to on Likert scales through an online survey at different stages of the Report Card development process (late development and post launch).

  - Time spent per week

The intermediate mentors will be asked to report the time per week they dedicate for mentoring through an online survey at different stages of the Report Card development process (late development and post launch).

- **Responsiveness, engagement and organization of regional mentors**

  - Rating on Likert scale though surveys

The new Report Card leaders and the intermediate mentors will be asked to rate the responsiveness, the engagement and the organization of the regional mentor they are related to on Likert scales through an online survey at different stages of the Report Card development process (late development and post launch).

  - Time spent by week

The Regional mentors will be asked to report the time per week they dedicate for mentoring through an online survey at different stages of the Report Card development process (late development and post launch).

- **Responsiveness, engagement and organization of AHKGA**

  - Rating on Likert scale though surveys

All the Report Card leaders who are not members of the AHKGA Executive Committee will be asked to rate the responsiveness, the engagement and the organization of the AHKGA on Likert scales through an online survey at different stages of the Report Card development process (late development and post launch).

  - Numbers of meetings held and attendance at meetings

For every AHKGA Executive Committee meeting, the attendance and the discussion are reported in a written record of discussion. The total number and duration of meetings will be calculated, as well as the attendance of the meeting (in percentage).

- **Collateral Impact**

Any positive and/or negative side products of the Global Matrix 3.0 development process will be collected (base on the report by the Global Matrix 3.0 participants in the surveys and by e-mails).

- **Satisfaction measures**

The satisfaction and the likeliness to be part of the next Global Matrix edition (4.0) of all the country Report Card leaders, mentors and AHKGA members will be assessed though online surveys.

B. Impact indicators

The impact indicators monitor the progress of achieving the program's objectives, which usually relate to some type of short-term changes such as changes in knowledge, attitudes and intended behaviour (Lobo et al. 2010). Here will be reported the indicators relating the impact in terms of networking, raising awareness among the general population, research and capacity building.

- **Number of key stakeholders involved per country/in total**

The total number of Global Matrix 3.0 participants (i.e. Report Card leaders and team members, mentors, and AHKGA members) will be calculated at different stages of the Report Card development process (late development and post launch).

- **Media coverage report**

All the Report Card leaders were instructed to report any media hit (on television, on internet, on radio or printed) to AHKGA. All the media hit will be compiled and summarized in a media coverage report.

- **Publications in peer review journal**

All the scientific articles related to the Report Cards and the Global Matrix 3.0 published in peer review journals will be reported. In addition, the impact of these research articles will be measured with article-level metrics using Altmetric (www.altmetric.com):

  - the number of citations in peer reviewed articles
  - the number of time it was twitted

- the number of time it was shared on Facebook
- the number of view on Research Gate

- **Examples/ case studies of other types of impact/Larger jurisdiction impact**

Any other type of relevant impact example that will be reported to AHKGA will be recorded.

C. Outcome indicators

The outcome indicators assess if the program goal has been achieved and are therefore more likely to include actual behaviours, health status and quality of life (longer term changes or changes sustained over time) (Lobo et al. 2010).

- **Global Matrix of physical activity indicator grades**

The main result of this project will be the final table combing all the Report Card indicator grades from all the participating countries. The total number of incomplete grades and the average number of incomplete grades per country and indicators will also constitute indicators.

- **Evolution of grades**

Statistical comparison of indicator grades from the Global Matrix 1.0, 2.0, and 3.0 will be completed to analyze the evolution of the grades (per indicators, per countries, per continent, etc.) and of the incomplete grades.

- **Examples/ case studies of other types of outcome**

Any other type of relevant outcome example that will be reported to AHKGA will be recorded.

III. Online Surveys

All the surveys will be developed using REDCap Software (Harris et al., 2009). REDCap (Research Electronic Data Capture) is a secure, web-based application designed exclusively to support data capture for research studies. REDCap provides:
1) An intuitive interface for data entry (with data validation);
2) 128 bit encryption between the data entry client and the server (https);
3) Audit trails for tracking data manipulation and export procedures;
4) Automated export procedures for seamless data downloads to common statistical packages (SPSS, SAS, Stata, R);
5) Procedures for importing data from external sources; and

6) Advanced features, such as branching logic and calculated fields.

REDCap is developed and maintained by a team at Vanderbilt University and licensed free of charge by the Research Institute at the Children's Hospital of Eastern Ontario (CHEO). The application and data are housed on servers provided by CHEO. These servers are located within CHEO's secure data centre. The data centre is physically secured through limited badge access and security cameras. Local support for REDcap is provided by CHEO's Clinical Research Unit.

Timeline of the surveys

The anticipated dates of release of the surveys are presented in Table 1 below.

Year	2018											
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Report Card leader surveys												
Baseline												
Late development												
Post-launch												
Mentoring surveys												
Late development												
Post-launch												

Table 1: Timeline of the Report Card leader surveys and mentoring surveys

List of appendices:

The PDF versions of the surveys are attached to this document in the appendices. Please note that **there are logical pathways for most of the questions** (i.e. the questions appearance depends on how the participant answered to previous question). REDcap does not allow printing all the possible versions of the questionnaire but only creates a version where the first answer is selected by default for each question.

Report Card leader surveys:

- Baseline: p.14
- Late development: p.21
- Post-launch: p.30

Mentoring surveys:

- Late development: p.43
- Post-launch: p.51

IV. Ethical considerations

For transparency reasons, this evaluation plan will have to be approved by the AHKGA Executive Committee and circulated to the entire Global Matrix 3.0 participants prior to its implementation.

V. References

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VI. Appendices

Report Card Leader survey - Baseline

Please complete the survey below.

Thank you!

---

1. Country information

Are you leading or co-leading a country Report Card?

- ◯ Leading
- ◯ Co-leading

How many co-leaders are you in your team?

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4

What country Report Card do you lead/co-lead?

- ◯ Australia
- ◯ Bangladesh
- ◯ Belgium
- ◯ Botswana
- ◯ Brazil
- ◯ Canada
- ◯ Chile
- ◯ China
- ◯ Chinese Taipei
- ◯ Colombia
- ◯ Cuba
- ◯ Czech Republic
- ◯ Denmark
- ◯ Ecuador
- ◯ England
- ◯ Estonia
- ◯ Ethiopia
- ◯ Finland
- ◯ France
- ◯ Germany
- ◯ Ghana
- ◯ Guernsey Channel Islands
- ◯ Hong Kong
- ◯ India
- ◯ Iran
- ◯ Japan
- ◯ Jersey
- ◯ Kenya
- ◯ Republic of Korea
- ◯ Lebanon
- ◯ Lithuania
- ◯ Mexico
- ◯ Morocco
- ◯ Mozambique
- ◯ Nepal
- ◯ Netherlands
- ◯ New Zealand
- ◯ Nigeria
- ◯ Poland
- ◯ Portugal
- ◯ Qatar
- ◯ Scotland
- ◯ Slovenia
- ◯ South Africa
- ◯ Spain
- ◯ Sweden
- ◯ Thailand
- ◯ United Arab Emirates
- ◯ United States
- ◯ Uruguay
- ◯ Venezuela
- ◯ Zimbabwe

What guidelines will you follow to determine the proportion of school-aged children and youth meeting guidelines for the Overall Physical Activity indicator?

- ◯ Our own national guidelines
- ◯ Other

Please provide reference or link:

2. Your Report Card development team

How many people are on your Report Card Development Team/Committee? _____

From what sectors? (Please choose as many as needed).

☐ Research ☐ Education ☐ Communication/ Marketing ☐ Policy development ☐ Health
☐ Government ☐ Sport ☐ Play ☐ Active transportation ☐ Community design/built environment
☐ Other

Please specify:

Are you concerned that you are missing important representation on your Report Card team?
◯ Yes
◯ No

If yes, what sectors are you missing?

Open space for comments:

3. The registration fees, registration process, e-blasts and the mentorship

The registration fee structure for the Global Matrix 3.0 was determined using the current Human Development Index rankings by country as follows:

- Low income: $500 USD
- Medium income: $750 USD
- High income: $1000 USD
- Very high income: $1500 USD

Upon reflection, do you feel that:

You were satisfied with the cost of the registration fee? (Slide the rating button to the desired response).

Strongly Agree | Disagree | Neither Agree Nor | Strongly Disagree

(Place a mark on the scale above)

You were satisfied with the registration process?

Strongly Agree | Disagree | Neither Agree Nor | Strongly Disagree

(Place a mark on the scale above)

The e-blasts are helpful?

Strongly Agree | Disagree | Neither Agree Nor | Strongly Disagree

(Place a mark on the scale above)

The e-blasts are informative?

Strongly Agree | Disagree | Neither Agree Nor | Strongly Disagree

(Place a mark on the scale above)

You are satisfied with the Global Matrix 3.0 Mentorship Model?

Strongly Agree | Disagree | Neither Agree Nor | Strongly Disagree

(Place a mark on the scale above)

Your mentor/mentored countries is/are responsive?

Strongly Agree | Disagree | Neither Agree Nor | Strongly Disagree

(Place a mark on the scale above)

In general, you are satisfied to be part of this project?

Strongly Agree | Disagree | Neither Agree Nor | Strongly Disagree

(Place a mark on the scale above)

Open space for comments:

Did you have a source of funding for the registration of your country to the Global Matrix? ◯ Yes ◯ No

If yes, what was the funding source?

Did you apply for funding to register your country to the Global Matrix? ◯ Yes ◯ No

If yes, what was the funding source?

4. Collection of data/information and suitability of the indicators

Do you anticipate that:

Good quality data sources will be available for your country?

Strongly Agree | Neither Agree Nor Disagree | Strongly Disagree

(Place a mark on the scale above)

There are research gaps that will affect your ability to assign grades?

Strongly Agree | Neither Agree Nor Disagree | Strongly Disagree

(Place a mark on the scale above)

The 10 common indicators are coherent and suitable?

Strongly Agree | Neither Agree Nor Disagree | Strongly Disagree

(Place a mark on the scale above)

Open space for comments:

Are you planning to have additional indicators in your country Report Card?
◯ Yes
◯ No

Please specify and give your rationale:

Are you planning to collect your own data for your Country Report Card?
◯ Yes
◯ No

Please explain how:

5. Report an issue

Is/are there any specific or general problem(s)/issue(s) you encountered that you want to report?	◯ Yes ◯ No

Please specify:

Report Card Leader survey - Late development

Please complete the survey below.

Thank you!

---

1. Country information

What country Report Card do you lead/ co-lead?

- ◯ Australia
- ◯ Bangladesh
- ◯ Belgium
- ◯ Botswana
- ◯ Brazil
- ◯ Canada
- ◯ Chile
- ◯ China
- ◯ Chinese Taipei
- ◯ Colombia
- ◯ Cuba
- ◯ Czech Republic
- ◯ Denmark
- ◯ Ecuador
- ◯ England
- ◯ Estonia
- ◯ Ethiopia
- ◯ Finland
- ◯ France
- ◯ Germany
- ◯ Ghana
- ◯ Guernsey Channel Islands
- ◯ Hong Kong
- ◯ India
- ◯ Iran
- ◯ Japan
- ◯ Jersey
- ◯ Kenya
- ◯ Republic of Korea
- ◯ Lebanon
- ◯ Lithuania
- ◯ Mexico
- ◯ Morocco
- ◯ Mozambique
- ◯ Nepal
- ◯ Netherlands
- ◯ New Zealand
- ◯ Nigeria
- ◯ Poland
- ◯ Portugal
- ◯ Qatar
- ◯ Scotland
- ◯ Slovenia
- ◯ South Africa
- ◯ Spain
- ◯ Sweden
- ◯ Thailand
- ◯ United Arab Emirates
- ◯ United States
- ◯ Uruguay
- ◯ Venezuela
- ◯ Zimbabwe

2. Your Report Card development team

How many people are on your Report Card Development Team/Committee? _____

Has one or more member of your country Report Card team quit? ◯ Yes ◯ No

Please explain how many and the reason why for each of them.

Has one or more member of your country Report Card team been recently added? ◯ Yes ◯ No

Please explain how many and the reason why for each of them.

Upon reflection, do you feel that your country Report Card team:

Is the right size?

Strongly Agree — Neither Agree Nor Disagree — Strongly Disagree

(Place a mark on the scale above)

Is the right composition of people?

Strongly Agree — Neither Agree Nor Disagree — Strongly Disagree

(Place a mark on the scale above)

Functions effectively and efficiently?

Strongly Agree — Neither Agree Nor Disagree — Strongly Disagree

(Place a mark on the scale above)

Please explain your ratings above:

3. Collection of data/information and suitability of the indicators

Up to this point, do you feel that:

The evidence gathering process in your country is suitable for the Report Card?

Strongly Agree — Neither Agree Nor Disagree — Strongly Disagree

(Place a mark on the scale above)

The evidence gathering process functioned effectively and efficiently for your country?

Strongly Agree — Neither Agree Nor Disagree — Strongly Disagree

(Place a mark on the scale above)

Good quality data sources are available for your country?

Strongly Agree — Neither Agree Nor Disagree — Strongly Disagree

(Place a mark on the scale above)

There are research gaps that affects your ability to assign grades?

Strongly Agree — Neither Agree Nor Disagree — Strongly Disagree

(Place a mark on the scale above)

The 10 common indicators are coherent and suitable?

Strongly Agree — Neither Agree Nor Disagree — Strongly Disagree

(Place a mark on the scale above)

Please explain your ratings above:

Did you uncover data/evidence you were unaware of? ◯ Yes ◯ No

Please specify:

4. Synthesis/Interpretation of information and suitability of benchmarks

Up to this point, do you feel that:

The data synthesis and interpretation process was suitable for the Report Card?

Strongly Agree — Neither Agree Nor — Disagree — Strongly Disagree

(Place a mark on the scale above)

The data synthesis and interpretation process functioned effectively and efficiently for your country?

Strongly Agree — Neither Agree Nor — Disagree — Strongly Disagree

(Place a mark on the scale above)

You are confident with the quality of the data synthesis and interpretation in your report card?

Strongly Agree — Neither Agree Nor — Disagree — Strongly Disagree

(Place a mark on the scale above)

The benchmarks provided were helpful?

Strongly Agree — Neither Agree Nor — Disagree — Strongly Disagree

(Place a mark on the scale above)

The benchmarks provided were appropriate?

Strongly Agree — Neither Agree Nor — Disagree — Strongly Disagree

(Place a mark on the scale above)

Please explain your ratings above: _____

5. AHKGA Website

Do you check the AHKGA website for updates?

Never Sometimes Very often

(Place a mark on the scale above)

Do you use the "Member Area" section of the website?

Never Sometimes Very often

(Place a mark on the scale above)

Do you have any suggestions to improve the website? ◯ Yes ◯ No

If yes, what suggestions do you have?

6. Strengthening research capacity

Do you have funding to develop and produce your Report Card? ◯ Yes ◯ No

Please list source(s):

Do you have funding to attend the Global Matrix 3.0 release and present your country Report Card in Adelaide? ◯ Yes ◯ No

Please list source(s):

Have you applied for funding? ◯ Yes ◯ No

If so, please list all applications:

Do you have access to a scientific library during the Report Card development process? ◯ Yes ◯ No

Open space for comments:

7. Your personal participation

Up to this point, do you feel that:

In general, you are satisfied to be part of this project?

Strongly Agree	Neither Agree Nor Disagree	Strongly Disagree

(Place a mark on the scale above)

Please explain your rating above:

8. Reporting an issue

Is/are there any specific or general problem(s)/issue(s) you encountered that you want to report? ◯ Yes ◯ No

If yes, please explain:

Do you have any other comment/suggestion?

Report Card Leader survey - Post launch

Please complete the survey below.

Thank you!

---

1. Country information

What country Report Card did you lead/co-lead?

- ◯ Australia
- ◯ Bangladesh
- ◯ Belgium
- ◯ Botswana
- ◯ Brazil
- ◯ Canada
- ◯ Chile
- ◯ China
- ◯ Chinese Taipei
- ◯ Colombia
- ◯ Cuba
- ◯ Czech Republic
- ◯ Denmark
- ◯ Ecuador
- ◯ England
- ◯ Estonia
- ◯ Ethiopia
- ◯ Finland
- ◯ France
- ◯ Germany
- ◯ Ghana
- ◯ Guernsey Channel Islands
- ◯ Hong Kong
- ◯ India
- ◯ Iran
- ◯ Japan
- ◯ Jersey
- ◯ Kenya
- ◯ Republic of Korea
- ◯ Lebanon
- ◯ Lithuania
- ◯ Mexico
- ◯ Morocco
- ◯ Mozambique
- ◯ Nepal
- ◯ Netherlands
- ◯ New Zealand
- ◯ Nigeria
- ◯ Poland
- ◯ Portugal
- ◯ Qatar
- ◯ Scotland
- ◯ Slovenia
- ◯ South Africa
- ◯ Spain
- ◯ Sweden
- ◯ Thailand
- ◯ United Arab Emirates
- ◯ United States
- ◯ Uruguay
- ◯ Venezuela
- ◯ Zimbabwe

2. The e-blasts and the mentorship

Upon reflection, do you feel that:

The e-blasts were helpful?

Strongly Agree | Neither Agree Nor Disagree | Strongly Disagree

(Place a mark on the scale above)

The e-blasts were informative?

Strongly Agree | Neither Agree Nor Disagree | Strongly Disagree

(Place a mark on the scale above)

Your mentor was helpful?

Strongly Agree | Neither Agree Nor Disagree | Strongly Disagree

(Place a mark on the scale above)

Your mentor was responsive?

Strongly Agree | Neither Agree Nor Disagree | Strongly Disagree

(Place a mark on the scale above)

Your mentor was knowledgeable?

Strongly Agree | Neither Agree Nor Disagree | Strongly Disagree

(Place a mark on the scale above)

Mentorship is an important part of the Global Matrix initiative?

Strongly Agree | Neither Agree Nor Disagree | Strongly Disagree

(Place a mark on the scale above)

Please explain your ratings above:

3. Grade assignment and suitability of grade assignment framework

Upon reflection, do you feel that:

The grade assignment framework (rating scale and benchmark) was appropriate?

Strongly Agree — Neither Agree Nor — Disagree — Strongly Disagree

(Place a mark on the scale above)

The grade assignment process (meeting and methodology) was appropriate?

Strongly Agree — Neither Agree Nor — Disagree — Strongly Disagree

(Place a mark on the scale above)

The grade assignment process functioned well for your country?

Strongly Agree — Neither Agree Nor — Disagree — Strongly Disagree

(Place a mark on the scale above)

You are confident with the accuracy of the grades in your Report Card?

Strongly Agree — Neither Agree Nor — Disagree — Strongly Disagree

(Place a mark on the scale above)

Please explain your ratings above:

Do you want to suggest another grade assignment framework? ◯ Yes ◯ No

Please specify and give your rationale:

Upon reflection, do you feel that:

You had sufficient funds available to have your Report Card designed?

Strongly Agree — Neither Agree Nor — Disagree — Strongly Disagree

(Place a mark on the scale above)

Please explain your ratings above:

4. Report card presentation

Upon reflection, do you feel that:

The design elements had a positive effect on your country Report Card (i.e. clarity, appeal, ...)?

Strongly Agree — Neither Agree Nor — Disagree — Strongly Disagree

(Place a mark on the scale above)

The resources and support from AHKGA were helpful?

Strongly Agree — Neither Agree Nor — Disagree — Strongly Disagree

(Place a mark on the scale above)

You are happy with your short-form Report Card?

Strongly Agree — Neither Agree Nor — Disagree — Strongly Disagree

(Place a mark on the scale above)

You are happy with your long-form Report Card?

Strongly Agree — Neither Agree Nor — Disagree — Strongly Disagree

(Place a mark on the scale above)

You are satisfied with the journal choice for the publication of your regional article?

Strongly Agree — Neither Agree Nor — Disagree — Strongly Disagree

(Place a mark on the scale above)

Please explain your ratings above:

Do you have a dedicated website/website page for your country Report Card? ◯ Yes ◯ No

Can you give the link to the website?

Do you have an online social media account dedicated to the promotion of your report card and/or the Global Matrix 3.0? ◯ Yes ◯ No

Please specify:

Open space for comments:

5. Your Global Matrix 3.0 Regional article

Upon reflection, do you feel that:

The contribution from multiple authors to your Global Matrix 3.0 regional article worked well?

Strongly Agree | Neither Agree Nor Disagree | Strongly Disagree

(Place a mark on the scale above)

You are satisfied with your contribution to your Global Matrix 3.0 regional paper?

Strongly Agree | Neither Agree Nor Disagree | Strongly Disagree

(Place a mark on the scale above)

Your Global Matrix 3.0 regional article is of good scientific quality?

Strongly Agree | Neither Agree Nor Disagree | Strongly Disagree

(Place a mark on the scale above)

Your Global Matrix 3.0 regional article summarizes the Report Card results of you geographic area in a comprehensive manner?

Strongly Agree | Neither Agree Nor Disagree | Strongly Disagree

(Place a mark on the scale above)

Your Global Matrix 3.0 regional article is useful for practical applications?

Strongly Agree | Neither Agree Nor Disagree | Strongly Disagree

(Place a mark on the scale above)

Please explain your ratings above:

Do you plan on publishing an article for your own Report Card? ◯ Yes ◯ No

Please specify (intended journal, publication/ writing stage):

6. The main Global Matrix 3.0 article

Upon reflection, do you feel that:

The contribution from multiple authors to the Global Matrix 3.0 article worked well?

Strongly Agree | Neither Agree Nor Disagree | Strongly Disagree

(Place a mark on the scale above)

You are satisfied with your contribution to the Global Matrix 3.0 article?

Strongly Agree | Neither Agree Nor Disagree | Strongly Disagree

(Place a mark on the scale above)

The Global Matrix 3.0 article is of good scientific quality?

Strongly Agree | Neither Agree Nor Disagree | Strongly Disagree

(Place a mark on the scale above)

The Global Matrix 3.0 article summarizes the Report Card results in a comprehensive manner?

Strongly Agree | Neither Agree Nor Disagree | Strongly Disagree

(Place a mark on the scale above)

The Global Matrix 3.0 article is useful for practical applications?

Strongly Agree | Neither Agree Nor Disagree | Strongly Disagree

(Place a mark on the scale above)

Please explain your ratings above:

7. Outcomes

For analysis purposes, can you report the following information concerning the data source(s) for the physical activity and the sedentary behaviour indicators?

What was the main method of physical activity measurement in the data used to inform your report card?

◯ Objective ◯ Self-reported ◯ Mixed

Please describe briefly the method employed in the study informing the physical activity grade (number of studies included, questionnaire(s) or objective method used, ...):

What was the main method of sedentary behaviour measurement in the data used to inform your report card?

◯ Objective ◯ Self-reported ◯ Mixed

Please describe briefly the method employed in the study informing the sedentary behaviour grade (number of studies included, questionnaire(s) or objective method used, ...):

8. The Global Matrix 3.0 launch

Upon reflection, do you feel that:

The release of the Global Matrix 3.0 in Adelaide went well?

Strongly Agree — Neither Agree Nor — Disagree — Strongly Disagree

(Place a mark on the scale above)

The country Report Card presentation system in Adelaide worked well?

Strongly Agree — Neither Agree Nor — Disagree — Strongly Disagree

(Place a mark on the scale above)

Your country Report Card launch went well?

Strongly Agree — Neither Agree Nor — Disagree — Strongly Disagree

(Place a mark on the scale above)

Please explain your ratings above:

9. Impact, success and issues

Upon reflection, do you feel that:

You are satisfied with the media coverage for your country Report Card?

Strongly Agree — Neither Agree Nor — Disagree — Strongly Disagree

(Place a mark on the scale above)

You are satisfied with the media coverage for the release of the Global Matrix 3.0?

Strongly Agree — Neither Agree Nor — Disagree — Strongly Disagree

(Place a mark on the scale above)

The Global Matrix 3.0 is contributing to an increase in scientific knowledge?

Strongly Agree — Neither Agree Nor — Disagree — Strongly Disagree

(Place a mark on the scale above)

The Global Matrix 3.0 is contributing to "powering the movement to get kids moving"?

Strongly Agree — Neither Agree Nor — Disagree — Strongly Disagree

(Place a mark on the scale above)

Please explain your ratings above:

Do you expect your Report Card to have a positive influence on powering the movement to get kids moving' in your country? ◯ Yes ◯ No

If so, how? (Check all that apply)

☐ Increased public awareness
☐ Improved ability to keep up with research in the field, identifying research gaps and surveillance needs
☐ Improved capacity for advocacy
☐ Improved communications and public relations
☐ Created program development and training
☐ Forming partnerships
☐ Created policy/strategy development
☐ Briefing senior staff and elected officials
☐ Created revenue generation/proposals
☐ Other

Please specify:

Do you think the Global Matrix 3.0 provides other benefits to society?

◯ Yes
◯ No

Please explain:

10. Your personal participation

Upon reflection, do you feel that:

Participating in the Global Matrix 3.0 was enjoyable?

Strongly Agree | Neither Agree Nor Disagree | Strongly Disagree

(Place a mark on the scale above)

Participating in the Global Matrix 3.0 was personally rewarding?

Strongly Agree | Neither Agree Nor Disagree | Strongly Disagree

(Place a mark on the scale above)

Participating in the Global Matrix 3.0 was professionally rewarding?

Strongly Agree | Neither Agree Nor Disagree | Strongly Disagree

(Place a mark on the scale above)

Please explain your ratings above:

What was the biggest challenge/obstacle to developing your country's Report Card?

What was the biggest success in developing your country's Report Card?

What was the biggest challenge/obstacle to participating in the Global Matrix 3.0 (if different from above)?

What was the biggest success you achieved as a result of participating in the Global Matrix 3.0 ?

11. Perspectives

Are you (or someone else in your country) planning on participating in the Global Matrix 4.0?	◯ Yes	◯ No	◯ Unsure
Would you be interested in supporting, tutoring, and/or mentoring new country report card leaders?	◯ Yes	◯ No	◯ Unsure

Open space for comments:

12. Reporting an issue/ success story

Is/are there any specific or general problem(s)/issue(s) you encountered during your Report Card/the Global Matrix 3.0 development process that you want to report? ◯ Yes ◯ No

Please describe:

Do you have any other comment/suggestion? ◯ Yes ◯ No

Please describe:

Do you have any success story/ies related to your Report Card or your general participation in the Global Matrix 3.0 that you are willing to share? ◯ Yes ◯ No

Please describe:

Mentoring survey - Late development

Dear Report Card Leaders,

This survey aims to evaluate several aspects of the mentorship organization for the Global Matrix 3.0. Please see below for a summary of the mentorship organization.

Mentoring is characterized by three main levels:

Information on the AHKGA website is available for your reference, including background papers, previous report card papers, previous report cards, indicator and benchmark definitions, grading scheme, previous recommendations for improving the grade, fundraising suggestions, etc. Central support from the AHKGA Executive Committee provides guidance through e-blasts, information sharing, milestones, potential funding opportunities, advance planning suggestions, etc.

The regional mentors for the continents will ensure coordination and timeliness of the report card development for each country in their region. They will also serve as an experienced resource for both new countries and new mentors within their region.

The intermediate mentors will be the first and most regular point of contact for new countries, providing ongoing advice and guidance.

Thank you!

1. Intermediate mentor information

Are you an intermediate mentor for one or several countries?

◯ Yes
◯ No

How many countries are you the intermediate mentor for?

◯ 1
◯ 2
◯ 3

Which countries are you mentoring?

☐ Bangladesh
☐ Botswana
☐ Bulgaria
☐ Chile
☐ Chinese Taipei
☐ Cuba
☐ Czech Republic
☐ Ecuador
☐ Ethiopia
☐ France
☐ Germany
☐ Guernsey Channel Islands
☐ Iran
☐ Jersey
☐ Lebanon
☐ Lithuania
☐ Nepal
☐ Uruguay

Are you mentoring or co-mentoring these countries?

◯ Mentoring
◯ Co-mentoring

Please explain:

Is it the first time for you to be a mentor?

◯ Yes
◯ No

Do you have an intermediate mentor? (It should be the case if it is your first time participating in the Global Matrix).

◯ Yes
◯ No

Please enter the name and country of your intermediate mentor(s).

_____

2. Intermediate mentoring

If you are not an intermediate mentor or do note have an intermediate mentor, please skip this part.

On average, how many hours per week was spent mentoring?

◯ < 1
◯ 1
◯ 2
◯ 3
◯ 4
◯ 5
◯ >5

Please explain what you did during the time you were mentoring:

Are there any issues you encountered during your mentorship that you want to report?

◯ Yes
◯ No

Please specify:

How would you rate (on a scale from 1 to 10):

The responsiveness of the Report Card team/leader you are mentoring?

1 5 10

(Place a mark on the scale above)

How would you rate (on a scale from 1 to 10):

The engagement in the global matrix process of the Report Card team/leader you are mentoring?

1 5 10

(Place a mark on the scale above)

How would you rate (on a scale from 1 to 10):

The overall organization of the Report Card team/leader you are mentoring?

1 5 10

(Place a mark on the scale above)

Can you rate the following for each country you are mentoring? (Please specify first which country you are rating).

Country 1:

_____

How would you rate (on a scale from 1 to 10):

The responsiveness of the country 1 team/leader?

1 5 10

(Place a mark on the scale above)

How would you rate (on a scale from 1 to 10):

The engagement in the global matrix process of the country 1 team/leader?

1 5 10

(Place a mark on the scale above)

How would you rate (on a scale from 1 to 10):

The overall organization of the country 1 team/leader?

1 5 10

(Place a mark on the scale above)

Country 2:

_____

How would you rate (on a scale from 1 to 10):

The responsiveness of the country 2 team/leader?

1 5 10

(Place a mark on the scale above)

How would you rate (on a scale from 1 to 10):

The engagement in the global matrix process of the country 2 team/leader?

1 5 10

(Place a mark on the scale above)

How would you rate (on a scale from 1 to 10):

The overall organization of the country 2 team/leader?

1 5 10

(Place a mark on the scale above)

Country 3:

_____

How would you rate (on a scale from 1 to 10):

The responsiveness of the country 3 team/leader?

1 5 10

(Place a mark on the scale above)

How would you rate (on a scale from 1 to 10):

The engagement in the global matrix process of the country 3 team/leader?

1 5 10

(Place a mark on the scale above)

How would you rate (on a scale from 1 to 10):

The overall organization of the country 3 team/leader?

1 5 10

(Place a mark on the scale above)

Are there any issues you encountered during your mentorship that you want to report?

◯ Yes
◯ No

Please specify:

How would you rate (on a scale from 1 to 10):

The responsiveness of your intermediate mentor(s)?

1 5 10

(Place a mark on the scale above)

How would you rate (on a scale from 1 to 10):

The engagement in the global matrix process of your intermediate mentor(s)?

1 5 10

(Place a mark on the scale above)

How would you rate (on a scale from 1 to 10):

The overall organization of your intermediate mentor(s)?

1 5 10

(Place a mark on the scale above)

3. Regional Mentoring

Are you a regional mentor? ◯ Yes ◯ No

What region are you mentoring?

◯ Africa ◯ Asia ◯ Europe ◯ North America ◯ Oceania ◯ South America

How would you rate, on a scale from 0 to 10, the responsiveness of all the Report Card leader/team you are mentoring?

Please reply following this model:
Country name 1 - grade
Country name 2 - grade
Etc...

How would you rate, on a scale from 0 to 10, the engagement in the global matrix process of all the Report Card leader/team you are mentoring?

Please reply following this model:
Country name 1 - grade
Country name 2 - grade
Etc...

How would you rate, on a scale from 0 to 10, the overall organization of all the Report Card leader/team you are mentoring?

Please reply following this model:
Country name 1 - grade
Country name 2 - grade
Etc...

How many hours per week did you spend mentoring on average?

◯ < 1 ◯ 1 ◯ 2 ◯ 3 ◯ 4

Please explain what you did during the time you were mentoring:

Are there any issues you encountered during your mentorship that you want to report?

◯ Yes
◯ No

Please specify:

From what region is the Report Card you are leading?

◯ Africa ◯ Asia ◯ Europe ◯ North America ◯ Oceania ◯ South America

How would you rate (on a scale from 1 to 10):

The responsiveness of your regional mentor?

1 5 10

(Place a mark on the scale above)

How would you rate (on a scale from 1 to 10):

The engagement in the global matrix process of your regional mentor?

1 5 10

(Place a mark on the scale above)

How would you rate (on a scale from 1 to 10):

The overall organization of your regional mentor?

1 5 10

(Place a mark on the scale above)

Are there any issues you encountered concerning the regional mentoring that you want to report?

◯ Yes
◯ No

Please specify:

4. AHKGA Executive Committee

Are you a member of the AHKGA Executive Committee? ◯ Yes ◯ No

How would you rate (on a scale from 1 to 10):

The responsiveness of the AHKGA Executive Committee?

1 5 10

(Place a mark on the scale above)

How would you rate (on a scale from 1 to 10):

The engagement in the global matrix process of the AHKGA Executive Committee?

1 5 10

(Place a mark on the scale above)

How would you rate (on a scale from 1 to 10):

The overall organization of the AHKGA Executive Committee?

1 5 10

(Place a mark on the scale above)

Are there any issues you encountered with the AHKGA Executive Committee that you want to report?

◯ Yes
◯ No

Please specify:

Mentoring survey - Post Lauch

Dear Report Card Leaders,

This survey aims to evaluate several aspects of the mentorship organization for the Global Matrix 3.0. Please see below for a summary of the mentorship organization.

Mentoring is characterized by three main levels:

Information on the AHKGA website is available for your reference, including background papers, previous report card papers, previous report cards, indicator and benchmark definitions, grading scheme, previous recommendations for improving the grade, fundraising suggestions, etc. Central support from the AHKGA Executive Committee provides guidance through e-blasts, information sharing, milestones, potential funding opportunities, advance planning suggestions, etc.

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The intermediate mentors will be the first and most regular point of contact for new countries, providing ongoing advice and guidance.

Thank you!

1. Intermediate mentor information

Are you an intermediate mentor for one or several countries?

◯ Yes
◯ No

How many countries are you the intermediate mentor for?

◯ 1
◯ 2
◯ 3

Which countries are you mentoring?

☐ Bangladesh
☐ Botswana
☐ Bulgaria
☐ Chile
☐ Chinese Taipei
☐ Cuba
☐ Czech Republic
☐ Ecuador
☐ Ethiopia
☐ France
☐ Germany
☐ Guernsey Channel Islands
☐ Iran
☐ Jersey
☐ Lebanon
☐ Lithuania
☐ Nepal
☐ Uruguay

Are you mentoring or co-mentoring these countries?

◯ Mentoring
◯ Co-mentoring

Please explain:

Do you have an intermediate mentor? (It should be the case if it is your first time participating in the Global Matrix).

◯ Yes
◯ No

Please enter the name and country of your intermediate mentor(s).

_____

2. Intermediate mentoring

If you are not an intermediate mentor or do note have an intermediate mentor, please skip this part.

On average, how many hours per week was spent mentoring?

◯ < 1
◯ 1
◯ 2
◯ 3
◯ 4
◯ 5
◯ >5

Please explain what you did during the time you were mentoring:

Are there any issues you encountered during your mentorship that you want to report?

◯ Yes
◯ No

Please specify:

How would you rate (on a scale from 1 to 10):

The responsiveness of the Report Card team/leader you are mentoring?

1 5 10

(Place a mark on the scale above)

How would you rate (on a scale from 1 to 10):

The engagement in the global matrix process of the Report Card team/leader you are mentoring?

1 5 10

(Place a mark on the scale above)

How would you rate (on a scale from 1 to 10):

The overall organization of the Report Card team/leader you are mentoring?

1 5 10

(Place a mark on the scale above)

Can you rate the following for each country you are mentoring? (Please specify first which country you are rating).

Country 1:

_____

How would you rate (on a scale from 1 to 10):

The responsiveness of the country 1 team/leader?

1 5 10

(Place a mark on the scale above)

How would you rate (on a scale from 1 to 10):

The engagement in the global matrix process of the country 1 team/leader?

1 5 10

(Place a mark on the scale above)

How would you rate (on a scale from 1 to 10):

The overall organization of the country 1 team/leader?

1 5 10

(Place a mark on the scale above)

Country 2:

_____

How would you rate (on a scale from 1 to 10):

The responsiveness of the country 2 team/leader?

1 5 10

(Place a mark on the scale above)

How would you rate (on a scale from 1 to 10):

The engagement in the global matrix process of the country 2 team/leader?

1 5 10

(Place a mark on the scale above)

How would you rate (on a scale from 1 to 10):

The overall organization of the country 2 team/leader?

1 5 10

(Place a mark on the scale above)

Country 3:

_____

How would you rate (on a scale from 1 to 10):

The responsiveness of the country 3 team/leader?

1 5 10

(Place a mark on the scale above)

How would you rate (on a scale from 1 to 10):

The engagement in the global matrix process of the country 3 team/leader?

1 5 10

(Place a mark on the scale above)

How would you rate (on a scale from 1 to 10):

The overall organization of the country 3 team/leader?

1 5 10

(Place a mark on the scale above)

Are there any issues you encountered during your mentorship that you want to report?

◯ Yes
◯ No

Please specify:

How would you rate (on a scale from 1 to 10):

The responsiveness of your intermediate mentor(s)?

1 5 10

(Place a mark on the scale above)

How would you rate (on a scale from 1 to 10):

The engagement in the global matrix process of your intermediate mentor(s)?

1 5 10

(Place a mark on the scale above)

How would you rate (on a scale from 1 to 10):

The overall organization of your intermediate mentor(s)?

1 5 10

(Place a mark on the scale above)

3. Regional Mentoring

Are you a regional mentor? ◯ Yes ◯ No

What region are you mentoring?

◯ Africa ◯ Asia ◯ Europe ◯ North America ◯ Oceania ◯ South America

How would you rate, on a scale from 0 to 10, the responsiveness of all the Report Card leader/team you are mentoring?

Please reply following this model:
Country name 1 - grade
Country name 2 - grade
Etc...

How would you rate, on a scale from 0 to 10, the engagement in the global matrix process of all the Report Card leader/team you are mentoring?

Please reply following this model:
Country name 1 - grade
Country name 2 - grade
Etc...

How would you rate, on a scale from 0 to 10, the overall organization of all the Report Card leader/team you are mentoring?

Please reply following this model:
Country name 1 - grade
Country name 2 - grade
Etc...

How many hours per week did you spend mentoring on average?

◯ < 1 ◯ 1 ◯ 2 ◯ 3 ◯ 4

Please explain what you did during the time you were mentoring:

Are there any issues you encountered during your mentorship that you want to report?

◯ Yes
◯ No

Please specify:

3. Regional Mentoring

Are you a regional mentor? ◯ Yes ◯ No

What region are you mentoring?

◯ Africa ◯ Asia ◯ Europe ◯ North America ◯ Oceania ◯ South America

How would you rate, on a scale from 0 to 10, the responsiveness of all the Report Card leader/team you are mentoring?

Please reply following this model:
Country name 1 - grade
Country name 2 - grade
Etc...

How would you rate, on a scale from 0 to 10, the engagement in the global matrix process of all the Report Card leader/team you are mentoring?

Please reply following this model:
Country name 1 - grade
Country name 2 - grade
Etc...

How would you rate, on a scale from 0 to 10, the overall organization of all the Report Card leader/team you are mentoring?

Please reply following this model:
Country name 1 - grade
Country name 2 - grade
Etc...

How many hours per week did you spend mentoring on average?

◯ < 1 ◯ 1 ◯ 2 ◯ 3 ◯ 4

Please explain what you did during the time you were mentoring:

Are there any issues you encountered during your mentorship that you want to report?

◯ Yes
◯ No

Please specify:

4. AHKGA Executive Committee

Are you a member of the AHKGA Executive Committee? ◯ Yes ◯ No

How would you rate (on a scale from 1 to 10):

The responsiveness of the AHKGA Executive Committee?

1 5 10

(Place a mark on the scale above)

How would you rate (on a scale from 1 to 10):

The engagement in the global matrix process of the AHKGA Executive Committee?

1 5 10

(Place a mark on the scale above)

How would you rate (on a scale from 1 to 10):

The overall organization of the AHKGA Executive Committee?

1 5 10

(Place a mark on the scale above)

Are there any issues you encountered with the AHKGA Executive Committee that you want to report?

◯ Yes
◯ No

Please specify: