The association between exposure to fast food marketing and brand preferences and fast food intake patterns among youth

Mariangela Bagnato

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School of Epidemiology and Public Health

Faculty of Medicine

University of Ottawa

Preface

Student Contributions

All research pertaining to this thesis was completed at the University of Ottawa in the OUTLIVE Lab. Mariangela Bagnato was the primary investigator and author of the thesis and component article. The methodology and study design was completed collaboratively with Dr. Monique Potvin Kent, Dr. Marie-Hélène Roy-Gagnon and Dr. Lana Vanderlee. Data cleaning, analysis and interpretation were completed primarily by Mariangela Bagnato with assistance from Dr. Marie-Hélène Roy-Gagnon and Dr. Lana Vanderlee. The draft of the manuscript was completed by Mariangela Bagnato with feedback and revisions from Dr. Monique Potvin Kent, Dr. Marie-Hélène Roy-Gagnon, Dr. Lana Vanderlee and Dr. David Hammond. The final article manuscript was reviewed and approved by all authors.

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Abstract

Background: Youth consume high volumes of fast food, putting them at risk for poor diet, weight gain and several noncommunicable diseases. Fast food marketing can affect youth's food-related behaviours and has been identified as a determinant of excess weight and obesity. The aim of this research is to examine the relationship between exposure to fast food marketing and the fast food brand preferences and intake amongst youth aged 10-17 across six countries.

Methods: The International Food Policy Study youth survey collects data on dietary patterns and behaviours amongst youth aged 10-17 living in six countries. Data on fast food marketing exposure, brand preferences and intake were compared using regression models adjusted for age, sex, income adequacy and ethnicity.

Results: Exposure to fast food marketing was positively associated with both brand preferences and fast food intake across most countries. Brand preferences were consistently high across all countries when exposed to brand-specific marketing. Fast food intake was higher amongst ethnic minority respondents than ethnic majority respondents and amongst males compared to females.

Conclusion: Fast food marketing is consistently associated with brand preferences and intake across all countries investigated, which points to the need for stringent government regulation to reduce unhealthy food marketing to youth in all 6 countries.

Description of Chapters

The composition of this thesis is guided by the "thesis by article" style. Chapter 1 of this thesis includes a background of the problem, a review of international literature on the topic, a review of the policy environments surrounding unhealthy food and beverage marketing to youth within the countries in this study and details the knowledge contributions this thesis provides to existing literature. Chapter 2 contains a thorough outline of the methodology and study design, as well as a description of the statistical analyses employed. Chapter 3 contains the manuscript that will be submitted for peer review. Chapter 4 discusses the results of this study, policy implications, considerations for future research and the strengths and limitations of this study.

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Abbreviations

US: United States

NCDs: noncommunicable diseases

UK: United Kingdom

g: grams

WHO: World Health Organization

CAI: Children's Food and Beverage Advertising Initiative

MP: Member of Parliament

AANA: Australian Association of National Advertisers

RCMI: Responsible Children's Marketing Initiative

QSRI: Quick Service Restaurant Industry Initiative for Responsible Advertising and Marketing to Children

CFBAI*:* Children's Food and Beverage Advertising Initiative

BCAP: UK Code of Broadcast Advertising

HFSS: high in fat, sugar and sodium

IFPS: International Food Policy Study

KFC: Kentucky Fried Chicken

OR: odds ratio

CI: confidence interval

ref: reference

FF: fast food

IRR: incidence rate ratio

mg: milligrams

Chapter 1: Introduction

1.1 Background of the Problem

Unhealthy diets have detrimental effects on health, and numerous studies have indicated that this is one of the leading contributors to the current burden of chronic disease.[1-4] Chronic disease is a steadily worsening worldwide epidemic in itself, as it is currently the leading cause of premature mortality around the world and creates an avoidable burden on health care systems in Canada and globally.[5,6] Excess weight and obesity affects between 30-40% of children and adolescents living in Canada and the United States (US).[7,8] Not only are individuals exhibiting excess weight and obesity at a heightened risk of developing a plethora of chronic diseases, including diabetes, heart disease, stroke and metabolic syndrome, but they are also at increased risk of developing psychological comorbidities, including depression, anxiety, lowered self-esteem, compromised quality of life and behavioural disorders.[8,9] Poor dietary habits among children and adolescents and the excess intake of low-nutrient, calorie-dense foods in these age groups have been shown to continue throughout adulthood, and as a direct result, can contribute to substantial levels of worsening psychological comorbidities, chronic disease and premature death.[10,11]

The strain that these adverse health outcomes are placing on health care systems is consistent with the burden created by smoking and more distressing than that created by physical inactivity.[1,12,13] In Canada specifically, the yearly cost overweight and obesity have on the nation is an estimated $1.27 to $11.08 billion, which includes direct costs to treat obesity and related comorbidities, as well as indirect costs related to mortality and morbidity due to short- or long-term disability.[14] In 2009, the health care burden of overweight and obesity represented an estimated 12% of total health care dollars in Canada.[14] The economic burden of unhealthy eating

(a precursor to excess weight and obesity), particularly not meeting or surpassing recommended intakes of 5 key protective (i.e., vegetables, fruit, whole grains, milk and nuts and seeds) and 3 harmful foods (i.e., processed meat, red meat and sugar-sweetened beverages) as outlined by Canada's Food Guide, comes at a cost of an estimated $13.8 billion/year to the health care system.[12]

Excess weight and obesity in children and adolescents continue to worsen around the globe. In 2016, it was reported that over 340 million children and adolescents aged 5-19 worldwide had overweight or obesity.[15] Worldwide, between 1975 and 2016, the prevalence of obesity and overweight amongst youth between the ages of 5 and 19, which is linked to the poor dietary habits amongst this population, has increased from 4% to 18%.[15] Globally, the daily consumption of unhealthy food nutrients, such as sugar, fat and sodium, amongst youth is high and often exceeds recommended intake guidelines, whereas recommended consumption guidelines for healthier foods, such as fruit and vegetables is often not met.[16-20] Nutrient inadequacies and excesses during childhood and adolescence are harmful, as they can lead to problems with growth and development, as well as increase one's risk for chronic disease.[21] Dietary patterns amongst youth are worsened by their high intake of ultra-processed foods, high in sugar, saturated fats and sodium.[22] For instance, in 2015, 57% of calories consumed by Canadians aged 9-13 came from ultra-processed foods, high in sugar, saturated fats and sodium.[5] High consumption of ultra-processed foods is associated with elevated short- and long-term risks to health, including excess weight and obesity, mortality, and the development of noncommunicable diseases, which is a cause for concern.[23]

1.1.1 Fast Food Intake Among Children and Adolescents

Children and adolescents' intake of fast food in particular is of significant concern. In the US from 2015-2018, approximately 15% of total daily calories consumed by children and adolescents aged 2-19 were from fast food and 36% consumed fast food daily.[8] From 2009-2018, the average percentage of daily calories from fast food amongst US children and adolescents increased from 10.6% to 14.4%.[24] In Canada, according to the 2015 Canadian Community Health Survey-Nutrition, approximately 21% of youth aged 13-18 consumed fast food the day prior to completing the survey.[25] High consumption of fast food is associated with obesity and other serious health consequences, such as cardiovascular disease, cancer and psychological comorbidities.[26] High consumption of fast food has also been linked to poorer dietary intake including lower intake of nutrient-rich foods, such as fruits, vegetables and dairy, which may also amplify one's risk of developing negative health consequences.[27] On average, compared to youth who did not consume food away from home the day prior to the survey, those who did consume fast food reported higher daily average intakes of sugar and fat.[25] Average sugar intake of fast food consumers was 60.1g for adolescent females and 53.6g for adolescent males, in comparison to 56.5g for females and 54.5g for males who did not consume fast food.[25] Similar patterns were reported for fat intake, where average daily consumption for fast food consumers was 36.2g for adolescent females and 38.1g for adolescent males, where non-fast food adolescent consumers reported daily intake averages of 36.1g for females and 34.7g for males.[25]

1.1.2 Attempts to Facilitate Healthy Eating in Canada

To help mitigate the burden from chronic disease, Health Canada developed the Healthy Eating Strategy in 2016, a suite of nutrition policies which includes improving healthy eating information and the nutritional quality of foods, supporting access, and improving availability of

nutritious foods, and restricting unhealthy food advertising to children under 13.[28] To address the latter, the Child Health Protection Act (Bill S-228), a proposed change to the Food and Drugs Act prohibiting food marketing to children under the age of 13, was introduced in the Senate in 2016, but this Bill was not passed prior to the dissolution of Parliament in June 2019.[29] Although unsuccessful, surveillance of food marketing to children continues to be a focus for Health Canada, and new evidence in this regard may help to inform future policy change.[28] While monitoring is ongoing, Bill C-252, a private member's bill to amend the *Food and Drugs Act* was recently introduced in the Canadian House of Commons in February 2022. This Act proposes to restrict advertising of food and beverages high in added sugar, saturated fats and sodium that are directed to children under 13 years of age.[30] If adopted, this Act will come into effect one year following royal assent.[30] In countries like Chile and the UK, the implementation of mandatory policy targeting population-level interventions, such as the implementation of strict restrictions on unhealthy food marketing to children, have resulted in decreases in consumer purchases of unhealthy foods high in sugar, fat and salt.[31,32]

1.2 Food and Beverage Advertising to Children and Adolescents

Food advertising is defined by the World Health Organization (WHO) as "any form of commercial communication that is designed to increase recognition, appeal, and/or consumption of a particular product/service" and has been identified as a determinant of excess weight in children and adolescents.[33-35] According to the logic model of unhealthy food promotion effects produced by Kelly et al., awareness, attitudes and preferences, purchase intent, purchase and consumption of unhealthy foods are all direct effects of food marketing that lead to long-term post-consumption effects, such as weight gain and diet-related disease.[36] Evidence from

systematic reviews and meta-analyses have indicated that the marketing of unhealthy foods and beverages is considered a determinant of health, as it increases child and adolescent choices, preferences for and consumption of energy-dense, nutrient-poor foods.[37,38]

Food and beverage marketing (herein referred to as "food marketing") and regulation is also a key component of an individual's food environment.[39] According to the food environments framework by Turner et al., accessibility, affordability, convenience and desirability of food products are all part of the personal domain which interact with the external domain, including availability, prices, vendor and product properties, and marketing and regulation, to determine one's consumption and health and nutrition outcomes in the future.[39]

Children and adolescents are exposed to high levels of food marketing as not only are they exposed in day-to-day settings, such as in schools, recreation centers and movie theatres, but they are also targeted in various media including television, radio, digital media, print media and out-of-home marketing.[40,41] Recent research investigating food marketing on children's television stations in 22 countries has shown that Canadian stations display the highest level of food advertising.[42] Similarly in digital media, 50 million food and beverage advertisements were detected on the top 10 websites preferred by Canadian children over the span of only one year.[43] Another study investigating unhealthy food marketing on social media found that adolescents are estimated to view about 9000 advertisements per year on channels such as YouTube and Instagram, and children are estimated to view about 1560 ads/year.[44]

Research indicates that child and adolescent-targeted expenditures on the marketing of food products is high, along with their high consumption of media and autonomous buying power.[45-50] In Canada in 2019, approximately $57.2 million was spent on marketing food products and brands targeted to children, overall (Potvin Kent et al., unpublished). Of these

marketing expenditures, approximately $44.0 million was spent on television, $10.1 million on digital media, $2.6 million on out-of-home advertising, $446,000 on radio, and $132,000 on print media (Potvin Kent et al., unpublished). High marketing expenditures were also reported for adolescent-targeted products and brands, with $110.9 million spent overall in 2019; $85.5 million on television, $8.5 million on out-of-home advertising, $8.4 million on radio, $8.2 million on digital media, and $328,000 on print media.[50] More than three quarters of both child and adolescent-targeted expenditures were spent on television, while digital media accounted for about one fifth of child-targeted expenditures (Potvin Kent et al., unpublished).[50] High expenditures in these media are worrisome, as children and adolescents are spending approximately 4-9 hours viewing various media, including television and digital media, every day.[51] Similar patterns in spending were reported in the US in 2009, where $1.79 billion was spent on food and beverage marketing to youth aged 2-17.[49] Of these child- and adolescent-directed expenditures, an approximate total of $739 million was spent on television, $149 million on in-school marketing, $122.5 million on digital media, and $64.6 million on radio and print media.[49] Similar to Canada, expenditures for traditional measured media including television, radio and print, dominated spending accounting for 39% of all youth-directed marketing expenditures, while digital media accounted for about 7% of expenditures.[49]

1.2.1 Unhealthy Food and Beverage Marketing to Children and Adolescents

Research investigating food marketing targeting children and adolescents in several high-income countries has revealed that the majority of food promotions across all media channels are focused on advertising unhealthy products high in fat, sugar and sodium, such as fast food, candy and chocolate, breakfast food and snacks.[36-38,44,52] Recent research has shown that across media in Canada, the highest marketing expenditures overall were spent on the promotion of

restaurants, with fast food restaurants accounting for 82% of these expenditures.[54] Similar patterns were seen in the US, where of the $1.01 billion spent promoting food and beverages directly to adolescents in 2009, 90% of these expenditures were focused on products classified as unhealthy, such as fast food, beverages, sugary cereals and snacks.[45]

Globally, an investigation of advertisements broadcast on television during children's peak and non-peak viewing times in Canada, Costa Rica, Guatemala, Chile, Malaysia, New Zealand, and Australia found that advertisements considered "restricted" for advertising to children according to WHO guidelines were broadcast 35% more frequently during children's peak viewing times than non-peak times, and the majority of these advertisements promoted unhealthy products.[42] On television in particular, Canadian data from 2019 revealed that more than half of food advertisements viewed by children promoted unhealthy products, with fast food accounting for 43% of their exposure.[55] Similarly for adolescents, the food category contributing to the greatest exposure on television in 2016 was fast food, accounting for 42% of overall exposures.[53]

Similar patterns have also been reported across digital media channels, where exposures are also high, and the most promoted products are unhealthy. In a study investigating food advertising on children's top 10 websites in Canada, it was found that 90% of advertised food and beverage products were high in fat, sugar and/or sodium.[43] Additionally, a study examining social media advertising exposure amongst children and adolescents found that 72% of respondents were exposed to food advertising during the 10-minute study period, and 44% of all advertisements promoted fast food.[44] From a public health perspective, high marketing exposures to fast food products that are generally low in nutritional value and associated with poor diet and weight gain create for several negative downstream effects on child health.[56,57]

With a greater time investment on digital media platforms, such as social media and the internet, this equates to longer and increased exposure to food marketing. Evidence has shown that these novel platforms have the ability to negatively affect youth more than traditional platforms in a variety of areas, including food-related behaviours such as preferences and consumption.[58,59] It is evident that advertisers are taking advantage of these more targeted platforms as an outlet to more effectively market their products, as overall digital media advertising expenditures increased by 13% from 2019 to 2020, while spending in traditional media decreased by the same amount.[60,61] The timing of this increase is notable, considering 2020 denoted the beginning of the COVID-19 pandemic, where over the past 2 years, increases in sedentary time spent at home have triggered technology and digital media use to reach all-time highs.[62-64] Bringing light to this concern is also the high prevalence of fast food marketing online. A study investigating marketing exposures seen by children and adolescents on social media applications found that the most promoted food category across both age groups was fast food, accounting for 27% and 50% of exposures, respectively.[44] Restaurants (fast food and dine-in) were also the most frequently promoted food category on children's preferred websites in Canada, accounting for 32% of total exposure between 2015 and 2016.[43]

Monitoring the effects of unhealthy food marketing on youth's food-related behaviours is fundamental to measuring its influence on this population. Currently, research evaluating the impact of unhealthy food marketing on preferences and intake of youth globally is scarce, as the few studies identified do not investigate multiple countries, are focused on exposure from a specific media channel (mostly television), use a wide variety of data collection methods, rely on data collected from parents, and/or have a narrow age range and small sample size.[65-77]

1.2.2. The power of unhealthy food marketing to children and adolescents

Both exposure and power are key functional components of effective advertising.[78] The power of food advertisements, defined as the creative content and execution of the advertised message (ex. the use of marketing techniques such as cartoon characters and teen themes), is another component of effective advertising which has been shown to affect preferences and taste perceptions of these products in youth.[78] The use of marketing techniques which appeal to children (ex. cartoon characters, child themes of magic and mystery) and adolescents (ex. presence of celebrities, teen themes relating to sport culture) are often used by food advertisers to better tailor their advertising to these viewers and optimize the effectiveness of the advertisement.[78] Children and adolescents are an important target for the food and beverage industry, as they have great influence over household purchases, and adolescents particularly have autonomous purchasing power.[47,48,79,80] The use of certain marketing techniques in unhealthy food advertising has proven to be highly impactful. Research has indicated that marketing tactics such as the use of spokes characters (ex. Tony the Tiger) and licensed characters (ex. Dora the Explorer), as well as celebrities influences children's taste perceptions and preferences.[81,82]

In addition to their high impact, marketing techniques are frequently used in food marketing to children. Online, reports show that 83% of websites contained marketing techniques targeted to children under the age of 12, all of which were purposefully sampled websites of companies who were signatories under regulatory codes governing food and beverage marketing directed at children.[83] Additionally, certain child-directed techniques are used more often in advertisements for unhealthy products as opposed to healthier ones.[84] Global literature suggests that promotional characters are used more frequently in advertisements for

unhealthy foods on television, with 79% of unhealthy food advertising containing these characters compared to 15% of healthier food advertising.[84] Fast food restaurants in particular often use premiums such as free toys in kid's meals, to entice the desires of youth.[79] Toy premiums, as used in the famous McDonald's Happy Meal®, have proven to persuade youth's food choices more than the food itself, as an experimental study found that children were more likely to choose a "healthier" Happy Meal® option with a toy instead of an unhealthy Happy Meal® option without a toy.[85]

1.2.3 The impact of branding

Brand identity is important for companies to communicate their values and build rapport with the public.[86] Popular brands, such as McDonald's and Coke have built a strong, lasting rapport with consumers, resulting in higher recognition and consumer influence through their branding.[86] A company's branding has proven to be a powerful marketing tool, as research assessing the influence of fast food chain branding on youth found that exposure to the brand's logo itself positively influences children's preferences and taste perceptions.[87] Several food and fast food companies also use brand-specific marketing techniques such as spokes characters (ex. Tony the Tiger, Ronald McDonald), that appeal to youth to build their brand identity and attract the attention of youth consumers.[88] Literature suggests that the use of these brand-owned characters has a more powerful influence on youth's preferences, choices and consumption of unhealthy foods compared to healthier foods.[88]

1.3 International Food and Beverage Marketing Policy Landscape

In 2010, the WHO recommended that member states develop restrictions for food marketing to children.[10] Globally, the regulatory approaches for food marketing to children and adolescents differ and range from no regulation to self-regulation to government regulation. Food marketing to children in Canada (excluding Quebec), Australia and the US is voluntary and self-regulated by industry, whilst countries such as the UK, Chile, Mexico, and the province of Quebec in Canada have government regulations in place.

1.3.1 Food and Beverage Marketing Policy: Canada

Currently in Canada, excluding Quebec, food marketing to children is self-regulated by industry under the *Broadcast Code for Advertising to Children* and the *Children's Food and Beverage Advertising Initiative* (CAI) and enforced by Ad Standards, an independent, non-profit organization composed of advertisers, advertising agencies, media organizations and advertising sector suppliers, which aims to ensure "truthful, fair and accurate" advertising in Canada.[89-91] The *Broadcast Code for Advertising to Children* is a self-regulatory initiative by the broadcasting industry, which promises that any advertising to children under 12 will not discourage healthy lifestyles or encourage the excessive consumption of food and will promote adherence to Canada's Food Guide.[90]

The *Children's Food and Beverage Advertising Initiative* is also a self-regulatory initiative in which 15 food and beverage companies, including one fast food chain, formally pledged to not advertise their products at all to children under the age of 12 or to only market "better-for-you" foods, according to Uniform Nutrition Criteria developed by the industry itself.[91] This initiative claims to restrict any unhealthy food advertising messages to children on television, radio, print and the internet (excluding social media).[92] These industry pledges have

been shown to be ineffective to date on reducing food and beverage advertising on television and digital advertising to children.[43,53,93-96] Items defined as "better-for-you" foods that are still advertised under these restrictions include sugar-packed cereals, such as Lucky Charms and Froot Loops, and sugary snacks like Fruit by the Foot.[92]

In 2015, Prime Minister Justin Trudeau assigned Minister of Health Jane Philpott the mandate to restrict unhealthy commercial food marketing to children.[97] Within a year, a bill to prohibit food marketing to children under the age of 12, *The Child Health Protection Act* (Bill S-228), was introduced in the Senate in 2016.[29] The original Bill aimed to ban all marketing of unhealthy food and beverages in all media and settings to those under 17 years old but was amended in 2017 to only ban such marketing to children under 13.[29] In the Fall of 2018, the Bill was then passed to the House of Commons and sent to the Senate for its final vote.[29] Unfortunately, due to purposeful delays caused by extensive industry and stakeholder lobbying, the Bill died and was not passed prior to the dissolution of Parliament in June 2019.[29,98]

In December 2019, Prime Minister Trudeau again highlighted the need to introduce new restrictions on the commercial marketing of food to children in his mandate letter to Minister of Health Patty Hajdu.[99] Two years later in February 2022, Bill C-252, an Act to amend the *Food and Drugs Act* which intends to restrict advertising of food and beverages high in added sugar, saturated fats and sodium directed to children under 13 was introduced in the Canadian House of Commons by Liberal MP Patricia Lattanzio.[30] This Act also highlights the importance of monitoring food marketing to individuals between 13 and 16 years of age who are also vulnerable to the effects of food marketing.[30]

Federal government regulation is crucial, as the current self-regulatory environment in Canada has proven to be ineffective.[43,52,93-96] In a benchmarking study exploring unhealthy food

marketing exposure to children in 22 countries, it was found that for every advertisement shown on television that is permitted for advertising to children in Canada, 12 advertisements that are not permitted for advertising to children are shown, according to the WHO European Region nutrient profiling model.[42] Interestingly, the average number of not permitted television advertisements broadcast in Canada is 3 times higher than the overall average across 22 countries.[42]

The policy environment for food marketing to youth differs in the province of Quebec. The *Consumer Protection Act* (1980, 2012) is the provincial regulation in place that bans all commercial advertising to children under the age of 13.[10,100] The Act considers time, place, and audience of the advertisement in order to determine whether the advertisement is subject to restrictions. Determination of whether an advertisement is subject to restrictions is measured using the following criteria: 1) Is the product intended to appeal to children?; 2) Is the advertisement designed to be appealing to children?; 3) Is the timing and placement of the advertisement favouring child exposure (>15% of audience are children)?.[10]

Despite regulation, research suggests that children in Quebec are still viewing high amounts of unhealthy food and beverage marketing.[101] It has also been suggested that banning "child-directed" marketing where the viewership consists of at least 15% children is not sufficiently protecting this population, as they often view advertisements that are not "directed" to them (ex. advertisements targeting adolescents and adults).[101] Nevertheless, although the legislation needs to be strengthened, it has been shown that advertising to children in Quebec is less powerful, and slightly less frequent.[102-104] It has also been estimated that the likelihood of children's consumption of fast food in Quebec had decreased by 13% compared to Ontario in 2011, and Quebec has lower rates of childhood obesity than most other provinces in

Canada.[102,105] Such results may be an outcome of lower levels of food marketing to children and children being exposed to less powerful advertisements in Quebec with fewer marketing techniques that would appeal to them.[103,104]

1.3.2 Food and Beverage Marketing Policy: Australia

In Australia, food marketing to youth is self-regulated to a limited extent by both the advertising and food industries. Under its codes of practice, the Australian Association of National Advertisers (AANA) attempts to regulate the marketing industry using a set of guidelines for marketers to follow to determine whether an ad is 'directed primarily to children' who are 14 years of age and under.[106] Additionally, the Australian Food and Grocery Council under its voluntary codes, the Responsible Children's Marketing Initiative (RCMI) and the Quick Service Restaurant Industry Initiative for Responsible Advertising and Marketing to Children (QSRI), attempt to place marketing to children restrictions on the food industry.[106] The RCMI attempts to restrict food and beverage advertising 'directed primarily to' children under 12, excluding fast food marketing, while the QSRI attempts to restrict fast food marketing 'directed primarily to' children under 14.[106] Although these codes provide some protection to Australian youth, this protection is very limited; youth over the ages of 12 and 14 are not protected, the prohibition of advertisements 'directed primarily at children' is not clearly defined, not all forms and types of marketing are included in these codes, the perception of healthfulness is determined by the manufacturers and code compliance is not actively monitored.[106] Recently, independent MP Dr. Sophie Scamps announced her intent to introduce a private member's bill to ban junk food advertising broadcast on television during prime time and through sport sponsorship to children.[107]

Attesting to the limited protection these guidelines are providing, evidence by Kelly and colleagues examining the average frequency of food and beverage advertisements on television that are not permitted to be advertised to children (WHO European Region nutrient profiling model) found that 75% of these advertisements in Australia were classified as not permitted for advertising, with ready-made food accounting for 43% of ads.[42] Overall, studies investigating various media have illustrated the ineffectiveness of these guidelines and highlighted the need for more stringent control of unhealthy food marketing directed to children.[42,67,106-110]

1.3.3 Food and Beverage Marketing Policy: United States

In the US, the *Children's Food and Beverage Advertising Initiative (CFBAI)* is a self-regulated initiative which attempts to restrict unhealthy food marketing to children under 12 years.[111] The CFBAI currently includes 17 major food and beverage companies and two fast food chain members.[112] These members have pledged to only advertise products that abide with the CFBAI's Uniform Category-Specific Nutrition Criteria (2020), which includes certain nutrient requirements (i.e., calcium) and limits on fats, sugar and sodium.[112] Overall, the CFBAI has been proven to be ineffective as children are still being exposed to high levels of unhealthy food marketing.[113] As of January 2023, this code will be revised and extended to restrict marketing directed to children under the age of 13.[111]

1.3.4 Food and Beverage Marketing Policy: United Kingdom

In the UK, government regulation through the UK Code of Broadcast Advertising (BCAP) restricts all broadcast advertising of foods and beverages high in fat, sugar and sodium (HFSS) directed to individuals under the age of 16, as well as promotions broadcast on media where youth under 16 account for over 25% of the viewership.[114] To identify HFSS foods, they use a nutrient profiling model developed by the Food Standards Agency in 2004-2005.[114] This

model uses a scoring system where points for healthy foods and their components (i.e., fruits, protein, etc.) are subtracted from a point total of unhealthy food components (saturated fat, sugar, sodium and energy).[115] If a food scores over 4 points, it is labelled as a "HFSS" food and is restricted from television advertisements.[115] In comparison to the other countries investigated, the UK had the lowest ratio of average permitted to not permitted food advertisements with 2 not permitted ads for every permitted ad viewed on television in 2009.[42] The presence of stringent television regulation for those 4-15 years old could be responsible for lower exposure in this country. New restrictions will come into force in January 2024, and this will include the restriction of all HFSS products advertised before 9pm on television and on-demand programming and the prohibition of paid advertising of HFSS products online.[114]

1.3.5 Food and Beverage Marketing Policy: Chile

The Chilean government, through the Chilean Law of Food Labelling and Advertising (2016, 2018), has the most strict and comprehensive food marketing restrictions worldwide.[115] This law prohibits any food marketing of products high in sugar, sodium, fat and calories to youth under the age of 14, in which marketing techniques are assessed as child-targeted based on exposure and power of the advertisement.[116] These regulations apply across almost all media channels, with the exception of sporting and cultural events.[116] Regulated food products under these regulations also prohibit the use of child-targeted marketing strategies, such as the use of child-appealing visuals, gifts/incentives with purchase or sweepstake invitations.[116]

Following the implementation of this law, the amount of time children and adolescents were exposed to high-in food advertising weekly decreased by 44% and 58%, respectively which suggests the policy is having an impact.[117]

1.3.6 Food and Beverage Marketing Policy: Mexico

In Mexico, the Mexican Ministry of Health regulates unhealthy food marketing to children on television. This Ministry orders advertisements for food and sweetened beverages to be restricted on television to audiences with over 35% children (<13 years of age) between 2:30pm and 7:30pm on weekdays and 7:00am and 7:30pm on weekends.[115] They define unhealthy foods using a nutrient profile model for specific food and beverage categories.[115] With the onset of the COVID-19 pandemic in 2020 and some of the highest obesity rates in the world, some Mexican states have also banned the sale, promotion and distribution of all drinks high in sugar and junk food to individuals under the age of 18.[118]

Despite government regulation, 80% of food advertisements broadcast on Mexican television are still considered not permitted for advertising to children (WHO European Region nutrient profiling model).[42] This proportion was higher than the corresponding global average across 22 countries, which is notable considering Mexico was 1 of 5 countries that was enforcing government regulation at the time of data collection.[42]

1.4 Thesis Rationale

Differing policy environments for marketing to children and adolescents around the world result in different degrees of protection to this population.[42] The 2019 International Food Policy Youth Study was designed to examine the effects of these unique policy environments on many outcomes, including children and adolescents' fast food intake and preferences in six countries - Canada, Australia, Mexico, Chile, the UK, and the US. Analyzing this data is crucial in determining the degree to which food marketing restrictions are having an effect. Little research has specifically examined the impact of fast food marketing on youth. Given that fast

food marketing is the most prevalent food category being advertised across all media, further investigation of the effects this marketing is having on children and adolescents is necessary. To address this gap, the main objective of this study is to examine the relationship between exposure to fast food marketing and the fast food preferences and intake of youth in Australia, Canada, Mexico, Chile, the UK, and the US.

1.5 Specific Study Objectives and Hypotheses

The research objectives of this study are:

1. To examine the association between children and adolescents' exposure to fast food marketing and fast food brand preference.
2. To examine the association between children and adolescents' exposure to fast food marketing and fast food intake.
3. To explore the relationship between sociodemographic characteristics and fast food preferences and intake.

It was hypothesized that:

1. Children and adolescents' exposure to fast food marketing would be positively associated with preference for, and intake of fast food.

Chapter 2: Materials and Methods Overview

The detailed methods and statistical analyses used in the study *"The impact of fast food marketing on brand preferences and fast food intake of youth aged 10-17 across six countries"* are presented in Chapter 3. The present chapter provides an overview of the methodology and the statistical analyses employed.

2.1 Methodology Overview

Data were from the 2019 International Food Policy Study (IFPS) Youth Survey, an annual repeat cross-sectional survey conducted in six countries; Australia, Canada, Chile, Mexico, UK and the US. Data were collected via self-completed web-based surveys conducted in November-December 2019 with children and adolescents aged 10 to 17 years. Respondents were recruited through parents/guardians enrolled in the Nielsen Consumer Insights Global Panel and their partners' panels. Email invitations with unique survey links were sent to adult panelists within each country. Those who confirmed they had a child aged 10 to 17 living in their household were asked for permission for their child to complete the survey (only one child per household was invited). Children and adolescents aged 10 to 17 years were eligible to participate, with quotas for age and sex groups in the UK and US. Participants were grouped into their subsequent age categories by country as follows: Australia (10-13yrs), (14-17yrs); Canada (10-11yrs), (12-13yrs), (14-15yrs), (16-17yrs); Chile (10-13yrs), (14-17yrs); Mexico (10-14yrs), (15-17yrs); UK (10-13yrs), (14-17yrs); and US (10-13yrs), (14-17yrs). After eligibility screening, all potential respondents were provided with information about the study and asked to provide assent. Surveys were conducted in English in Australia and the UK; Spanish in Chile and Mexico; English or French in Canada; and English or Spanish in the US. Members of the

research team who were native speakers in each language reviewed the French and Spanish translations independently. The median survey time was 24 minutes.[119]

The child's parent/guardian received remuneration in accordance with their panel's usual incentive structure (e.g., points-based or monetary rewards, chances to win prizes). The study was reviewed by and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE# 41477) and a University of Ottawa Research Ethics Committee (H-06-20-5908). A full description of the study methods can be found in the International Food Policy Study: Technical Report – 2019 Youth Survey.[119]

2.1.1 Self-Reported Outcome Measures

The first self-reported outcome measure assessed was "fast food intake". This outcome was examined using the following measure: *Think about the last 7 days. How many days did you have a meal (breakfast, lunch or dinner) from restaurants, fast food places, food stands, or vending machines? (Don't include meals at schools).* Individuals had the option of selecting a total number of days between 0 and 7, *"don't know"* or *"refuse to answer"*. Since responses for *"don't know"* and *"refuse to answer"*, along with any responses that were blank/missing, did not provide any relevant information to the analysis, and deleting these responses did not skew any data, these respondents were deleted from the dataset.

The second self-reported outcome measure assessed was "fast food brand preference". This outcome investigated 3 restaurant brands, McDonalds, Kentucky Fried Chicken (KFC), and Subway, and each brand was examined using the following measure: *How much would you like to go to this restaurant?* The degree of preference for each brand was measured using an emoji-based Likert scale consisting of 7 different emojis, scaling ordinally from least preferred to most preferred; confounded face (), angry face (), confused face (), expressionless face (),

smiling face with smiling eyes (😊), grinning face (😀), and smiling face with heart eyes (😍). Respondents also had the option of selecting *"don't know"* or *"refuse to answer"*, but since these responses and those that were blank/missing did not provide any relevant information to the analysis, these respondents were removed from the dataset. Given that each emoji could be perceived differently by respondents, the 7 emojis were analyzed in 3 groups according to the overall preference being either "not preferred", "neutral", or "preferred". The analyzed groups consist of the following emojis: "not preferred" (😖, 😠, 😕), "neutral" (😐), and "preferred" (😊, 😀, 😍).

2.1.2 Self-Reported Exposure - Independent Variables

Self-reported exposure to fast food marketing was examined using two measures. The first measure assessing general exposure to fast food marketing was investigated using the following measure using the sub-variable "Ads for fast food from a restaurant": *In the last 30 days, how often did you see or hear advertisements for these kinds of food or drinks?* Respondents had the option of selecting from the following ordinal responses: *"never", "less than once a week", "once a week", "a few times a week", "every day", "more than once a day", "don't know"* or *"refuse to answer"*. Responses for *"don't know"* and *"refuse to answer"*, along with responses that were blank/missing were removed from the dataset. Given the potential for loss of analytic significance across the response scale, the 6 responses were re-grouped into 3 groups as follows: never *("never")*, ≤1x/week *("less than once a week", "once a week")*, and ≥2x/week (*"a few times a week", "every day", "more than once a day"*).

The second self-reported exposure measure was restaurant brand exposure. Exposure to three restaurant brands, McDonalds, KFC and Subway, were assessed using the following measure displayed alongside their corresponding brand logo: *Have you seen an advertisement for*

this restaurant in the last 30 days? Respondents were randomized to provide a response for one of the three brands had the option of selecting *"yes", "no", "don't know"* or *"refuse to answer"*. Responses for *"don't know"* and *"refuse to answer"*, as well as responses that were blank/missing for each brand were deleted from the dataset.

2.1.3 Sociodemographic Measures

Sociodemographic variables collected and included were age, sex at birth, income adequacy and ethnicity. Age of the respondent was collected in the survey using a continuous scale from 10 to 17 years old. A binary variable, coding for either *"male"* or *"female"*, was used to collect the respondent's sex at birth. Perceived income adequacy was collected using the following measure: *Does your family have enough money to pay for things your family needs?* (response options: *"not enough money", "barely enough money", "enough money", "more than enough money", "don't know"* or *"refuse to answer"*). For the purpose of this study, these four groups were collapsed into two groups: *"enough money"* ("enough money" and "more than enough money") and *"not enough money"* ("not enough money" and "barely enough money"). Given that selecting *"don't know"* or *"refuse to answer"* does not provide conclusive data for the respondent's perceived income adequacy, these respondents, as well as those that left this response blank, were deleted from the dataset.

Data on ethnicity was collected using a derived variable, coding for either "majority", "minority" or "not stated". This variable was derived based on the country-specific ethnicity measured, which was specific to what is considered to be the ethnicities of "majority" and "minority" in each of the 6 countries.

In Canada, "majority" was classified as individuals who selected 'White (European descent)' or if they specified a response of *'Caucasian', 'Canadian'* or *'Jewish'* under the

'other' category. Respondents were considered to be "minority" if they specified being *'Arab'* or *'multiple'* under the *'other'* category, or if they selected any of the following responses: *'East/Southeast Asian', 'South Asian', 'Black', 'Indigenous', 'Latino'*, or *'Middle Eastern'*.

In Australia, a respondent was classified under the "majority" ethnicity if they selected that they only spoke English at home. Respondents were classified as "minority" if they spoke any language other than English at home, or if they indicated that they are an *'Aboriginal'* or *'Torres Straight Islander'*.

In the UK, respondents were classified as the "majority" ethnicity if they identified their ethnic background as being any of the options under *'white'* or specified any other white background. Respondents were considered to be of the "minority" ethnicity if they selected any category out of the following: *'Mixed/multiple ethnic groups'* or specified any other mixed/multiple ethnic background, *'Asian/Asian British'* or specified any other Asian background, *'Black/African/Caribbean/Black British'* or specified any other Black/African/Caribbean background or selected *'Arab'* or specified any other ethnic group.

In the US, respondents were classified as "majority" if they only selected *'white'* when asked to identify their racial background. Respondents were classified as "minority" if they selected any other category out of the following: *'Black or African American'*, *'Hispanic or Latino', 'Asian or Pacific Islander', 'Native American Indian'*, or specified *'other'*. In both Mexico and Chile, respondents were considered as "majority" if they did not self-identify as indigenous and were considered "minority" if they did self-identify as indigenous.

For all countries, "not stated" consisted of anyone who checked *"don't know", "refuse to answer"* or provided an open text response such as *"human"* to the *'other'* prompt. For Australia specifically, respondents also fell under the "not stated" classification for ethnicity if they

answered *"don't know"* or *"refuse to answer"* to the following question: '*Are you Aboriginal or Torres Strait Islander?'* Since these responses did not allow for identification of the respondent's ethnicity, respondents with a "not stated" ethnicity were deleted from the dataset.

2.2 Statistical Analysis

There was a total of 11,108 respondents to the 2019 IFPS youth survey from the six countries: Australia (n=1,435), Canada (n=3,682), Chile (n=1,252) Mexico (n=1,616), the UK (n=1,520), and the US (n=1,603). 1,413 respondents (12.7%) were removed from the dataset due to missing and/or incomplete data on sociodemographic characteristics, predictor variables and outcome variables (i.e., *"don't know", "refuse to answer"* or left their answer selection blank), and 9,695 respondents were retained in the final analytical sample. All country data were weighted with post-stratification sample weights constructed with known population estimates from each country's census, based on age, sex and ethnicity. Weighting of samples were computed to minimize the effect of differential non-response on the generalizability of the findings to the population of interest. All variables included in this study will have post-stratification weights applied. Statistical analysis was completed using SAS Studio OnDemand for Academics (SAS Institute Inc., 2021).

2.2.1 Research Objective 1: Association between youth's self-reported exposure to restaurant fast food marketing and brand preference

We used ordinal logistic regression to explore whether there is an association between youth's self-reported exposure to restaurant fast food marketing and their brand preference. Ordinal logistic regression is a technique used to model the relationship between multiple categorical or continuous predictor variables (e.g., age, sex, etc.) and an ordinal outcome (e.g.,

brand preference).[120] In this case, the association between the respondent's preference for each of the three brands (McDonalds, KFC and Subway) and self-reported exposure to restaurant fast food marketing, sex, age, ethnicity and income adequacy was examined using ordinal logistic regression. Maximum likelihood estimation was used to estimate the regression parameters and statistical significance was determined using 95% confidence intervals and p-values less than 0.05, where the significance level was set at $\alpha<0.05$. The 7-item emoji scale that measured brand preference was re-categorized into 3 groups for each of the brands: "not preferred" (😖, 😠, 😕), "neutral" (😐), "preferred" (😊, 😀, 😍). Brand preference categories were re-categorized and trialled until the proportional odds assumption for all models were tenable and not significant ($p>0.05$). The proportional odds assumption tests the logistic regression assumption that the relationships between the coefficients of the response variables are not statistically different across categories. The 6-item Likert scale for the general self-reported exposure to restaurant fast food marketing was also re-grouped into 3 categories: "never" (*"never"*), "≤1x/week" (*"less than once a week"*, *"once a week"*), and "≥2x/week" (*"a few times a week", "every day", "more than once a day"*). Multiple groupings for self-reported exposure were trialed and tested using the same method as brand preference. Differences in the association between outcomes and sociodemographic variables by country were tested and compared with and without interaction terms and the likelihood ratio test was used to determine if an interaction was present. Since there were no interactions identified between the sociodemographic variables by country for this outcome and exposure and the proportional odds assumptions were met, ordinal logistic regression was selected as the best fitting model.

We also used ordinal logistic regression to explore whether there is an association between youth's self-reported exposure to restaurant brand-specific marketing and their

preference for each respective brand (McDonald's, KFC and Subway). These models tested the association between the respondent's preference for each of the three brands (McDonalds, KFC and Subway) and self-reported exposure to each respective brand's marketing, sex, age, ethnicity and income adequacy, using maximum likelihood estimation to estimate the regression parameters, with statistical significance being determined at an alpha significance level of $\alpha<0.05$. The 7-item emoji scale measure for brand preference was grouped into the same three groups as the previous models for each brand: "not preferred" (😖, 😠, 😕), "neutral" (😐), "preferred" (😊, 😀, 😍). Again, brand preference categories were re-categorized and trialled until the proportional odds assumptions were met. Self-reported exposure to brand-specific marketing was assessed using a binary variable which measured those who reported being exposed (*"Yes"*) and those who reported not being exposed (*"No"*). Mirroring the identical process used in the previous models for the preference outcome, differences in the association between outcomes and sociodemographic variables by country were tested and compared with and without interaction terms and the likelihood ratio test was used to determine if an interaction was present. Since there were no interactions identified between the sociodemographic variables by country for this outcome and exposure and the proportional odds assumptions were met, ordinal logistic regression was again selected as the best fitting model.

2.2.2 Research Objective 2: Association between youth's self-reported exposure to restaurant fast food marketing and fast food intake

We used negative binomial regression models to explore whether there is an association between youth's self-reported exposure to restaurant fast food marketing and their intake of fast food. Negative binomial regression is used to model over-dispersed count outcome variables.[120] Ordinal logistic regression could not be used for this association, as the proportional odds

assumptions were not met and the models did not fit regardless of the selected re-categorized groups for intake and the general exposure variable. In this case, the respondent's self-reported fast food intake for the past 7 days and self-reported exposure to fast food brand-specific marketing, sex, age, ethnicity and income adequacy was examined using negative binomial regression. Maximum likelihood estimation was used to estimate the regression parameters and statistical significance was determined using 95% confidence intervals and p-values less than 0.05, where the significance level was set at $\alpha<0.05$. The 6-item Likert scale categories assessed for the general exposure variable were re-grouped into the same 3 groups as used in research objective 1. Again, differences in the association between outcomes and sociodemographic variables by country were tested and compared with and without interaction terms and the likelihood ratio test was used to determine if an interaction was present. Significant interactions were noted for this association ($p<0.05$).

We also used negative binomial regression models to explore whether there is an association between youth's self-reported exposure to fast food brand-specific marketing (McDonald's, KFC and Subway) and their intake of fast food. These models tested the association between the respondent's self-reported intake of fast food during the 7 days prior to the survey and exposure to marketing by each brand, sex, age, ethnicity and income adequacy using maximum likelihood estimation to estimate the regression parameters, with statistical significance being determined at an alpha significance level of $\alpha<0.05$. Self-reported intake of fast food was assessed using an 8-item ordinal scale from 0-7 days. Self-reported exposure to each of the 3 brands were assessed using the same binary variable as used in research objective 1. Mirroring the identical process used in the models for intake and general exposure, differences in the association between outcomes and sociodemographic variables by country were tested and

compared with and without interaction terms and the likelihood ratio test was used to determine if an interaction was present. Significant interactions were noted for this association ($p<0.05$).

As such, since some significant interactions were found throughout the analysis, all results were stratified by country.

Chapter 3: The impact of fast food marketing on brand preferences and fast food intake of youth aged 10-17 across six countries

Chapter 3 is based on an article titled *"The impact of fast food marketing on brand preferences and fast food intake of youth aged 10-17 across six countries"* which will be submitted to the *International Journal of Behavioural Nutrition and Physical Activity.* This manuscript focuses on all 3 objectives of this thesis: 1) To examine the association between children and adolescents' exposure to fast food marketing and fast food brand preference; 2) To examine the association between children and adolescents' exposure to fast food marketing and fast food intake; and 3) To explore the relationship between sociodemographic characteristics and fast food preferences and intake.

The full manuscript is included in this chapter. Ethics approval was not required for this study.

Authors: Mariangela Bagnato[1], Marie-Hélène Roy-Gagnon[1], Lana Vanderlee[2], David Hammond[3], Monique Potvin Kent[1]

Affiliations:

[1] School of Epidemiology and Public Health, Faculty of Medicine, University of Ottawa
[2] École de Nutrition, Centre Nutrition, santé et société (Centre NUTRISS), and Institut sur la nutrition et les aliments fonctionnels (INAF), Université Laval
[3] School of Public Health Sciences, University of Waterloo

All authors made significant contributions to the article.

Dr. Monique Potvin Kent designed the study and methodology, provided feedback and revisions to the manuscript draft, and supervised the study.

Dr. Marie-Hélène Roy-Gagnon provided guidance throughout the methodology design and formal analysis and provided feedback and revisions to the manuscript draft.

Dr. Lana Vanderlee provided guidance throughout the methodology design and formal analysis and provided feedback and revisions to the manuscript draft.

Dr. David Hammond provided guidance throughout the methodology design and provided feedback and revisions to the manuscript draft.

I, Ms. Mariangela Bagnato, was the principal investigator responsible for all aspects of the article research, including the study design, data cleaning, statistical analysis, interpretation, developing the manuscript and revising the manuscript.

3.1 Article to be submitted to the *IJBNPA*

Title: The impact of fast food marketing on brand preferences and fast food intake of youth aged 10-17 across six countries

Authors: Mariangela Bagnato[1], Marie-Hélène Roy-Gagnon[1], Lana Vanderlee[2], David Hammond[3], Monique Potvin Kent[1]

[1] School of Epidemiology and Public Health, Faculty of Medicine, University of Ottawa
[2] École de Nutrition, Centre Nutrition, santé et société (Centre NUTRISS), and Institut sur la nutrition et les aliments fonctionnels (INAF), Université Laval
[3] School of Public Health Sciences, University of Waterloo

Corresponding author:
Monique Potvin Kent, PhD
School of Epidemiology and Public Health
University of Ottawa
600 Peter Morand Crescent
Ottawa, Ontario K1G 5Z3, Canada
Phone: (613) 562-5800, ext 7447
Email: monique.potvinkent@uottawa.ca

ABSTRACT
Background: Consumption of fast food, which is associated with poor diet, weight gain and the development of noncommunicable diseases, is high amongst youth. Fast food marketing, a modifiable determinant of excess weight and obesity, affects youth's food-related behaviours. This study aimed to examine the relationship between exposure to fast food marketing and the fast food brand preferences and intake amongst youth aged 10-17 across six countries.
Methods: Data from 9,695 youth respondents living in Australia, Canada, Chile, Mexico, the United Kingdom (UK) and the United States (US) were analyzed from the 2019 International Food Policy Youth Study. Survey measures assessed exposure to fast food marketing and brand-specific marketing, and preference for these brands and fast food intake. Regression models adjusted for age, sex, income adequacy and ethnicity were used to examine the associations.
Results: Exposure to fast food marketing was positively associated with brand preferences and intake consistently across most countries. Overall, preference for McDonald's (*OR:*1.972; *CI:*1.520, 2.558), KFC (*OR:*1.608; *CI:*1.240, 2.085) and Subway (*OR:*1.731; *CI:*1.336, 2.243) were highest when exposed to general fast food marketing ≥2x/week compared to never. Preference for McDonald's (*OR:*2.316; *CI:*1.924, 2.788), KFC (*OR:*2.282; *CI:*1.945, 2.678) and Subway (*OR:*2.751; *CI:*2.317, 3.267) were also higher when exposed to marketing for each brand compared to not. Fast food intake was highest in Chile (*IRR:*1.8958; *CI:*1.4477, 2.4826), the UK (*IRR:*1.3998; CI:1.2039, 1.6275), Canada (*IRR:*1.3241; *CI:*1.1877, 1.4761), Mexico (*IRR:*1.2640; *CI:*1.0478, 1.5249) and the US (*IRR:*1.2147; *CI:*1.0495, 1.4059) when exposed to general fast food marketing ≥2x/week compared to never and was higher across most countries when exposed to brand-specific marketing compared to not. Respondents classified as ethnic minorities were more likely to report consuming fast food than ethnic majorities, and females were less likely to report consuming fast food than males.
Conclusions: Exposure to fast food marketing is consistently and positively associated with brand preferences and fast food intake in all six countries. Our results highlight the need for strict government regulation to reduce exposure of unhealthy food marketing to youth in all six countries.

Keywords: Fast food, advertising to youth, food environment, marketing, intake, preferences

Introduction

The burden caused by noncommunicable diseases (NCDs) is on the rise globally. In 2019, 20% of adolescent deaths worldwide occurred as a result of NCDs and it has been estimated that 70% of premature deaths in adults are linked to behaviours that developed during childhood and adolescence.[1] Obesity and excess weight are modifiable precursors to NCDs that are an ongoing threat to health internationally.[2] Between 1975 and 2016, the prevalence of obesity and overweight amongst children and adolescents between the ages of 5 and 19 worldwide increased from 4% to 18%, alongside the intake of ultra-processed foods, high in sugar, saturated fats and sodium amongst youth.[3,4] In Canada, youth between the ages of 2 and 18 consume over 50% of their total daily energy intake from ultra-processed food, elevating short- and long-term risks to health, including excess weight and obesity, mortality, and the development of noncommunicable diseases.[5,6]

Fast food in particular accounts for a large share of food consumed by youth. Data from Canada and the United States indicates that the daily consumption of fast food amongst youth is high and, on average, over 15% of daily calories come from such foods.[7,8] Unsurprisingly, due to the poor nutrient quality of fast food, intake of these foods and beverages is associated with poor dietary quality and weight gain.[9] Intake of fast food amongst youth may compromise nutrient requirements necessary for proper growth, leading to potential nutrient deficiencies and issues with growth and development.[10]

The food environment has been recognized as a determinant of obesity and the marketing of unhealthy foods and beverages to children has been identified as a cause of poor diet and excess weight in youth.[11-13] Youth are valuable advertising targets for the food and beverage industry, as promoting sales in this highly impressionable age group may help to create

life-long brand loyalty.[14-17] Children and adolescents are exposed to food and beverage marketing (herein referred to as food marketing) daily in a variety of media and settings, which have the power to influence consumption and future health outcomes.[10-13,18-25] Research from high-income countries found that the majority of advertisements on youth-oriented media promote unhealthy products and fast food in particular accounts for the largest exposure.[19,23,26-32] Expenditure data also shows that expenditures on youth-oriented advertising across all media is high and overall, the majority of advertising spend is devoted to unhealthy products, with fast food advertising accounting for the majority of expenditures.[22,33] This emphasis on fast food marketing is notable as youth spend a lot of time viewing various media and hold autonomous buying power.[14-17]

In response to the ongoing concern caused by industry marketing practices and its negative impacts on youth health, in 2010, the World Health Organization recommended that its members develop restrictions to limit the marketing of foods high in sugars, fats, and sodium (HFSS) to children.[34] Globally, food marketing restrictions are either non-existent, self-regulated by the food and beverage and/or advertising industries or government regulated. With respect to the countries investigated in this study, Canada (excluding Quebec), Australia and the United States (US) have self-regulatory, voluntary initiatives by the food and beverage and advertising industries.[35-38] The United Kingdom (UK) and Chile have government regulations in place to restrict marketing of HFSS foods directed to youth under the age of 16 and 14, respectively, across most media.[39,40] Food marketing in Mexico is also government-regulated and television advertisements for unhealthy food to children under 13 when audiences are over 35% children during popular viewing times are restricted.[41]

The logic model of unhealthy food promotion effects have posited that preferences and consumption of unhealthy foods, in addition to awareness, attitudes, purchase intent, and purchase of unhealthy foods are all direct effects of food marketing exposure that eventually lead to long-term post consumption effects such as weight gain and diet-related disease.[42] Investigating the effects that exposure to unhealthy food marketing is having on the brand preferences and intake of youth is crucial in determining the extent to which unhealthy food marketing is influencing this population and to help inform policymakers of the need for stringent policies that restrict this exposure to youth internationally. Currently, the breadth of research evaluating the impact of unhealthy food marketing on preferences and intake of youth globally is limited, as the few studies identified do not investigate more than one country, are focused on exposure from a specific media channel (mostly television), use a wide variety of data collection methods, rely on data collected from parents, and/or have a narrow age range and small sample size.[43-55]

To make comparisons across data in different countries and investigate the impact current food marketing policies are having, more generalized evidence spanning a wider age range and various media is necessary.[56] No previous studies have tested the association between youth's self-reported exposure to and preference for specific fast food brands, nor does any investigate fast food marketing exposure, fast food restaurant brand preferences and fast food intake in this population simultaneously. Given that fast food is the most marketed food category to youth across most media [19,22,26,30,33], further investigation of its effects on youth is warranted. The purpose of this study was to examine the relationship between exposure to fast food marketing and the fast food brand preferences and intake of children and adolescents in six upper and middle income countries and to explore the relationship between sociodemographic

characteristics and fast food preferences and intake. It was hypothesized that youth's exposure to fast food marketing would be positively associated with preference for and intake of fast food across all countries.

Methods

Data were from the 2019 International Food Policy Study (IFPS) Youth Survey, an annual repeat cross-sectional survey conducted in six countries; Australia, Canada, Chile, Mexico, UK and the US. Data were collected via self-completed web-based surveys conducted in November-December 2019 with youth aged 10-17 years old. Respondents were recruited through parents/guardians enrolled in the Nielsen Consumer Insights Global Panel and their partners' panels and invitation links were sent to panelists within each country. Those who confirmed they had a child aged 10-17 living in their household were asked for permission for their child to complete the survey (only one child per household). Youth aged 10-17 years were eligible to participate, with quotas for age and sex groups in the UK and US. After eligibility screening, all potential respondents were provided with information about the study and asked to provide assent. Surveys were conducted in English in Australia and the UK; Spanish in Chile and Mexico; English or French in Canada; and English or Spanish in the US. Members of the research team who were native speakers in each language reviewed the French and Spanish translations independently. The median survey time was 24 minutes.[57]

The parent/guardian of each child received remuneration in accordance with their panel's usual incentive structure (e.g., points-based or monetary rewards, etc.). A full description of the study methods can be found in the International Food Policy Study: Technical Report – 2019 Youth Survey.[57]

Measures

Independent Measures: Self-reported exposure to fast food marketing

Self-reported exposure to fast food marketing was assessed using two measures: general exposure to fast food marketing and exposure to brand-specific fast food marketing. First, general exposure to fast food marketing was assessed using the following measure for *"Ads for fast food from a restaurant": "In the last 30 days, how often did you see or hear advertisements for these kinds of food or drinks?"*. Respondents had the option of selecting: *"never", "less than once a week", "once a week", "a few times a week", "every day", "more than once a day", "don't know"* or *"refuse to answer"*. The 6-item Likert scale for general exposure to fast food marketing was recategorized into the following: *"never" ("never"), "≤1x/week" ("less than once a week", "once a week"),* and *"≥2x/week" ("a few times a week", "every day", "more than once a day")*. Second, self-reported exposure to McDonald's, KFC and Subway marketing specifically, was assessed using the corresponding brand's logo displayed with the following measure: "*Have you seen an advertisement for this restaurant in the last 30 days?"*. For this measure, the sample was randomized to provide a response for only one of the three brands. Respondents had the option of selecting *"yes", "no", "don't know"* or *"refuse to answer"*.

Outcome Measures: Self-reported fast-food intake and fast food brand preference

Self-reported intake of fast food was assessed using the following measure: "*Think about the last 7 days. How many days did you have a meal (breakfast, lunch or dinner) from restaurants, fast food places, food stands, or vending machines? (Don't include meals at schools)."* Respondents had the option of selecting: a total number of days between 0-7, *"don't know"* or *"refuse to answer"*. Self-reported preference for McDonald's, KFC and Subway specifically, was

assessed using the corresponding brand's logo displayed with the following measure: "*How much would you like to go to this restaurant?".* Respondents had the option of selecting from a 7-item emoji-scale, as displayed in **Figure 1**. *"Don't know"* and *"refuse to answer"* were also response options. The emoji-scale was recategorized into the following: *"not preferred"* (😖, 😠, 😕), *"neutral"* (😐), *"preferred"* (😊, 😀, 😍).

Figure 1. 7-item emoji-based Likert scale used for the measurement of fast food brand preference

Sociodemographic measures

The sociodemographic measures included in this study were the respondent's age, sex at birth, perceived income adequacy and ethnicity. Age was collected as a continuous variable. Sex at birth was collected as a binary variable for either *"male"* or *"female"*. Income adequacy was collected using the following measure: "*Does your family have enough money to pay for things your family needs?".* Respondents had the option of selecting from the following options: *"not enough money", "barely enough money", "enough money", "more than enough money", "don't know"* or *"refuse to answer"*. Perceived income adequacy was recategorized into a binary variable for either *"enough money"* (*"enough money"* and *"more than enough money"*) or *"not enough money"* (*"not enough money"* and *"barely enough money"*). Ethnicity was assessed using census measures from each country and re-coded to either "majority" or "minority" to derive comparable measures across countries.

Data Analysis

The analytic sample included 11,108 respondents (Australia: n=1,435; Canada: n=3,682; Chile: n=1,252; Mexico: n=1,616; UK: n=1,520; US: n=1,603). A sub-sample of 9,695 respondents were included in the current analysis after excluding those with missing and/or incomplete data on sociodemographic characteristics (i.e., *"don't know", "refuse to answer"* or left their answer selection blank), predictor variables and outcome variables (1,413 respondents; 12.7%). Data were weighted with post-stratification sample weights constructed using a raking algorithm with population estimates from the census in each country based on age group, sex, region in all countries, and ethnicity (except in Canada, where ethnicity wasn't considered in the sample weights). All estimates reported throughout are weighted. Statistical analyses were conducted using SAS Studio OnDemand for Academics (SAS Institute Inc., 2021).

Ordinal logistic or negative binomial regression models were used to model the associations as appropriate. Each model was adjusted for age, sex, perceived income adequacy and ethnicity, and an indicator variable for country was used to examine the associations within each country. Statistical significance for all models was set at an alpha level <0.05, and significance was determined using a p-value < 0.05 or a 95% confidence interval. Differences in the association between outcomes and sociodemographic variables by country were tested and compared with and without interaction terms and the likelihood ratio test was used to determine if an interaction was present. Significant interactions were noted for the associations between youth's self-reported general exposure to fast food brand-specific marketing and self-reported fast food intake ($p<0.05$), and the association between youth's self-reported exposure to brand-specific marketing and self-reported fast food intake ($p<0.05$). As such, since some significant interactions were found, all results were stratified by country.

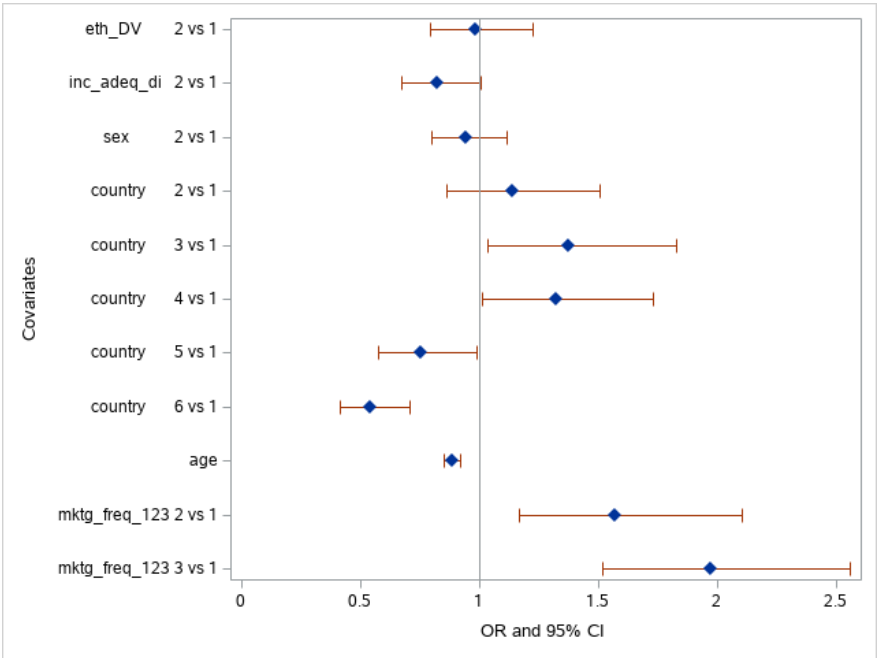
Results

Weighted sample characteristics of youth respondents aged 10-17 in all six countries are presented in **Table 1**. Proportional differences in sociodemographic characteristics were noted across all countries. Overall, there was a higher proportion of adolescents aged 13-17 in all countries, the US had a higher proportion of minority respondents than other countries, and Canada had a higher proportion of respondents who perceived their family to have enough money compared to the other countries.

Association between youth's self-reported general exposure to fast food marketing and fast food brand preference

General exposure to fast food marketing and preference for McDonald's

Overall, the odds of preferring McDonald's were significantly higher in the UK (*OR:*1.375; *CI:*1.036, 1.826) and the US (*OR:*1.325; *CI:*1.014, 1.731) and significantly lower in Mexico (*OR:*1.754; *CI:*0.575, 0.987) and Chile (*OR:*0.542; *CI:*0.416, 0.707) compared to Canada **(Additional file 1; Figure 2)**. In terms of general exposure to fast food marketing, overall, respondents reportedly preferred McDonald's most when exposed to general fast food marketing ≥2x/week (*OR:*1.972; *CI:*1.520, 2.558) and ≤1x/week *(OR:*1.568; *CI:*1.169, 2.102*)* compared to never being exposed to this marketing. Additionally, the odds of preferring McDonald's decreased with increasing age (*OR:*0.887; *CI:*0.854, 0.922).



Legend: eth_dv=ethnicity; eth_dv=1: 'majority'; eth_dv=2: 'minority'
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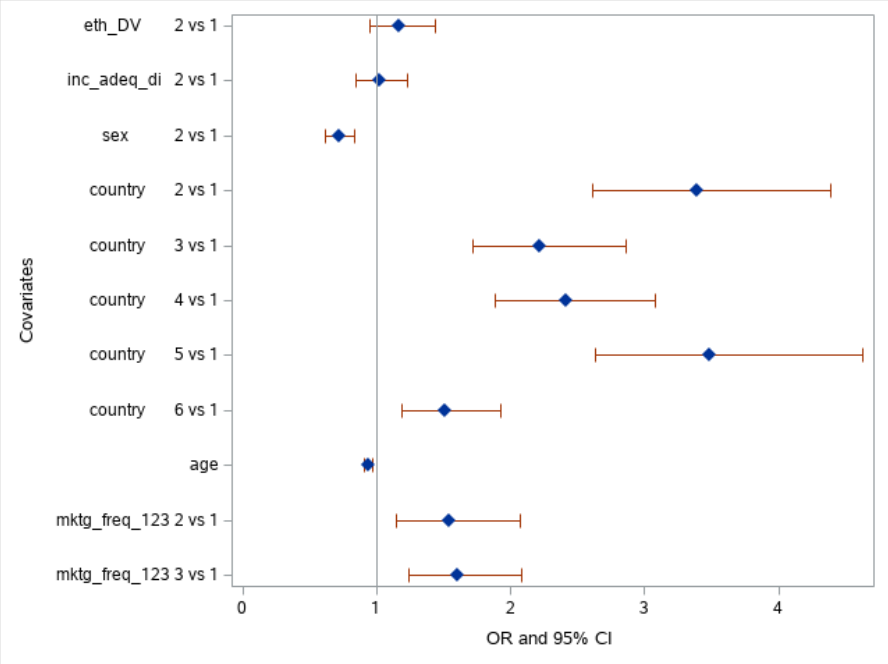
mktg_freq_123=3: '≥2x/week'

Figure 2. Odds ratio estimates and 95% CIs for general exposure to fast food marketing and McDonald's preference

By country, the odds of preferring McDonald's when exposed to general fast food marketing ≥2x/week compared to never being exposed in a week were greatest in the US (*OR:*2.278; *CI:*1.101, 4.710), followed by the UK (*OR:*2.197; *CI:*1.156;4.175), Canada (*OR:*2.021; *CI:*1.297, 3.149) and Australia (*OR:*2.019; *CI:*1.055, 3.864) **(Additional file 2)**. When exposed to general fast food marketing ≤1x/week, the odds of preferring McDonald's in the US was 2.784 times greater (*CI:*1.168, 6.638) compared to not being exposed at all in a week. In terms of age, preference for McDonald's decreased with increasing age in most countries.

General exposure to fast food marketing and preference for KFC

Compared to Canada, overall, respondents from all countries were more likely to prefer KFC more, with the odds being highest in Mexico (*OR:*3.488; *CI:*2.629, 4.627), followed by Australia (*OR:*3.387; *CI:*2.612, 4.393), the US (*OR:*2.412, *CI:*1.888, 1.926), the UK (*OR:*2.219; *CI:*1.718, 2.866), and Chile (*OR:*1.512, *CI:*1.188, 1.926**) (Additional file 1; Figure 3)**. Females were also less likely to prefer KFC than males (*OR:*0.719; *CI:*0.616, 0.839). In terms of general exposure to fast food marketing, the likelihood of preferring KFC was highest when respondents reportedly viewed this type of marketing ≥2x/week (*OR:*1.608; *CI:*1.240, 2.085) and ≤1x/week (*OR:*1.541; *CI:*1.150, 2.066) compared to not at all.



Legend: eth_dv=ethnicity; eth_dv=1: 'majority'; eth_dv=2: 'minority'
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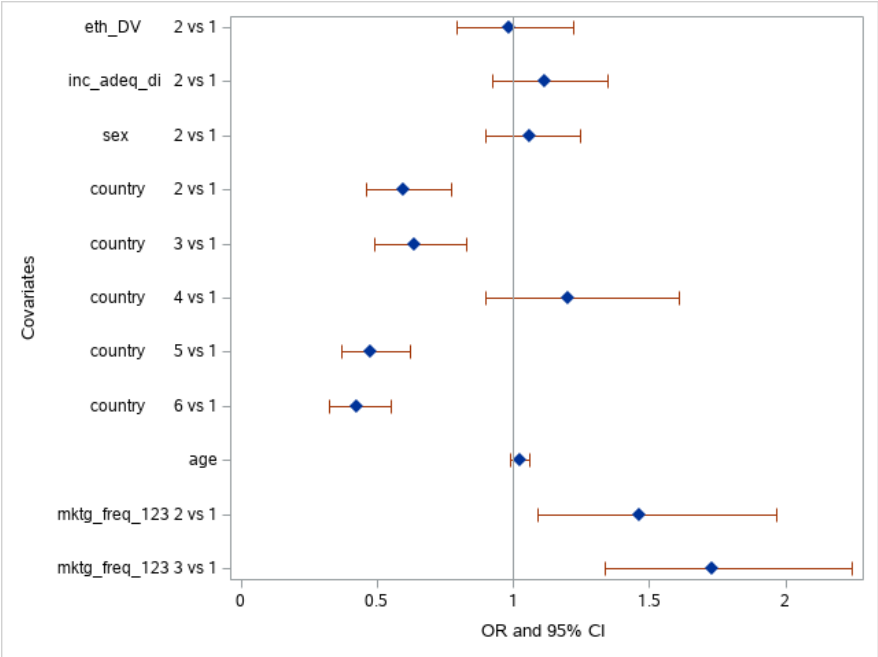
country=1: Canada; country=2: Australia; country=3: UK; country=4: US; country=5: Mexico; country=6: Chile
mktg_freq_123=general exposure to fast food marketing; mktg_freq_123=1: 'Never'; mktg_freq_123=2: '≤1x/week'; mktg_freq_123=3: '≥2x/week'

Figure 3. Odds ratio estimates and 95% CIs for general exposure to fast food marketing and KFC preference

By country, the odds of preferring KFC when exposed to general fast food marketing ≥2x/week compared to not being exposed to this marketing at all were highest in Chile (*OR:*2.338; *CI:*1.005, 5.443), followed by Australia (*OR:*2.146; *CI:*1.134, 4.059) and the UK (*OR:*1.987; *CI:*1.044, 3.784) **(Additional file 2)**. In addition, the odds of preferring KFC in Australia were 2.811 times greater (*CI:*1.233, 6.410) when exposed to general fast food marketing ≤1x/week compared to not being exposed at all in a week. In terms of sociodemographic characteristics, female respondents in Australia (*OR:*0.514; *CI:*0.320, 0.828) and Canada (*OR:*0.554, *CI:*0.435, 0.707) had a significantly lower preference for KFC compared to males, and in Canada, individuals who identified as a minority ethnicity preferred KFC significantly more than those who identified as a majority ethnicity (*OR:*1.374; *CI:*1.032, 1.828).

General exposure to fast food marketing and preference for Subway

Overall, compared to Canada, the likelihood of preferring Subway was significantly lower in most countries, with the lowest odds in Chile (*OR:*0.423; *CI:*0.324, 0.552), followed by Mexico (*OR:*0.477; *CI:*0.368, 0.619), Australia (*OR:*0.596; *CI:*0.459, 0.774) and the UK (*OR:*0.636; *CI:* 0.489, 0.826**) (Additional file 1; Figure 4)**. When respondents were exposed to general fast food marketing, the odds of preferring Subway was highest when exposed ≥2x/week (*OR:*1.731; *CI:*1.335, 2.243) and ≤1x/week (*OR:*1.463; *CI:*1.088, 1.967) compared to not being exposed at all.



Legend: eth_dv=ethnicity; eth_dv=1: 'majority'; eth_dv=2: 'minority'
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mktg_freq_123=general exposure to fast food marketing; mktg_freq_123=1: 'Never'; mktg_freq_123=2: '≤1x/week; mktg_freq_123=3: '≥2x/week'

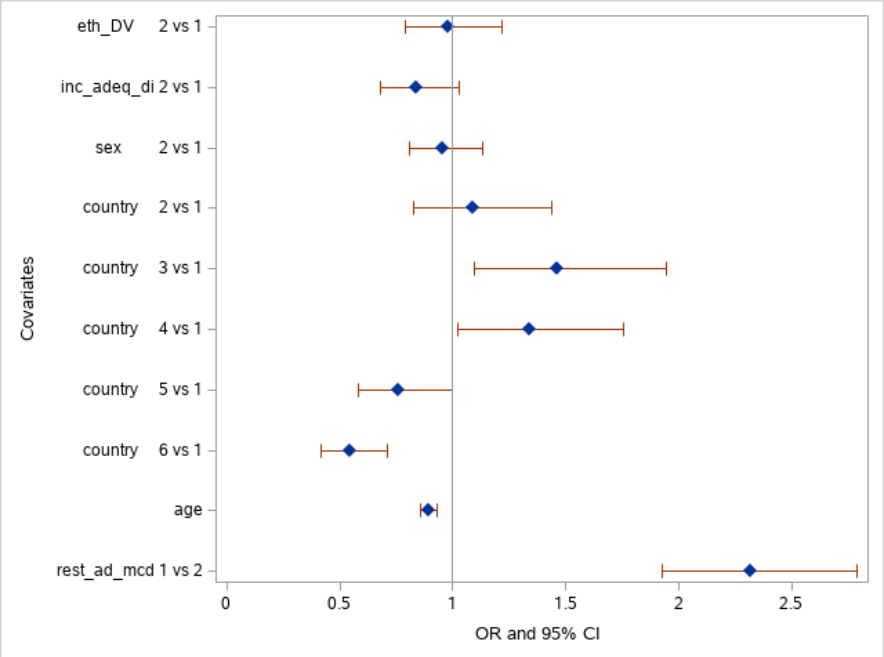
Figure 4. Odds ratio estimates and 95% CIs for general exposure to fast food marketing and Subway preference

By country, in Mexico and the UK, the odds of preferring Subway were 2.8 times (*CI:*1.327, 5.910) and 1.994 times greater (*CI:*1.101, 2.408), respectively, when exposed to general fast food marketing ≥2x/week compared to never being exposed to this marketing in a week **(Additional file 2)**. In Mexico, the odds of preferring Subway were 2.483 times greater (*CI:*1.060, 5.816) when exposed to general fast food marketing ≤1x/week as opposed to not being exposed at all. With respect to sociodemographic characteristics, in the UK, females were 1.569 times more likely (*CI:*1.023, 2.408) to prefer Subway than males, and in Chile, those who reported perceiving their family to have enough money were 1.931 times more likely (*CI:*1.199, 3.109) to prefer Subway than those who perceived their family to not have enough money.

Association between youth's self-reported exposure to McDonald's, Subway and KFC marketing and respective fast food brand preference

Exposure to McDonald's marketing and preference for McDonald's

Similar to the models above, overall, the odds of preferring McDonald's were significantly higher in the UK (*OR:*1.459; *CI:*1.095, 1.945) and the US (*OR:*1.337; *CI:*1.020, 1.753) and significantly lower in Chile (*OR:*0.545; *CI:*0.418, 0.710) and Mexico (*OR:*0.760; *CI:*0.579, 0.997) compared to Canada **(Additional file 3; Figure 5)**. When exposed to McDonald's marketing, the odds of respondents preferring McDonald's were 2.316 times higher (*CI:*1.924, 2.788), compared to not being exposed. In terms of age, preference for McDonald's decreased with increasing age (*OR:*0.893; *CI:*0.859, 0.927).



Legend: eth_dv=ethnicity; eth_dv=1: 'majority'; eth_dv=2: 'minority'
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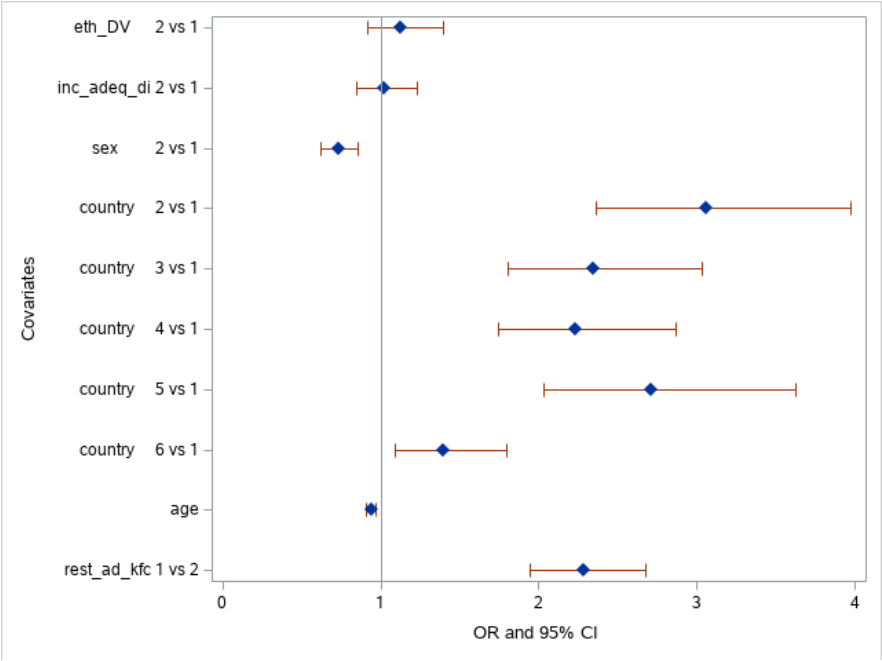
country=1: Canada; country=2: Australia; country=3: UK; country=4: US; country=5: Mexico; country=6: Chile
rest_ad_mcd=exposure to McDonald's marketing; rest_ad_mcd=1: 'Exposed'; rest_ad_mcd=2: 'Not exposed'

Figure 5. Odds ratio estimates and 95% CIs for exposure to McDonald's marketing and McDonald's preference

By country, the odds of preferring McDonald's were greater when exposed to McDonald's marketing as opposed to not being exposed in all countries **(Additional file 4)**. The highest odds being in Chile (*OR:*3.215; *CI:*1.872, 5.521), followed by Australia (*OR:*2.869; *CI:*1.663, 4.951), Mexico (*OR:*2.277; *CI:*1.327, 3.908), the US (*OR:*2.119; *CI:*1.272, 3.531), Canada (*OR:*2.083; *CI:*1.524, 2.849) and the UK (*OR:*2.080; *CI:*1.271, 3.404). The likelihood of preferring McDonald's decreased with increasing age in Canada (*OR:*0.878; *CI:*0.826, 0.934) and the US (*OR:*0.884; *CI:*0.793, 0.986).

Exposure to KFC marketing and preference for KFC

Similar to the previous models, compared to Canada, the odds of preferring KFC were significantly higher in all countries, with the highest odds of preference being in Australia (*OR:*3.063; *CI:*2.360, 3.976), followed by Mexico (OR:2.713; *CI:*2.033, 3.621), the UK (*OR:*2.341; *CI:*1.805, 3.036), the US (*OR:*2.234; *CI:*1.741, 2.866) and Chile (*OR:*1.397; *CI:*1.089, 1.793) **(Additional file 3; Figure 6)**. In terms of sex, females were less likely to prefer KFC than males overall (*OR:*0.730; *CI:*0.624, 0.853). When reportedly viewing KFC marketing compared to not, the odds of preferring KFC were significantly higher by a factor of 2.282 (*CI:* 1.945, 2.678).



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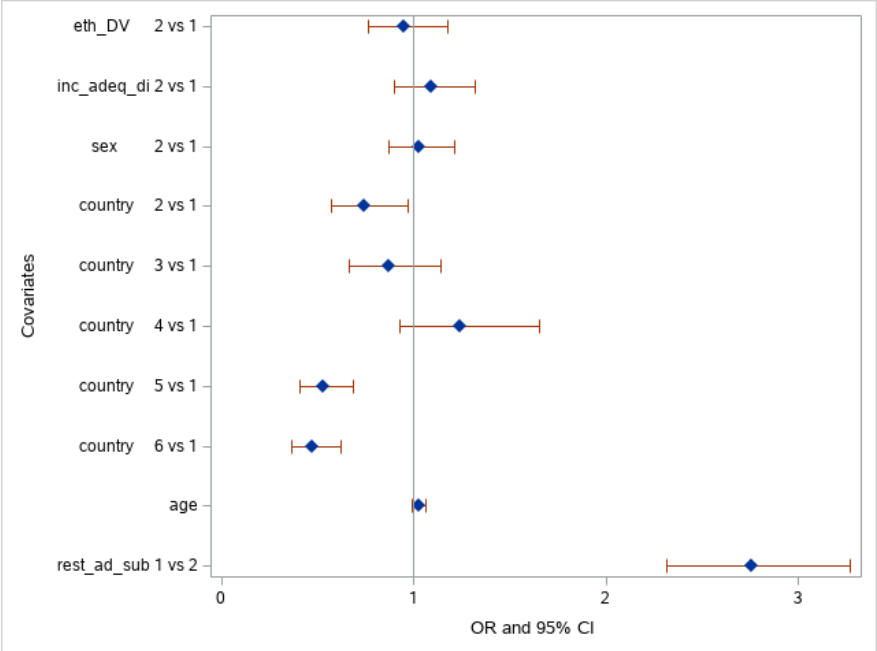
rest_ad_kfc=exposure to KFC marketing; rest_ad_kfc=1: 'Exposed'; rest_ad_kfc=2: 'Not exposed'

Figure 6. Odds ratio estimates and 95% CIs for exposure to KFC marketing and KFC preference

By country, the odds of preferring KFC was higher in all countries when exposed to KFC marketing compared to not being exposed, with the greatest odds of preference in Canada (*OR:*2.801; *CI:*2.184, 3.593), followed by Australia (*OR:*2.587; *CI:*1.595, 4.199), the UK (*OR:*2.349; *CI:*1.458, 3.785), Mexico (*OR:*2.022; *CI:*1.094, 3.739), the US (*OR:*1.865; *CI:*1.201, 2.896) and Chile (*OR:*1.640; *CI:*1.065, 2.524) **(Additional file 4)**. Females reportedly preferred KFC significantly less than males in Australia (*OR:*0.482; *CI:*0.302, 0.769) and Canada (*OR:*0.565; *CI:*0.441, 0.724). In Canada, the odds of preferring KFC decreased with increasing age (*OR:*0.879; *CI:*0.832, 0.928).

Exposure to Subway marketing and preference for Subway

Overall, the odds of preferring Subway were significantly lower in Chile (*OR:*0.475; *CI:*0.363, 0.621), Mexico (OR:0.529; *CI:*0.407, 0.688) and Australia (*OR:*0.743; *CI:*0.569, 0.971) compared to Canada **(Additional file 3; Figure 7)**. Additionally, respondents who reported being exposed to Subway marketing were significantly more likely to prefer Subway compared to those who were not exposed to this marketing (*OR:*2.751; *CI:*2.317, 3.267).



Legend: eth_dv=ethnicity; eth_dv=1: 'majority'; eth_dv=2: 'minority'
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country=1: Canada; country=2: Australia; country=3: UK; country=4: US; country=5: Mexico; country=6: Chile
rest_ad_sub=exposure to Subway marketing; rest_ad_sub=1: 'Exposed'; rest_ad_sub=2: 'Not exposed'

Figure 7. Odds ratio estimates and 95% CIs for exposure to Subway marketing and Subway preference

By country, the odds of preferring Subway in all countries was greater when exposed to Subway marketing compared to not being exposed, with the highest odds in the US (*OR:*4.196; *CI:*2.494, 7.061), followed by the UK (*OR:*3.440; *CI:*2.067, 5.723), Chile (*OR:*2.778; *CI:*1.763, 4.377), Mexico (*OR:*2.655; *CI:*1.752, 4.023), Australia (*OR:*2.639; *CI:*1.665, 4.184) and Canada (*OR:*2.262; *CI:*1.650, 3.102) **(Additional file 4)**. In Chile specifically, those who reportedly

perceived their families to have enough money were 1.760 times more likely (*CI:*1.077, 2.876) to prefer Subway than those who did not perceived their families to have enough money.

Association between youth's self-reported general exposure to fast food marketing and fast food intake

In most countries, the odds of fast food intake were highest when exposed to general fast food marketing ≥2x/week compared to reportedly never being exposed, with the highest odds being in Chile (*IRR:*1.8958; *CI:*1.4477, 2.4826), followed by the UK (*IRR:*1.3998; CI:1.2039, 1.6275), Canada (*IRR:*1.3241; *CI:*1.1877, 1.4761), Mexico (*IRR:*1.2640; *CI:*1.0478, 1.5249) and the US (*IRR:*1.2147; *CI:*1.0495, 1.4059) **(Additional file 5)**. The odds of reportedly consuming fast food were also higher in the UK (*IRR:*1.3982; *CI:*1.1852, 1.6495) and Canada (*IRR:*1.2123; *CI:*1.0745, 1.3678) when exposed to general fast food marketing ≤1x/week as opposed to never. In terms of sociodemographic variables, in four countries, the odds of reported intake were significantly lower for females than males. Additionally, in almost all countries, the odds of reported fast food intake were significantly higher for those who identified as a minority compared to those who identified as a majority.

Association between youth's self-reported exposure to McDonald's, KFC and Subway marketing and fast food intake

Fast food intake and exposure to McDonald's marketing

In almost all countries, the odds of reported fast food intake were higher for those who were reportedly exposed to McDonald's marketing compared to those who were not exposed, with the highest odds being in Chile (*IRR:*1.4301; *CI:*1.2202, 1.6760), followed by Canada

(*IRR:*1.2568; *CI:*1.1676, 1.3529), the UK (*IRR:*1.2268; *CI:*1.1056, 1.3612), the US (*IRR:*1.1589; *CI:*1.0531, 1.2754) and Mexico (*IRR:*1.1423; *CI:*1.0381, 1.2570) **(Additional file 6)**. With respect to sociodemographic characteristics, in four countries, the odds of reportedly consuming fast food were significantly lower for females than males. With regard to ethnicity, in almost all countries, the odds of reportedly eating fast food was significantly higher amongst those who identified as a minority in their country as opposed to a majority. The likelihood of fast food intake was significantly higher for those who perceived their families to have enough money compared to those who did not perceive an adequate income in Mexico (*IRR:*1.3203; *CI:*1.2189, 1.4301) and the US (*IRR:*1.1390; *CI:*1.0544, 1.2304).

Fast food intake and exposure to KFC marketing

In almost all countries, the odds of reportedly consuming fast food were higher for those who were reportedly exposed to KFC marketing compared to those who were not, with the highest odds being in Canada (*IRR:*1.3536; *CI:*1.2790, 1.4326), followed by the UK (*IRR:*1.2877; *CI:*1.1702, 1.4170), the US (*IRR:*1.2202; *CI:*1.1336, 1.3134), Chile (*IRR:*1.2175; *CI:*1.0697, 1.3858) and Mexico (*IRR:*1.1144; *CI:*1.0124, 1.2267) **(Additional file 6)**. In terms of sex, in four countries, females reportedly ate fast food significantly less than males. In almost all countries, the odds of consuming fast food were higher amongst those who identified as a minority compared to those who identified as a majority. The likelihood of fast food intake was significantly higher for those who perceived income adequacy in their family compared to those who did not in Mexico (*IRR:*1.3189; *CI:*1.2176, 1.4286) and the US (*IRR:*1.1256; *CI:*1.0424, 1.2154).

Fast food intake and exposure to Subway marketing

In all countries, the odds of reportedly eating fast food was significantly higher when exposed to Subway marketing as opposed to not being exposed, with the highest odds being in Chile (*IRR:*1.3281; *CI:*1.1749, 1.5012), followed by the UK (*IRR:*1.2543; *CI:*1.1364, 1.3844), Mexico (*IRR:*1.2311; *CI:*1.1471, 1.3212), the US (*IRR:*1.1441; *CI:*1.0591, 1.2359), Canada (*IRR:*1.1231; *CI:*1.0547, 1.1959) and Australia (*IRR:*1.1005; *CI:*1.0055, 1.2045) **(Additional file 6)**. In terms of sex, in four countries, females reportedly ate fast food significantly less than males. The odds of consuming fast food were also significantly higher for those who identified as a minority compared to those who identified as a majority in almost all countries. Respondents who perceived their families to have an adequate income had a higher likelihood of consuming fast food compared to those who did not perceive an adequate family income in Mexico (*IRR:*1.2985; *CI:*1.1991, 1.4061) and the US (*IRR:*1.1335; *CI:*1.0493, 1.2243).

Discussion

Overall, the findings of this study were consistent with our hypotheses, revealing positive associations between exposure to fast food marketing and fast food brand preferences and intake. Preference for specific fast food brands was generally highest across countries when exposed to general fast food marketing ≥2x/week and ≤1x/week compared to those who were not exposed. Preference for these brands was also higher among those who self-reported exposure to marketing for each respective brand compared to those who did not, and this relationship was consistent across all countries. In terms of fast food intake, reported consumption was generally highest across countries when exposed to general fast food marketing ≥2x/week and ≤1x/week compared to those who were not exposed. Across almost all countries, reported consumption of

fast food was higher amongst those who were exposed to marketing for McDonald's, KFC and Subway as opposed to those who were not. With respect to sociodemographic characteristics, across most countries overall, respondents who identified as a minority ethnicity were more likely to consume fast food than those of a majority ethnicity, and females were less likely to reportedly consume fast food than males.

The study findings suggest that the likelihood of preferring a fast food brand and consuming fast food increased with both exposure to brand specific and general fast food marketing. These findings are consistent with previous epidemiological evidence assessing the association between food marketing that is not food category specific and health behaviours including youth's intake and preferences, and also consistent with similarly designed cross-sectional observational studies among adults and younger age groups and specific food categories.[58-65,43] Our findings build on this current body of knowledge by providing evidence for these associations for fast food specifically, which is important since it is the most marketed of all food categories.[19,22,26,30,33] As expected, this study also found that the odds of preferring a brand were higher overall across models when variables included recall of brand-specific fast food marketing, as opposed to more general exposure to fast food marketing. This may indicate that fast food brand-specific marketing has a greater effect on youth's preferences for the respective brand compared to general fast food marketing, which would be consistent with data from other fields of research investigating the association between cigarette brand-specific marketing and brand preferences amongst adolescents and young adults.[66,67] This stronger association may also be due to improved recall of instances of brand-specific marketing (compared to general instances of fast food marketing), as well as the type of questions asked (e.g., brand-specific marketing exposure was measured using a response of *"yes"* or *"no"*,

compared to general marketing exposure which was assessed using a 6-item Likert scale). To help address this, the 6-item scale was re-categorized into a 3-item scale, but the associations amongst the brand-specific measure remained stronger. Unfortunately, although the results were largely consistent across countries, we cannot fully conclude from this study alone that these associations are causal, due to the self-reported, cross-sectional nature of the data. Regardless, the interpretation of our results is supported by existing epidemiological data and will also help to strengthen existing associations between exposure to unhealthy food marketing and increased preference and consumption.[68]

Overall, the country-stratified results throughout were fairly consistent and did not differ by much across countries. As mentioned previously, the policy environments restricting unhealthy food marketing to children differ in stringency across the countries investigated, but yet, exposures are still high and the relationships between these exposures and eating behaviours are also consistently unfavoured across countries. Although most existing policies apply to children under the age of 13 and this study investigated those 10-17 years old, these findings still indicate that fast food marketing exposure is affecting the eating behaviours of youth and that current regulatory policies need to be strengthened.

This comprehensive survey also allowed for exploration of sociodemographic differences within the measured associations. Overall, it was found that females in most countries were less likely to report consumption of fast food than males, which is congruent with previous research measuring fast food intake.[70-72] An explanation for this consistent finding could be that female youth are more likely to engage in diet-related practices and are more attentive to their body image.[73,74] It may also be possible that males are targeted by industry marketing practices more often than females, as males are reportedly featured more frequently in food marketing, which

could lead to greater persuasion towards consuming the product.[75] We also found that individuals classified as ethnic minorities were more likely to report the consumption of fast food than ethnic majorities. Recent data has suggested that Black and Hispanic youth are being disproportionally exposed to more unhealthy food marketing, which suggests that targeted marketing practices could be a reason for this disparity.[76-80] This disparity brings concern as socioeconomic status is associated with ethnic minority status in countries like the US, and those with a lower socioeconomic status are more likely to exhibit poorer health outcomes.[81-83] It is clear that the industry is therefore targeting a group that is already disproportionality affected by poor health outcomes. However, these justifications need to be interpreted with caution, as our food intake models controlled for self-reported exposure, meaning exposure differences cannot directly explain differences in intake by sex or ethnicity. Nonetheless, the consistency and strength of the associations between exposure and intake indicate that these justifications are plausible. Implementing stringent regulations to protect youth from exposure to unhealthy food marketing may help to reduce these differences.[78]

Regardless of the policy landscape surrounding restricting unhealthy food marketing to children, it is evident that exposure to fast food marketing is negatively influencing youth's preference for and intake of these foods, as evidence has suggested that the odds of becoming overweight or developing obesity increases with fast food consumption.[84] The results demonstrate that current efforts to limit marketing to children and youth are not effective. As such, more comprehensive and stringent government regulation restricting fast food marketing to youth in all media may help reduce preferences and consumption of fast food. Including adolescents in these restrictions is also important, as they hold independent purchasing power, are easily influenced, spend a lot of time watching screens and have a high consumption of fast

food products.[24,25,72,85] Future research should examine if and how these modelled associations differ by child and adolescent age groups. This research could provide preliminary evidence on the likely influence of marketing exposure on older youth for whom there is little research[64] and to investigate whether existing policies protecting children under 13 years old are effective in reducing exposure to fast food marketing and its consequences, such as brand preferences and intake.

Strengths and Limitations

To our knowledge, this is the first study to examine the associations between specific fast food brand marketing exposure and youth-reported intake and preferences. This study employs consistent measures across a large sample size with a wide age range and includes respondents from a variety of ethnicities and socioeconomic backgrounds in six different countries, which allows for greater generalizability and between country comparisons. We also used sampling weights throughout the analysis to provide a more representative sample, which also increases generalizability of our findings. Additionally, as the exposure measures did not specifically focus on marketing in particular media, this allowed us to report our associations based on a wide range of exposures.

Understanding the limitations of self-reported data is crucial to contextualize the findings. In addition to being subject to recall bias and reverse causation, the self-reported exposure variables do not take into account the power, ad content, frequency, and extent to which it targets the individual. Past research has shown that certain marketing techniques affect's one's recall of the advertisement, which could have altered their ability to remember marketing exposures.[69] The self-reported fast food intake variable is also subject to recall bias and has its own

limitations, as it measures intake from a few settings (i.e., restaurants, food stands or vending machines) in addition to fast food places. However, we would argue that food from restaurants, food stands and vending machines can also be considered fast food, due to the ease of purchase and poor nutrient content of most foods sold from these sources. Aside from its limitations, self-reported measures are also valuable in that they are more feasible to collect. Objective measures are often more difficult to gather, as they are more resource-intense and do not accurately represent day-to-day choices.[68] Nevertheless, existing evidence suggests that self-reported exposure measures are correlated with objective exposure measures.[86,87] The increased feasibility of self-reported measures also allows for more frequent monitoring and the ability to collect and compare data across multiple countries simultaneously. To strengthen these findings, future research on fast food in this realm should consider the different components of marketing exposure to gain a more comprehensive understanding of the reported exposures and measure intake from fast food places specifically.

Additionally, it is possible that what respondents encompassed under 'fast food advertising' may have been interpreted differently by individuals, introducing additional bias. This study is also subject to survey research limitations, as recruitment was completed using nonprobability-based sampling, meaning these findings may not be representative of national estimates. To address this to an extent, data were weighted by age group, sex, region, and ethnicity (except in Canada), but this did not completely remove the effect.

Conclusion

Overall, we found positive associations between exposure to fast food marketing and the brand preferences and reported intake of youth across all six countries. Generally, in terms of

sociodemographic characteristics, females were less likely to report consuming fast food than males and ethnic minority individuals were more likely to report consuming fast food than ethnic majority individuals. The consistency and danger of these associations across countries highlights the need for more stringent regulation on unhealthy food marketing to youth.

List of Abbreviations:

- NCDs: noncommunicable diseases
- HFSS: high in fat, sugar and sodium
- IFPS: International Food Policy Study
- KFC: Kentucky Fried Chicken
- OR: odds ratio
- CI: confidence interval
- ref: reference
- FF: fast food
- IRR: incidence rate ratio

Declarations:

- **Ethics approval and consent to participate**
  -The study was reviewed by and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE# 41477) and a University of Ottawa Research Ethics Committee (H-06-20-5908).
- **Consent for publication**
  -Not applicable
- **Availability of data and materials**
  -The data that support the findings from this study are available from the International Food Policy Study team and are available under reasonable request.
- **Competing Interests**
  -None
- **Funding**
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- **Author Contributions**
  -MB and MPK designed the study and MRG, MPK and LV oversaw the analysis. MB conducted the analysis and drafted the manuscript. All authors read and approved the final manuscript.
- **Acknowledgements**
  -Not applicable

Table 1. Sample characteristics of youth aged 10-17 in six countries (weighted) N=9,695

Disposition	Australia (n=1,235)	Canada (n=3,127)	Chile (n=1,103)	Mexico (n=1,501)	United Kingdom (n=1,278)	United States (n=1,455)
Sex						
Male	51.3% (634)	50.7% (1585)	51.4% (567)	50.4% (757)	51.3% (656)	52.1% (758)
Female	48.7% (601)	49.3% (1541)	48.6% (536)	49.6% (744)	48.7% (622)	47.9% (697)
Age						
(mean; SE)	13.4 years (SE=0.07)	13.5 years (SE=0.04)	13.6 years (SE=0.07)	13.5 years (SE=0.07)	13.4 years (SE=0.06)	13.5 years (SE=0.06)
Age Group						
10-12 years	39.3% (485)	37.0% (1156)	35.5% (392)	36.6% (549)	36.9% (472)	36.3% (528)
13-17 years	60.7% (750)	63.0% (1970)	64.5% (711)	63.4% (952)	63.1% (806)	63.7% (928)
Ethnicity						
Majority	75.9% (937)	73.7% (2306)	85.6% (944)	77.9% (1169)	83.2% (1063)	67.9% (988)
Minority	24.1% (298)	26.3% (821)	14.4% (159)	22.1% (331)	16.8% (215)	32.1% (468)
Perceived Income Adequacy						
Not enough money	25.3% (313)	17.2% (537)	29.8% (329)	27.9% (418)	26.8% (342)	29.4% (428)
Enough money	74.7% (923)	82.8% (2590)	70.2% (774)	72.1% (1082)	73.2% (936)	70.6% (1027)
Self-reported exposure to fast food marketing (30 days)						
Never	13.4% (165)	9.1% (286)	7.8% (86)	4.3% (65)	14.9% (191)	7.5% (109)
≤1x/week	21.5% (266)	21.7% (679)	23.6% (260)	20.3% (305)	26.4% (337)	17.3% (252)
≥2x/week	65.1% (804)	69.1% (2161)	68.6% (757)	75.3% (1130)	58.7% (750)	75.2% (1094)
Self-reported exposure to *McDonald's* marketing (past 30 days)						
Yes	77.8% (961)	78.9% (2468)	78.0% (860)	84.0% (1260)	66.0% (843)	82.9% (1207)
No	22.2% (274)	21.1% (659)	22.0% (243)	16.0% (241)	34.0% (435)	17.1% (249)
Self-reported exposure to *Subway* marketing (past 30 days)						
Yes	47.5% (587)	68.8% (2152)	49.2% (543)	61.9% (929)	34.2% (437)	70.1% (1020)
No	52.5% (648)	31.2% (974)	50.8% (560)	38.1% (571)	65.8% (842)	29.9% (435)
Self-reported exposure to *KFC* marketing (past 30 days)						
Yes	65.6% (810)	48.4% (1512)	62.6% (690)	83.9% (1259)	44.4% (567)	64.3% (936)
No	34.4% (425)	51.6% (1615)	37.4% (412)	16.1% (241)	55.6% (711)	35.7% (520)
Self-reported frequency of breakfast, lunch or dinner from restaurants, fast food places, food stands, or vending machines (7 days)						
0 days (not at all)	14.4% (178)	15.9% (498)	28.7% (317)	12.0% (180)	19.5% (250)	9.8% (143)
1 day	29.4% (363)	29.6% (925)	27.6% (304)	21.5% (323)	29.9% (383)	17.0% (247)
2 days	27.3% (337)	25.4% (795)	18.3% (202)	24.8% (372)	21.5% (274)	25.4% (370)
3 days	14.6% (181)	13.5% (423)	11.8% (130)	20.3% (304)	11.8% (151)	19.8% (288)
4 days	5.1% (63)	6.2% (193)	4.0% (44)	6.3% (94)	5.0% (64)	11.0% (159)
5 days	3.6% (44)	5.9% (184)	2.7% (30)	7.2% (108)	6.8% (87)	9.3% (135)
6 days	1.0% (12)	0.7% (23)	0.7% (8)	1.5% (23)	0.6% (8)	1.3% (19)
7 days (every day)	4.6% (57)	2.7% (85)	6.2% (68)	6.4% (96)	4.8% (61)	6.4% (94)

Disposition	**Australia** (n=**395**/1,235)	**Canada** (n=**1076**/3,127)	**Chile** (n=**358**/1,103)	**Mexico** (n=**508**/1,501)	**United Kingdom** (n=**418**/1,278)	**United States** (n=**492**/1,455
Self-reported preference for *McDonald's* 😠 😠 😕 😑 😊 😄 😍						
Not preferred (😠, 😠, 😕)	14.7% (58)	16.4% (176)	26.5% (95)	19.5% (99)	11.7% (49)	10.4% (51)
Neutral (😐)	11.1% (44)	12.4% (133)	14.5% (52)	13.6% (69)	11.7% (49)	12.8% (63)
Preferred (😊, 😄, 😍)	74.2% (293)	71.3% (767)	58.9% (211)	66.9% (340)	76.6% (320)	76.8% (378)
Disposition	**Australia** (n=**426**/1,235)	**Canada** (n=**1025**/3,127)	**Chile** (n=**359**/1,103)	**Mexico** (n=**499**/1,501)	**United Kingdom** (n=**442**/1,278)	**United States** (n=**474**/1,455)
Self-reported preference for *Subway* 😠 😠 😕 😑 😊 😄 😍						
Not preferred (😠, 😠, 😕)	13.4% (57)	8.6% (88)	17.5% (63)	17.6% (88)	14.3% (63)	8.6% (41)
Neutral (😐)	20.0% (85)	13.8% (141)	23.7% (85)	18.8% (94)	17.4% (77)	10.1% (48)
Preferred (😊, 😄, 😍)	66.7% (284)	77.7% (796)	58.8% (211)	63.5% (317)	68.3% (302)	81.2% (385)
Disposition	**Australia** (n=**414**/1,235)	**Canada** (n=**1027**/3,127)	**Chile** (n=**386**/1,103)	**Mexico** (n=**494**/1,501)	**United Kingdom** (n=**420**/1,278)	**United States** (n=**490**/1,455)
Self-reported preference for *KFC* 😠 😠 😕 😑 😊 😄 😍						
Not preferred (😠, 😠, 😕)	11.8% (49)	33.4% (343)	24.6% (95)	11.3% (56)	19.5% (82)	14.9% (73)
Neutral (😐)	14.3% (59)	19.6% (201)	18.1% (70)	13.6% (67)	14.5% (61)	17.6% (86)
Preferred (😊, 😄, 😍)	73.9% (306)	47.0% (483)	57.3% (221)	75.1% (371)	66.0% (277)	67.6% (331)

Additional Files

Additional file 1. Overall odds ratio estimates from separate proportional odds regression models examining the association between general exposure to fast food marketing and preference for McDonald's, KFC and Subway among youth in six countries

	McDonald's		KFC		Subway	
Parameter	***OR***	***(95% CI)***	***OR***	***(95% CI)***	***OR***	***(95% CI)***
Country						
Canada	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Chile	0.542	(0.416, 0.707)*	1.512	(1.188, 1.926)*	0.423	(0.324, 0.552)*
Mexico	0.754	(0.575, 0.987)*	3.488	(2.629, 4.627)*	0.477	(0.368, 0.619)*
United States	1.325	(1.014, 1.731)*	2.412	(1.888, 1.926)*	1.203	(0.899, 1.610)
United Kingdom	1.375	(1.036, 1.826)*	2.219	(1.718, 2.866)*	0.636	(0.489, 0.826)*
Australia	1.141	(0.865, 1.505)	3.387	(2.612, 4.393)*	0.596	(0.459, 0.774)*
Age	0.887	(0.854, 0.922)*	0.940	(0.908, 0.973)*	1.024	(0.987, 1.062)
Sex						
Male	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Female	0.946	(0.800, 1.118)	0.719	(0.616, 0.839)*	1.057	(0.897, 1.246)
Ethnicity						
Majority	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Minority	0.984	(0.792, 1.224)	1.163	(0.945, 1.432)	0.984	(0.793, 1.221)
Income Adequacy						
Not enough money	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Enough money	0.823	(0.672, 1.009)	1.020	(0.848, 1.226)	1.113	(0.922, 1.345)
General Exposure to FF Marketing						
Never	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
≥2x/week	1.972	(1.520, 2.558)*	1.608	(1.240, 2.085)*	1.731	(1.336, 2.243)*
≤1x/week	1.568	(1.169, 2.102)*	1.541	(1.150, 2.066)*	1.463	(1.088, 1.967)*

* Indicates significant test at an alpha level of 0.05
OR: odds ratio
CI: confidence interval
ref: reference
FF: fast food

Additional file 2. Odds ratio estimates from separate proportional odds regression models stratified by country examining the association between general exposure to fast food marketing and preference for McDonald's, KFC and Subway among youth in six countries

	Canada		Australia		United Kingdom		United States		Mexico		Chile	
Parameter	***OR***	***(95% CI)***	***OR***	***(95% CI)***	***OR***	***(95% CI)***	***OR***	***(95% CI)***	***OR***	***(95% CI)***	***OR***	***(95% CI)***
General Exposure to Fast Food Marketing and Preference for McDonald's												
Age	0.874	(0.822, 0.930)*	0.889	(0.796, 0.993)*	0.901	(0.796, 1.018)	0.882	(0.792, 0.983)*	0.916	(0.827, 1.105)	0.885	(0.802, 0.977)*
Sex												
Male	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Female	0.913	(0.693, 1.204)	0.647	(0.393, 1.065)	0.972	(0.594, 1.591)	1.056	(0.665, 1.678)	1.188	(0.752, 1.876)	0.857	(0.548, 1.341)
Ethnicity												
Majority	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Minority	0.826	(0.602, 1.133)	1.081	(0.569, 2.055)	0.631	(0.292, 1.364)	1.353	(0.835, 2.193)	1.121	(0.578, 2.172)	1.218	(0.619, 2.396)
Income Adequacy												
Not enough money	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Enough money	0.843	(0.566, 1.255)	0.837	(0.486, 1.442)	0.944	(0.537, 1.661)	0.678	(0.395, 1.164)	1.012	(0.617, 1.658)	0.670	(0.403, 1.114)
General Exposure to FF Marketing												
Never	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
≥2x/week	2.021	(1.297, 3.149)*	2.019	(1.055, 3.864)*	2.197	(1.156, 4.175)*	2.278	(1.101, 4.710)*	1.235	(0.392, 3.885)	1.676	(0.723, 3.885)
≤1x/week	1.394	(0.846, 2.299)	1.185	(0.540, 2.601)	1.495	(0.746, 2.998)	2.784	(1.168, 6.638)*	1.216	(0.367, 4.036)	1.477	(0.596, 3.658)
General Exposure to Fast Food Marketing and Preference for KFC												
Age	0.886	(0.840, 0.935)*	0.992	(0.895, 1.099)	0.976	(0.874, 1.089)	1.012	(0.922, 1.110)	0.987	(0.881, 1.106)	0.927	(0.845, 1.018)
Sex												
Male	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Female	0.554	(0.435, 0.707)*	0.514	(0.320, 0.828)*	0.954	(0.611, 1.489)	0.949	(0.622, 1.449)	0.905	(0.545, 1.505)	0.875	(0.569, 1.345)
Ethnicity												
Majority	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Minority	1.374	(1.032, 1.828)*	0.958	(0.497, 1.846)	1.079	(0.515, 2.257)	1.225	(0.792, 1.894)	0.610	(0.311, 1.193)	1.511	(0.756, 3.017)
Income Adequacy												
Not enough money	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Enough money	0.778	(0.567, 1.068)	0.898	(0.520, 1.550)	0.967	(0.599, 1.562)	1.442	(0.905, 2.298)	1.469	(0.851, 2.535)	1.126	(0.707, 1.792)

General Exposure to FF Marketing												
Never	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
≥2x/week	1.334	(0.884, 2.013)	2.146	(1.134, 4.059)*	1.987	(1.044, 3.784)*	0.951	(0.423, 2.140)	1.534	(0.516, 4.562)	2.338	(1.005, 5.443)*
≤1x/week	1.376	(0.865, 2.189)	2.811	(1.233, 6.410)*	1.601	(0.799, 3.209)	0.943	(0.372, 2.388)	1.334	(0.408, 4.364)	1.689	(0.670, 4.262)
General Exposure to Fast Food Marketing and Preference for Subway												
Age	0.988	(0.924, 1.056)	1.100	(0.996, 1.216)	0.992	(0.904, 1.089)	1.039	(0.926, 1.165)	1.045	(0.952, 1.148)	1.025	(0.929, 1.130)
Sex												
Male	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Female	0.951	(0.702, 1.290)	1.124	(0.727, 1.739)	1.569	(1.023, 2.408)*	0.956	(0.581, 1.574)	1.026	(0.675, 1.560)	1.005	(0.642, 1.576)
Ethnicity												
Majority	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Minority	0.902	(0.643, 1.267)	0.968	(0.544, 1.722)	1.952	(0.918, 4.151)	0.775	(0.464, 1.295)	0.976	(0.518, 1.840)	0.965	(0.467, 1.994)
Income Adequacy												
Not enough money	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Enough money	1.012	(0.686, 1.494)	0.880	(0.528, 1.469)	0.792	(0.480, 1.307)	0.993	(0.576, 1.709)	1.379	(0.859, 2.215)	1.931	(1.199, 3.109)*
General Exposure to FF Marketing												
Never	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
≥2x/week	1.245	(0.748, 2.070)	1.838	(0.968, 3.491)	1.994	(1.101, 3.611)*	1.881	(0.772, 4.582)	2.800	(1.327, 5.910)*	1.567	(0.737, 3.332)
≤1x/week	1.099	(0.617, 1.958)	1.227	(0.601, 2.504)	1.431	(0.735, 2.789)	1.315	(0.454, 3.813)	2.483	(1.060, 5.816)*	2.021	(0.880, 4.640)

* Indicates significant test at an alpha level of 0.05
OR: odds ratio
CI: confidence interval
ref: reference
FF: fast food

Additional file 3. Overall odds ratio estimates from separate proportional odds regression models examining the association between exposure to McDonald's, KFC and Subway marketing and preference for each respective brand among youth in six countries

	McDonald's Marketing Exposure and Preference for McDonald's		KFC Marketing Exposure and Preference for KFC		Subway Marketing Exposure and Preference for Subway	
Parameter	***OR***	***(95% CI)***	***OR***	***(95% CI)***	***OR***	***(95% CI)***
Country						
Canada	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Chile	0.545	(0.418, 0.710)*	1.397	(1.089, 1.793)*	0.475	(0.363, 0.621)*
Mexico	0.760	(0.579, 0.997)*	2.713	(2.033, 3.621)*	0.529	(0.407, 0.688)*
United States	1.337	(1.020, 1.753)*	2.234	(1.741, 2.866)*	1.237	(0.926, 1.652)
United Kingdom	1.459	(1.095, 1.945)*	2.341	(1.805, 3.036)*	0.870	(0.665, 1.139)
Australia	1.091	(0.829, 1.436)	3.063	(2.360, 3.976)*	0.743	(0.569, 0.971)*
Age	0.893	(0.859, 0.927)*	0.939	(0.906, 0.972)	1.025	(0.988, 1.063)
Sex						
Male	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Female	0.958	(0.810, 1.133)	0.730	(0.624, 0.853)*	1.026	(0.869, 1.211)
Ethnicity						
Majority	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Minority	0.980	(0.787, 1.219)	1.128	(0.913, 1.394)	0.950	(0.766, 1.179)
Income Adequacy						
Not enough money	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Enough money	0.838	(0.683, 1.028)	1.017	(0.843, 1.227)	1.091	(0.901, 1.321)
Marketing Exposure to respective brand						
Not exposed	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Exposed	2.316	(1.924, 2.788)*	2.282	(1.945, 2.678)*	2.751	(2.317, 3.267)*

* Indicates significant test at an alpha level of 0.05
OR: odds ratio
CI: confidence interval
ref: reference

Additional file 4. Odds ratio estimates from separate proportional odds regression models stratified by country examining the association between exposure to McDonald's, KFC and Subway marketing and preference for McDonald's, KFC and Subway, respectively, among youth in six countries

	Canada		Australia		United Kingdom		United States		Mexico		Chile	
Parameter	***OR***	***(95% CI)***	***OR***	***(95% CI)***	***OR***	***(95% CI)***	***OR***	***(95% CI)***	***OR***	***(95% CI)***	***OR***	***(95% CI)***
Exposure to McDonald's Marketing and Preference for McDonald's												
Age	0.878	(0.826, 0.934)*	0.894	(0.797, 1.004)	0.911	(0.806, 1.029)	0.884	(0.793, 0.986)*	0.924	(0.832, 1.025)	0.904	(0.817, 1.002)
Sex												
Male	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Female	0.947	(0.717, 1.250)	0.687	(0.423, 1.116)	0.949	(0.584, 1.542)	1.127	(0.707, 1.796)	1.191	(0.750, 1.890)	0.814	(0.518, 1.280)
Ethnicity												
Majority	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Minority	0.853	(0.618, 1.175)	1.034	(0.538, 1.985)	0.622	(0.288, 1.343)	1.381	(0.848, 2.247)	1.018	(0.525, 1.974)	1.259	(0.658, 2.409)
Income Adequacy												
Not enough money	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Enough money	0.844	(0.568, 1.255)	0.860	(0.498, 1.484)	0.952	(0.539, 1.683)	0.699	(0.408, 1.196)	1.055	(0.640, 1.740)	0.643	(0.382, 1.081)
McDonald's Marketing Exposure												
Not Exposed	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Exposed	2.083	(1.524, 2.849)*	2.869	(1.663, 4.951)*	2.080	(1.271, 3.404)*	2.119	(1.272, 3.531)*	2.277	(1.327, 3.908)*	3.215	(1.872, 5.521)*
Exposure to KFC Marketing and Preference for KFC												
Age	0.879	(0.832, 0.928)*	0.972	(0.876, 1.079)	0.971	(0.871, 1.083)	1.008	(0.919, 1.106)	1.002	(0.896, 1.122)	0.934	(0.850, 1.025)
Sex												
Male	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Female	0.565	(0.441, 0.724)*	0.482	(0.302, 0.769)*	0.994	(0.636, 1.555)	0.966	(0.630, 1.483)	0.874	(0.525, 1.454)	0.936	(0.611, 1.433)
Ethnicity												
Majority	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Minority	1.324	(0.986, 1.776)	0.936	(0.494, 1.771)	1.045	(0.492, 2.220)	1.216	(0.781, 1.893)	0.589	(0.300, 1.156)	1.438	(0.715, 2.891)
Income Adequacy												
Not enough money	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Enough money	0.727	(0.528, 1.001)	0.956	(0.560, 1.633)	0.961	(0.586, 1.574)	1.352	(0.848, 2.157)	1.432	(0.829, 2.475)	1.191	(0.748, 1.895)

KFC Marketing Exposure												
Not Exposed	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Exposed	2.801	(2.184, 3.593)*	2.587	(1.595, 4.199)*	2.349	(1.458, 3.785)*	1.865	(1.201, 2.896)*	2.022	(1.094, 3.739)*	1.640	(1.065, 2.524)*
Exposure to Subway Marketing and Preference for Subway												
Age	0.993	(0.929, 1.062)	1.105	(1.000, 1.222)	0.992	(0.902, 1.091)	0.989	(0.880, 1.111)	1.065	(0.970, 1.169)	1.013	(0.918, 1.119)
Sex												
Male	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Female	0.946	(0.696, 1.286)	1.113	(0.719, 1.723)	1.530	(0.989, 2.366)	0.967	(0.587, 1.594)	0.890	(0.584, 1.354)	0.952	(0.613, 1.478)
Ethnicity												
Majority	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Minority	0.878	(0.622, 1.239)	0.904	(0.511, 1.598)	1.951	(0.909, 4.190)	0.771	(0.458, 1.298)	0.829	(0.449, 1.533)	1.061	(0.527, 2.136)
Income Adequacy												
Not enough money	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Enough money	1.028	(0.698, 1.516)	0.861	(0.518, 1.431)	0.781	(0.469, 1.302)	0.962	(0.558, 1.660)	1.336	(0.829, 2.153)	1.760	(1.077, 2.876)*
Subway Marketing Exposure												
Not Exposed	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Exposed	2.262	(1.650, 3.102)*	2.639	(1.665, 4.184)*	3.440	(2.067, 5.723)*	4.196	(2.494, 7.061)*	2.655	(1.752, 4.023)*	2.778	(1.763, 4.377)*

* Indicates significant test at an alpha level of 0.05
OR: odds ratio
CI: confidence interval
ref: reference

Additional file 5. Wald chi-square and contrast estimates (incidence rate ratios) from separate negative binomial regression models stratified by country examining the association between exposure to general fast food marketing and fast food intake among youth in six countries

	General exposure to fast food marketing and fast food intake											
	Canada		Australia		United Kingdom		United States		Mexico		Chile	
Parameter	***Wald* χ^2** *(p)*	***IRR*** *(95% CI)*	***Wald* χ^2** *(p)*	***IRR*** *(95% CI)*	***Wald* χ^2** *(p)*	***IRR*** *(95% CI)*	***Wald* χ^2** *(p)*	***IRR*** *(95% CI)*	***Wald* χ^2** *(p)*	***IRR*** *(95% CI)*	***Wald* χ^2** *(p)*	***IRR*** *(95% CI)*
Intercept	**2.85** *(0.0913)*		**1.56** *(0.2111)*		**0.10** *(0.7575)*		**0.2686** *(0.0410)**		**0.01** *(0.9196)*		**11.64** *(0.0006)**	
Age	**56.13** *(<0.0001)**		**16.96** *(<0.0001)**		**13.93** *(0.0002)**		**0.0325** *(<0.0001)**		**21.52** *(<0.0001)**		**17.88** *(<0.0001)**	
Sex												
Male	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Female	**11.92** *(0.0006)**	**0.9044** *(0.8542, 0.9575)**	**15.43** *(<0.0001)**	**0.8328** *(0.7601, 0.9124)**	**18.85** *(<0.0001)**	**0.8088** *(0.7349, 0.8901)**	**0.13** *(0.7200)*	**0.9875** *(0.9219, 1.0578)*	**1.19** *(0.2762)*	**0.9632** *(0.9002, 1.0305)*	**5.62** *(0.0178)**	**0.8621** *(0.7625, 0.9747)**
Ethnicity												
Majority	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Minority	**17.79** *(<0.0001)**	**1.1479** *(1.0766, 1.2239)**	**5.89** *(0.0152)**	**1.1510** *(1.0275, 1.2895)**	**10.30** *(0.0013)**	**1.2580** *(1.0934, 1.4474)**	**5.32** *(0.0210)**	**1.0882** *(1.0128, 1.1692)**	**20.39** *(<0.0001)**	**1.2331** *(1.1259, 1.3505)**	**2.34** *(0.1264)*	**1.1493** *(0.9615, 1.3739)*
Income Adequacy												
Not enough money	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Enough money	**0.65** *(0.4214)*	**0.9698** *(0.8999, 1.0451)*	**0.57** *(0.4506)*	**1.0407** *(0.9382, 1.1545)*	**2.05** *(0.1525)**	**0.9252** *(0.8317, 1.0292)*	**10.58** *(0.0011)**	**1.1367** *(1.0522, 1.2279)**	**44.46** *(<0.0001)**	**1.3120** *(1.2113, 1.4210)**	**1.72** *(0.1897)*	**1.0952** *(0.9560, 1.2546)*
General Exposure to FF Marketing												
Never	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
≥2x/week	**25.62** *(<0.0001)**	**1.3241** *(1.1877, 1.4761)**	**0.31** *(0.5787)*	**0.9626** *(0.8414, 1.1012)*	**19.13** *(<0.0001)**	**1.3998** *(1.2039, 1.6275)**	**6.80** *(0.0091)**	**1.2147** *(1.0495, 1.4059)**	**5.99** *(0.0144)**	**1.2640** *(1.0478, 1.5249)**	**21.61** *(<0.0001)**	**1.8958** *(1.4477, 2.4826)**
≤1x/week	**9.77** *(0.0018)**	**1.2123** *(1.0745, 1.3678)**	**1.09** (0.2961)	**0.9192** *(0.7849, 1.0765)*	**15.80** *(<0.0001)**	**1.3982** *(1.1852, 1.6495)**	**1.48** *(0.2232)*	**1.1080** *(0.9395, 1.3067)*	**0.87** *(0.3519)*	**1.0995** *(0.9005, 1.3425)*	**12.96** *(0.0003)**	**1.7005** *(1.2736, 2.2703)**

* Indicates significant test at an alpha level of 0.05
IRR: incidence rate ratio
$\chi 2$: chi-square
CI: confidence interval
ref: reference
FF: fast food

Additional file 6. Wald chi-square and contrast estimates (incidence rate ratios) from separate negative binomial regression models stratified by country examining the association between exposure to McDonald's, KFC and Subway marketing and fast food intake among youth in six countries

Parameter	Canada		Australia		United Kingdom		United States		Mexico		Chile	
	Wald χ^2 (p)	*IRR (95% CI)*	*Wald χ^2 (p)*	*IRR (95% CI)*	*Wald χ^2 (p)*	*IRR (95% CI)*	*Wald χ^2 (p)*	*IRR (95% CI)*	*Wald χ^2 (p)*	*IRR (95% CI)*	*Wald χ^2 (p)*	*IRR (95% CI)*
McDonald's marketing exposure and fast food intake												
Intercept	**2.37** *(0.1239)*		**1.14** *(0.2851)*		**0.17** *(0.6772)*		**5.50** *(0.0190)**		**0.37** *(0.5430)*		**7.39** *(0.0065)**	
Age	**61.06** *(<0.0001)**		**17.59** *(<0.0001)**		**15.71** *(<0.0001)**		**18.93** *(<0.0001)**		**23.45** *(<0.0001)**		**20.05** *(<0.0001)**	
Sex												
Male	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Female	**11.26** *(0.0008)**	**0.9071** *(0.8569, 0.9603)**	**15.15** *(<0.0001)**	**0.8342** *(0.7614, 0.9139)**	**18.88** *(<0.0001)**	**0.8081** *(0.7341, 0.8896)**	**0.08** *(0.7774)*	**0.9901** *(0.9243, 1.0606)*	**1.00** *(0.3184)*	**0.9662** *(0.9031, 1.0337)*	**4.41** *(0.0357)**	**0.8769** *(0.7757, 0.9912)**
Ethnicity												
Majority	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Minority	**17.72** *(<0.0001)**	**1.1473** *(1.0762, 1.2231)**	**5.78** *(0.0162)**	**1.1497** *(1.0261, 1.2882)**	**10.43** *(0.0012)**	**1.2606** *(1.0953, 1.4508)**	**5.36** *(0.0206)**	**1.0885** *(1.0131, 1.1696)**	**21.04** *(<0.0001)**	**1.2372** *(1.1296, 1.3550)**	**1.84** *(0.1747)*	**1.1319** *(0.9465, 1.3537)*
Income Adequacy												
Not enough money	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Enough money	**0.64** *(0.4240)*	**0.9700** *(0.9002, 1.0452)*	**0.48** *(0.4905)*	**1.0371** *(0.9350, 1.1505)*	**2.39** *(0.1224)*	**0.9192** *(0.8260, 1.0229)*	**10.93** *(0.0009)**	**1.1390** *(1.0544, 1.2304)**	**46.47** *(<0.0001)**	**1.3203** *(1.2189, 1.4301)**	**1.88** *(0.1704)*	**1.0995** *(0.9601, 1.2593)*
McDonald's Marketing Exposure												
Not exposed	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Exposed	**37.03** *(<0.0001)**	**1.2568** *(1.1676, 1.3529)**	**0.09** *(0.7669)*	**0.9837** *(0.8824, 1.0967)*	**14.84** *(0.0001)**	**1.2268** *(1.1056, 1.3612)**	**9.11** *(0.0025)**	**1.1589** *(1.0531, 1.2754)**	**7.43** *(0.0064)**	**1.1423** *(1.0381, 1.2570)**	**19.52** *(<0.0001)**	**1.4301** *(1.2202, 1.6760)**
KFC marketing exposure and fast food intake												
Intercept	**1.79** *(0.1815)*		**0.41** *(0.5196)*		**0.55** *(0.4595)*		**5.89** *(0.0152)**		**0.70** *(0.4036)*		**4.11** *(0.0426)**	

Age	**61.81** *(<0.0001)**		**17.67** *(<0.0001)**		**14.30** *(0.0002)**		**19.44** *(<0.0001)**		**22.94** *(<0.0001)**		**19.52** *(<0.0001)**	
Sex												
Male	[ref]	[ref]	[ref]		[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Female	**8.22** *(0.0041)**	**0.9207** *(0.8702, 0.9742)**	**15.52** *(<0.0001)**	**0.8324** *(0.7599, 0.9120)**	**17.79** *(<0.0001)**	**0.8140** *(0.7398, 0.8957)**	**0.05** *(0.8151)*	**0.9919** *(0.9264, 1.0620)*	**1.06** *(0.3036)*	**0.9651** *(0.9019, 1.0327)*	**3.91** *(0.0480)**	**0.8833** *(0.7811, 0.9989)**
Ethnicity												
Majority	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Minority	**10.57** *(0.0012)**	**1.1111** *(1.0427, 1.1840)**	**5.25** *(0.0220)**	**1.1421** *(1.0194, 1.2795)**	**8.79** *(0.0030)**	**1.2365** *(1.0746, 1.4228)**	**5.17** *(0.0229)**	**1.0863** *(1.0115, 1.1666)**	**20.92** *(<0.0001)**	**1.2368** *(1.1292, 1.3548)**	**1.80** *(0.1794)*	**1.1310** *(0.9450, 1.3536)*
Income Adequacy												
Not enough money	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Enough money	**0.44** *(0.5084)*	**0.9754** *(0.9059, 1.0502)*	**0.66** *(0.4166)*	**1.0439** *(0.9411, 1.1580)*	**2.60** *(0.1070)*	**0.9162** *(0.8238, 1.0191)*	**9.12** *(0.0025)**	**1.1256** *(1.0424, 1.2154)**	**46.07** *(<0.0001)**	**1.3189** *(1.2176, 1.4286)**	**2.29** *(0.1303)*	**1.1110** *(0.9694, 1.2732)*
KFC Marketing Exposure												
Not exposed	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Exposed	**109.58** *(<0.0001)**	**1.3536** *(1.2790, 1.4326)**	**2.51** *(0.1130)*	**1.0805** *(0.9818, 1.1891)*	**26.84** *(<0.0001)**	**1.2877** *(1.1702, 1.4170)**	**28.06** *(<0.0001)**	**1.2202** *(1.1336, 1.3134)**	**4.89** *(0.0270)**	**1.1144** *(1.0124, 1.2267)**	**8.88** *(0.0029)**	**1.2175** *(1.0697, 1.3858)**
Subway marketing exposure and fast food intake												
Intercept	**0.22** *(0.6409)*		**0.48** *(0.4906)*		**0.54** *(0.4637)*		**0.54** *(0.4637)*		**0.76** *(0.3831)*		**0.76** *(0.3831)*	
Age	**59.94** *(<0.0001)**		**17.63** *(<0.0001)**		**15.84** *(<0.0001)**		**15.84** *(<0.0001)**		**21.28** *(<0.0001)**		**21.28** *(<0.0001)**	
Sex												
Male	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Female	**10.91** *(0.0010)**	**0.9081** *(0.8577, 0.9616)**	**15.20** *(<0.0001)**	**0.8342** *(0.7615, 0.9138)**	**17.65** *(<0.0001)**	**0.8142** *(0.7398, 0.8961)**	**17.65** *(<0.0001)**	**0.9847** *(0.9194, 1.0546)*	**1.79** *(0.1808)*	**0.9550** *(0.8928, 1.0216)*	**1.79** *(0.1808)*	**0.8609** *(0.7614, 0.9733)**
Ethnicity												
Majority	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Minority	**17.41** *(<0.0001)**	**1.1466** *(1.0752, 1.2226)**	**5.01** *(0.0252)**	**1.1386** *(1.0163, 1.2757)**	**9.68** *(0.0019)**	**1.2498** *(1.0860, 1.4383)**	**9.68** *(0.0019)**	**1.0881** *(1.0128, 1.1690)**	**18.80** *(<0.0001)**	**1.2220** *(1.1161, 1.3378)**	**18.80** *(<0.0001)**	**1.1200** *(0.9366, 1.3392)*

Income Adequacy												
Not enough money	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Enough money	**0.88** *(0.3495)*	**0.9649** *(0.8952, 1.0399)*	**0.66** *(0.4182)*	**1.0437** *(0.9410, 1.1576)*	**2.16** *(0.1418)*	**0.9233** *(0.8299, 1.0270)*	**10.14** *(0.0015)**	**1.1335** *(1.0493, 1.2243)**	**41.36** *(<0.0001)**	**1.2985** *(1.1991, 1.4061)**	**41.36** *(<0.0001)**	**1.0844** *(0.9469, 1.2419)*
Subway Marketing Exposure												
Not exposed	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]	[ref]
Exposed	**13.12** *(0.0003)**	**1.1231** *(1.0547, 1.1959)**	**4.32** *(0.0376)**	**1.1005** *(1.0055, 1.2045)**	**20.25** *(<0.0001)**	**1.2543** *(1.1364, 1.3844)**	**11.69** *(0.0006)**	**1.1441** *(1.0591, 1.2359)**	**33.23** *(<0.0001)**	**1.2311** *(1.1471, 1.3212)**	**33.23** *(<0.0001)**	**1.3281** *(1.1749, 1.5012)**

* Indicates significant test at an alpha level of 0.05
IRR: incidence rate ratio
$\chi 2$: chi-square
CI: confidence interval
ref: reference

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Chapter 4: Discussion

4.1 Summary of findings

Fast food marketing has an important influence on youth's preferences and intake of these foods, which is worrisome from a public health perspective as fast food consumption is linked to poor health outcomes[25-27]. Youth in particular have considerable buying power and cognitive vulnerabilities that the food and beverage and advertising industries appear to be exploiting.[9,121] Yet, in many countries, these industries are voluntarily responsible for the regulation of their own unhealthy food marketing to children.[122,123] Although the nature of this study did not allow us to explore whether different policy environments surrounding unhealthy food marketing to youth are having a direct effect, this study explored the extent to which exposure to fast food marketing is associated with brand preferences and consumption of fast food amongst youth between the ages of 10-17 in six countries. It is extremely important to explore the potential downstream effects of fast food marketing in order to determine whether or not exposure is influencing these outcomes, which is valuable evidence for policymakers trying to foster healthier food environments for youth.

Overall, the results of the study were consistent with our hypotheses that fast food marketing exposure is positively associated with both fast food brand preferences and intake. Generally across countries, preference for fast food brands (McDonald's, KFC and Subway) was highest when youth reported being exposed to general fast food marketing ≥2x/week and higher when exposed ≤1x/week compared to those who were not exposed to this marketing. This was also consistent with our findings regarding the relationship between self-reported marketing exposure for these brands and brand preferences, as those who reported being exposed to marketing for a brand had a greater likelihood of preferring that brand across all countries. The

relationship between these exposures and fast food intake was also consistent with our hypotheses and reported consumption was generally highest when youth were exposed to general fast food marketing ≥2x/week and higher when exposed ≤1x/week compared to those who were not at all exposed in a week, across most countries. Reported fast food consumption was also found to be higher across the majority of countries amongst those who were exposed to marketing for the specific brands compared to those who were not exposed to this marketing. Finally, exploration across sociodemographic variables found that across most countries and models overall, respondents who identified as a minority ethnicity in their country were more likely to report consuming fast food compared to those who identified as a majority. We also found that females were less likely to report consuming fast food than males, which was also consistent across most countries and models.

4.2 Fast food marketing is associated with brand preferences and fast food intake

This study found consistent and strong associations between exposure to both general and brand-specific fast food marketing and brand preferences amongst youth across most countries. It was found that the likelihood of preferring a fast food brand was high both when comparing exposure to general fast food marketing ≥2x/week as opposed to never being exposed (in the past 30 days), and when comparing exposure to general fast food marketing ≤1x/week as opposed to never being exposed. Although both general exposure categories revealed positive associations with brand preferences, we found that when higher exposure was reported (i.e., ≥2x/week), the likelihood of preferring a fast food brand was higher. This finding suggests that the more exposed an individual is to fast food marketing, the more likely they are to prefer a fast food brand.

This study also revealed a strong relationship between exposure to brand-specific marketing and preference for each respective brand. As expected, this finding suggests that the odds of preferring a certain fast food brand increases with exposure to marketing for that brand. This positive relationship was also consistently stronger across countries than the relationship between general fast food marketing and brand preference. This noted difference may indicate that brand-specific marketing has a greater impact on youth's fast food brand preferences than general fast food marketing, which is consistent with existing research investigating the relationship between brand-specific tobacco marketing and brand preferences among adolescents and young adults.[124] It is also possible that the nature of the two marketing exposure measures themselves may have influenced the strength of the associations. The general fast food marketing exposure variable was measured using a 6-item Likert scale, whereas the brand-specific marketing exposure variables were measured using a binary variable indicating "yes" or "no" to being exposed. In our analysis, the 6-item scale was re-categorized into a 3-item scale to help address the potential loss of strength, but the odds of brand preference remained higher when modelled with brand-specific marketing exposure. It is also possible that individuals may be better able to report and recall brand-specific marketing rather than fast food marketing in general, due to the branding itself and/or having positive attitudes towards the specific brand, which could both increase recall.[125,126] As the latter may be more difficult to accurately report and recall, this also may be a justification for the stronger observed associations for brand-specific marketing.

This study also found consistent associations between exposure to both general and brand-specific fast food marketing and fast food intake amongst youth across most countries. It was found that the likelihood of consuming fast food was high both when comparing exposure to

general fast food marketing ≥2x/week as opposed to never being exposed, and when comparing exposure to general fast food marketing ≤1x/week as opposed to never being exposed. We also found that across most countries, the odds of consuming fast food increased when exposed to brand-specific fast food marketing compared to not being exposed. These findings, being consistent across both general and brand-specific exposures, suggest that exposure to fast food marketing overall may lead to higher consumption of these foods amongst exposed individuals.

Although causality could not be determined due to the cross-sectional nature of the data, consistency with existing epidemiological data and across models and countries in this study reinforce the current body of evidence showing the influence fast food marketing has on food preferences and intake.[33,37,127-135] Existing literature assessing the association between exposure to several categories of unhealthy food marketing and food-related behaviours, including preferences and intake, as well as similar research investigating these associations amongst adults and younger children by specific food categories, have also confirmed the presence of these associations.[33,37,127-135]

Investigating the effects of fast food marketing on this young population is particularly important, as recent literature has identified fast food as the most advertised food category across various media and settings and the food category accounting for the greatest share of advertising expenditures.[44,45,50,54,55,136] The danger of frequent exposure to fast food marketing amongst youth is exacerbated by the unhealthfulness of fast food itself and its negative consequences to the current and future health of an individual when consumed.[14,137] As a result, it is crucial that we protect youth from exposure to fast food marketing to reduce the influence this marketing is having on their preferences and intake of these unhealthy foods.

4.3 Sociodemographic disparity

The results of this study also allowed us to explore sociodemographic differences in associations. We included and adjusted our models for age, sex at birth, perceived income adequacy and ethnicity, as they may have had independent effects on the outcome variables investigated. We revealed that overall, females across most countries and models were less likely to report consumption of fast food than males. This finding is consistent with previous data exploring sex differences for fast food intake, which has shown that intake is consistently high across both sexes, but significantly higher for males.[138-140] This finding could have multiple explanations, but the most consistently reported explanation across existing literature is that females are less likely to consume fast food as they are more likely to take part in diet-related practices, such as meal skipping and calorie restricting.[141,142] Females are generally more attentive to their body image than males, and fast food is consequently perceived to be unhealthy and known to cause weight gain.[141-143] In fact, data from high income countries found that the prevalence of obesity and overweight amongst male youth is nearly two times greater than this prevalence amongst female youth, which may be a consequence of higher reported consumption of fast food amongst males.[144] Literature has also suggested that males are more targeted by the food and beverage industry, as males are more likely to be exposed to and featured in more advertisements than females.[145] This strategy increases the relatability and persuasive power of the ad, leading males to potentially purchase the product.[145] Advertisers also have the ability to use different marketing techniques that appeal more to a certain sex, if this is a goal of their promotion. For instance, evidence shows that males are more attentive and attracted to advertisements that include sports celebrity endorsements or toys compared to females.[146] The use of marketing techniques like these introduces sex bias in food marketing and may make

males more vulnerable to fast food marketing. From a public health perspective, this is notable as males generally have a higher prevalence of excess weight and obesity, and also report higher rates of fast food consumption compared to females.[144,147,148]

Our findings also revealed that individuals who identified as a minority ethnicity in their country were more likely to report fast food consumption than those who identified as a majority ethnicity, which were consistent across most models and countries. Unfortunately, this is consistent with previous evidence that shows that fast food consumption is generally higher amongst ethnic minority populations compared to ethnic majority populations.[149-151] In some countries, these findings may be the result of socioeconomic differences in ethnic majority versus minority groups. This disparity can also be potentially explained by cultural differences, where individuals may be more likely to consume fast food if the restaurant accommodates their cultural food preferences or if there is more opportunity for socialization with other members of their cultural group.[152,153] Previous data also suggests that Black and Hispanic youth are being exposed to more unhealthy food marketing than White youth in the United States.[154-158] Higher exposures amongst these minority groups may demonstrate targeted advertising practices by the industry, which could be placing ethnic minorities at an unavoidable disadvantage and is concerning considering the association between socioeconomic status and minority status in countries like the US.[159] Individuals with a lower socioeconomic status are more likely to encounter poorer health outcomes, and these targeted advertising practices may be further affecting a group that is already disproportionality affected by negative health outcomes.[160,161] However, the proposed explanations for these findings need to be interpreted with caution, as our food intake models controlled for self-reported exposure, meaning that within these models, differences in exposure cannot directly explain sex and race differences in reported intake.

Nevertheless, it is still possible that differences in exposure may still be driving disparities in intake, due to the strong link between exposure and intake and the consistency of results across countries. Future research in this area should investigate a broader scope of social and environmental influences affecting fast food intake and marketing exposure amongst youth of various ethnic backgrounds. This research may help inform policy restricting marketing of these unhealthy products on the multitude of factors affecting youth's fast food behaviours across a greater variety of ethnic groups.

4.4 Policy implications

4.4.1 The importance of regulation

Unfortunately, individual-level interventions aimed at improving food intake and preferences are not overly successful.[19,20] As such, changes to the food environment at the population-level should be implemented, which can influence factors that are shaping these behaviours.[10,15] As outlined in the logic model of unhealthy food promotion effects, intake and preferences are both direct effects of food promotion which can eventually lead to weight gain and the development of chronic disease.[115] Additionally, literature has shown that unhealthy food marketing to children itself increases their intake of these foods, as well as their consumption of foods with little nutritional value overall.[37] Therefore, upstream interventions restricting promotion of unhealthy food and beverages can help to alleviate these dangerous downstream outcomes on diet and health. International studies assessing the cost-effectiveness of obesity prevention interventions found that policy-based interventions restricting marketing of unhealthy foods would be very effective in reducing healthcare costs and increasing life years.[162,163] The importance of intervening to improve the food environments of younger populations in particular

is critical, as habits developed at a young age can carry throughout adulthood and lead to diet-related disease and premature death.[164]

Unhealthy food marketing to youth is complex, multi-dimensional and highly dynamic, making it challenging to regulate. Food marketing pervades all aspects of our daily lives, whether we are watching television, passing by billboards or transit stops outdoors, walking through a mall, or scrolling through social media, among many other possible media channels or settings where marketing is found.[41-44,52,165,166] Marketing techniques used by advertisers to attract consumers increase the persuasive power of the advertisement and vary across media type and audience. They can increase children's recall of branded products as well as their preferences for unhealthy marketed products.[167,168] Child-related marketing techniques such as spokes characters and animations, and adolescent-related techniques such as the use of sporting culture and celebrities are often used by advertisers to market their products more effectively to youth.[132,134,135] Our study was unable to assess associations by exposure to these different techniques but understanding their contribution to exposure as a whole is important to understanding the complexity of our exposure measures.

Other factors such as the length and frequency of advertisements can also affect children's preferences and behaviours toward the promoted product.[169] It is important that policies restricting unhealthy food marketing to youth also consider the power of advertisements, to reduce the persuasive effects of this marketing.

4.4.2 The failure of self-regulation

The food and beverage industry is known to have a large influence on the marketing policy environment in most countries, which also influences an individual's exposure and recall. In some countries, including Canada, Australia and the US, the food and beverage and

advertising industries set their own standards for what can and cannot be advertised to children, which is interesting considering a company's overall goal is to make a profit, and marketing to youth is highly profitable. Additionally, not all food and beverage companies are keen to join or comply with these codes. Companies who comply with these voluntary standards are put at a disadvantage compared to their competitors who do not join or comply, as they are free to advertise to youth and will not lose out on any profits.

Without surprise, industry self-regulatory initiatives to restrict unhealthy food marketing to children in Canada, the US and Australia have proven to be ineffective.[136,170,171] Within these loose voluntary guidelines, it is easy for food companies to take advantage of loopholes such as weak and narrow definitions of what encompasses "child marketing", ineffective nutrition criteria and poorly defined thresholds used to identify high child viewership.[93,94,172-174] For instance, a website that includes multiple instances of child marketing could have a vast general audience base, and consequently will not meet the established child viewership threshold even though its child audience is significant.[43] Unless strict government regulation is in place that includes clear cut and inclusive definitions of food marketing, settings and media where the regulations apply, clear nutritional definitions of what is considered "unhealthy", and marketing techniques that cannot be used, industry will continue exploiting loopholes and targeting youth through their advertisements.

In our study, we found that reported exposure to McDonald's marketing was consistently high across all countries, including countries that have government regulation to restrict this exposure to youth and countries that are self-regulated by the food and beverage and advertising industries. For instance, in Canada, McDonald's is the only fast food company that is actively participating in the self-regulatory *Canadian Children's Food and Beverage Advertising*

Initiative (CAI). Under this code, McDonald's pledges that 100% of their advertising that is directed to individuals under the age of 12 promotes "better-for-you" products and claim to not advertise in settings where 35% or more of the viewership is composed of children under the age of 12.[92] Similarly in the US, McDonald's is one of two fast food companies who are actively participating in the *Children's Food and Beverage Advertising Initiative (CFBAI)*, their regulatory initiative for food and beverage advertising directed to children under 12.[111] McDonald's pledges that any advertising directed to children under the age of 12 will meet the CFBAI's Category-Specific Uniform Nutrition Criteria and commits to not advertise foods that do not meet this criteria when children under the age of 12 constitute at least 30% of the viewership.[175] Two times a year, the CFBAI will share lists of products that participants identified as permitted for advertising to children. In the list of qualifying products from July 2022, McDonald's list of products that comply with the CFBAI's Uniform Nutrition Criteria included the 6-piece Chicken McNugget Happy Meal® and Hamburger Happy Meals®, amongst others.[176] From a nutrition standpoint, a 6-piece Chicken McNugget Happy Meal® with a kid's size fry, 1% milk and apple slices contains 475 calories, 22g of total fat, 670mg of sodium and 14g of sugar.[177] To put these values into perspective, the recommended daily calorie intake for US children between the ages of 4 and 13 is 1200-1800 calories and it is recommended that 25-35% of their total dietary intake come from fats (healthy, unsaturated fats) and that they consume less than 1900-2000mg of sodium.[178] The Happy Meal® itself accounts for approximately 70% of a child's daily value of fat, with most of this coming from unhealthy fats, and accounts for approximately 35% of their daily value of sodium. It is evident that the Uniform Nutrition Criteria is not sufficient in only encompassing "better-for-you" foods when the contents of fat, sodium and sugar in just one product investigated is consistently high.

Looking at our results, self-reported exposure to McDonald's marketing frequencies in Canada and the US are high and when modelled, exposure to this marketing is also associated with higher preferences for McDonald's and intake of fast food. However, not much can be concluded from this, as our study measured self-reported exposure for individuals aged 10-17 and these pledges only apply to individuals under 12. This finding does however indicate that more individuals aged 10-17 are reporting being exposed to McDonald's marketing than not, highlighting the need for restrictions to encompass older youth as well. Regardless, considering the identification of the poor Uniform Nutrition Criteria defining "better-for-you" foods under the CFBAI, it is safe to assume that inclusion of older youth in these self-regulatory initiatives would not make these codes much more effective. Fast food company pledges under self-regulatory codes illustrate the need for stricter nutrition criteria for foods that should not be marketed to children, as well as tighter definitions for what is considered "child-marketing".

Some jurisdictions around the world have implemented stricter restrictions for marketing to children and have resulted in promising change. For example, in the Canadian province of Quebec, the policy environment surrounding marketing to kids is different than the rest of Canada. In Quebec, the *Consumer Protection Act* bans all commercial marketing targeted to children under 13.[100] Since its implementation in 1980, the likelihood of fast food purchases amongst children has decreased by 13% and literature has noted lower exposure to food and beverage advertising, and decreased use of child-appealing techniques in Quebec food advertisements.[101,103] Quebec also has the lowest childhood obesity rates amongst all Canadian provinces and Quebec children also report the highest intake of fruits and vegetables in Canada.[102] Although this legislation has had some impact, it was not specifically created to restrict unhealthy food marketing to children and has vast potential for improvement.[101,103]

4.4.3 Exclusion of adolescents from current restrictions

Adolescents are an age group that is consistently overlooked when it comes to restricting unhealthy food marketing. A recent systematic review concluded that evidence on exposure and behavioural consequences of unhealthy food marketed to adolescents is lacking, which may be a reason for the exclusion of this important age group from current regulations.[132] Of the 6 countries included in this study, the UK is the only country that includes older adolescents in their regulations. Interestingly, in terms of crude frequencies of individuals reporting being exposed to brand-specific and general fast food marketing, the UK had the lowest reported exposure across all four exposure variables compared to the other countries. The inclusion of individuals under the age of 16 in their government-regulated unhealthy food marketing environment may have had an effect on these lower reported exposures.

Adolescents are also an important age group for food and beverage advertisers, as they are highly influenced by food marketing, cognitively vulnerable and have independent purchasing power.[9,121] It is evident that adolescents are being targeted by fast food advertisers, as a Canadian study found that fast food restaurants dominated food marketing on adolescent-targeted programs on television in 2018, compared to all other age groups and food categories investigated, findings that are consistent with previous data in this area.[43-45,50,53,165,166,179] Additionally, the advertising expenditure share of products advertised to adolescents across media is also high, and the majority of expenditures are devoted to promoting calorie-dense, nutrient-poor products.[45,50] Although opponents of including older adolescents in restrictions on food marketing would argue that younger children are more vulnerable to the effects of this marketing than adolescents, their stage of development makes them uniquely vulnerable.[79,134,135,180] In addition to their independent decision making and purchasing power,

literature suggests that marketing that includes messages relating to developmental processes at this stage of life, including concerns related to self-identity, appearance and belonging, can persuade this age group.[79]

As we have outlined previously, consumption of unhealthy foods is a direct effect of food marketing exposure and can lead to poor diet and weight gain.[36] Data illustrates that a large proportion of both children and adolescents worldwide have obesity or are overweight and both age groups have a high consumption of ultra-processed foods.[15,22,25] Making change at the level of the food environment to restrict marketing exposure of unhealthy foods to adolescents aged 13-17, in addition to children, can help to reduce the burden of these downstream effects on adolescent health.

The rise in digital media marketing and usage is also especially important to this age group. Although this study was not able to assess marketing exposure across different media, marketing in digital media likely played a role in youth's reports of exposure. Adolescents spend a lot of time viewing screens and are frequent users of digital media. Reports on this media usage in the UK outline that adolescents are spending approximately 21 hours per week browsing the internet and another 17 hours using a digital device which are owned by 84% of UK adolescents.[181,182] The large amount of time that adolescents spend using digital media is likely resulting in more frequent and longer exposure to advertisements.[45,183] Marketing in digital media is also more cost effective for advertisers, and with the increased usage of this media, advertising practices are predicted to continue shifting away from more traditional forms of media and towards more novel, digital forms.[49,184-186] Digital media platforms also introduce the opportunity for more advanced and effective marketing, through progressive technologies such as artificial intelligence software.[187,188] These technologies have the ability to collect information

on its users and using this information, create more targeted and personalized marketing to increase the persuasive power of advertisements.[53,63] The competition surrounding marketing "air-time" on digital media is also non-existent, which is also advantageous for advertisers, but disadvantageous for consumers. The plethora of dangers that digital media contributes to the landscape of unhealthy food marketing is exacerbated by reports which indicate that marketing in new media, such as social media, have a heightened ability to negatively affect food-related behaviours amongst youth compared to traditional marketing platforms.[44,45,52,189] As adolescents are highly exposed to powerful marketing strategies used in digital media marketing, it is recommended that restrictions on unhealthy food marketing protecting children are also extended to include adolescents.

4.4.4 Policy recommendations

As mentioned throughout, the consistency of the relationship between self-reported exposure to fast food marketing and greater preference and consumption of these foods across all six countries is a public health concern. Since we cannot directly intervene on preferences and consumption at the individual level, population-level interventions improving the food environment for youth is warranted. As such, there is a strong need for the implementation of more strict and comprehensive laws restricting unhealthy food and beverage marketing to youth across all six countries. As member states of the World Health Organization, these countries were called on in 2010 to develop comprehensive approaches to combating the impact of unhealthy foods being marketed to children. Twelve years later, these recommendations to "restrict all marketing to children of foods with a high content of saturated fats, trans-fatty acids, free sugars, or salt, which **fully** eliminates the exposure, and thereby also the power, of that marketing" are being widely ignored and overlooked.[10] The WHO also recommended that the

components of the policies be clearly defined, to allow for standard and uniform implementation across all marketing. This recommendation has also proven to be overlooked, as definitions are commonly unclear, allowing for advertisers to have more freedom and opportunity to exploit loopholes in the restrictions. [93,94,172-174] Self-regulatory codes also permit signatories to narrowly define "child-marketing", allowing them to easily exploit loopholes. In addition to more strict and comprehensive regulation, it is recommended that adolescents are also included in efforts to restrict unhealthy food marketing. The current policy landscape surrounding restricting unhealthy food marketing to youth needs to be strengthened to improve the overall food environment surrounding youth.

4.5 Contribution of thesis and generalizability

Our study is unique in that it models associations between youth's self-reported exposure to fast food marketing, both generally and brand-specific, and the relationship these exposures have with brand preferences and fast food intake using youth respondents within a 7-year age range. The consistency of collected data across the six countries investigated also allowed for international comparison of these associations, which has not been done with this age group and fast food specifically. This study also fills gaps in the literature, as evidence on fast food marketing exposure and food-related behaviours amongst older youth is scarce.

Sampling weights using population estimates from the census in each country were applied in order to address differential non-response across country samples. Weighting this data also improved the generalizability of the findings across the nations investigated. Large sample sizes across all six countries also allowed for greater representativeness of the samples.

However, the extent to which this data is generalizable to each country is limited by the nonprobability-based sampling method used to recruit survey participants.

4.6 Strengths and limitations

4.6.1. Strengths

Large sample size and multi-country design

A major strength of this study was the large sample size that was included in the analysis, as well as large sample sizes in each of the examined countries. Larger sample sizes increase the reliability of the findings, as well as the generalizability of the samples. A greater number of respondents also allowed us to remove outliers (i.e., *"don't know"* and *"refuse to answer"* responses and missing data) without skewing the data. Removing these outliers allowed for more precise estimates, increasing the quality of the study. The multi-country study design allowing for the investigation of six countries simultaneously was also advantageous, as the data collected in each country was consistent, permitting comparisons across countries.

Wide age range and ethnically diverse sample

Another advantage of this study is the wide age range of respondents and the inclusion of respondents from different ethnic groups. Including participants aged 10-17 provided a 7-year age range that is inclusive of older children, and younger and older adolescents. Most previous literature only focuses on one of these categories with a smaller age range.[65,68,70,71,74,75] Older adolescents have often been overlooked in research of this kind, so including these individuals in this research addresses a prominent and important gap. This study also includes individuals from a wide range of ethnic backgrounds. This not only increased the representativeness of the

samples, but also allowed for the identification of differences in associations by ethnic subgroup (minority or majority).

Non-specific exposure measures

Another strength of this study is that the self-reported exposure measures collected did not focus on specific components of marketing exposure. In other words, respondents reported their exposures generally, without taking into account which media their exposure occurred in or the power, ad content or degree of the marketing exposure. A large amount of previous research only investigates exposure in one media platform at a time, so the broader scope of exposure could be advantageous in that it is filling this gap and providing novel evidence in this area.[65-67,71-75] This could also be a limitation, as marketing techniques and degree of exposure can affect an individual's recall, which could have resulted in measurement error.[168]

4.6.2. Limitations

Self-reported measures

As data were collected using a cross-sectional survey, measures for exposure and intake were self-reported. This is a limitation to the results as the data is subject to recall bias and reverse causation. Respondents were asked to recall intake from the past 7 days and recall their estimated weekly exposure to fast food marketing within a reference period of the past 30 days, which may introduce recall bias if the respondents were not able to exactly remember their intake and exposures during these timeframes. Reverse causation may have also had an influence on the self-reported exposure measures as participants who consume more fast food may be more likely to be attentive to and report exposure to fast food marketing. Additionally, the self-reported exposure measures do not consider the power, ad content and extent to which the marketing targets the participants. This could have introduced measurement error, as literature

suggests that certain features of an advertisement have the ability to affect one's recall.[168] Nevertheless, previous literature has outlined that self-reported exposure measures are correlated with objective measures and are not very different.[190,191]

Another limitation specific to the self-reported intake of fast food variable is that it is not an exclusive measure of visits to fast food restaurants exclusively. Rather, the variable measures intake from fast food places, restaurants, food stands and vending machines collectively. However, we would argue that food purchased from restaurants, food stands and vending machines can also be categorized as fast food, due to the ease of purchase and poor nutrient content of foods available from these places.

The self-reported nature of our variables can also be considered a strength, in that these subjective measures are more feasible to collect than objective measures. Objective measures, often collected in an experimental setting on this topic, are more difficult to collect, use more resources and are not always representative of everyday lifestyle choices.[38] The increased feasibility that these self-reported measures contribute also allows for the data to be better monitored, as it can be collected more often.

Definition of "Ads from a fast food restaurant"

Another limitation to this study could be the way participants interpreted what exposures are encompassed under "Ads from a fast food restaurant". It is possible that this phrase could be interpreted differently by participants, which could further bias the results. For instance, one respondent may have interpreted this as solely exposure to restaurant branding, whereas another respondent may have interpreted this as restaurant branding, marketing of fast food places as well as marketing for sit down restaurants. Providing a definition of what type of exposures should be encompassed under this measure would help to address this concern.

Nonprobability-based sampling

This study is also limited in that survey sampling was completed using nonprobability-based sampling. This means that respondents who were recruited to participate in the survey were selected from a specific, non-random population. In this case, participants were recruited through parents/guardians enrolled in the Nielsen Consumer Insights Global Panel and their partners' panels in each country. Youth participants aged 10-17 were then deemed eligible to participate if they were living in the same household as their parent panelist. Due to this limitation, the results obtained from this study may not be representative of national estimates. To address this limitation, all analyses were completed using survey weights, weighted by age group, sex, region and ethnicity (except in Canada, where ethnicity wasn't considered in the sample weights) to increase the representativeness and generalizability of the study, as well as remove the effect of this sampling method to an extent.

4.7 Future research

Future research should consider the different components of marketing exposure (ex. ad content, extent of being targeted, marketing techniques used, etc.) when measuring exposure, in order to gain a more comprehensive understanding of the effects of the different parts of exposure on the measured associations. It is also recommended that future research investigating consumption of fast food should measure intake of fast food from fast food restaurants exclusively. This way, intake of fast food can be specific to just intake from fast food places, as opposed to food that is quick and easy to obtain. Future research should also examine if and how these modelled associations differ by child and adolescent age groups (10-13 years and 14-17 years). This research could provide preliminary evidence on the likely influence of marketing

exposure on older youth for whom there is little research and to investigate whether existing policies protecting children under 13 years old are effective in reducing exposure to fast food marketing and its consequences, such as brand preferences and intake.[132]

4.8 Conclusion

The results from this thesis provide evidence on the negative effects exposure to fast food marketing has on the fast food preferences and consumption amongst youth in six upper and middle income countries. The consistently positive associations between marketing exposure and these food-related outcomes across all countries strengthen existing evidence on this topic. This study allowed us to fill some gaps in the literature relating to the inclusion of older adolescents, individuals from multiple ethnic backgrounds, investigation of fast food specifically and also extended existing knowledge by providing consistent data for 6 different countries and high reliability due to the large sample sizes.

The consistency of these associations across countries and the negative implications that exposure to fast food marketing can have on youth in this critical stage of development highlights the need for more stringent regulation on unhealthy food marketing to this population. Current regulation has proven to be weak and flawed, and there is ample opportunity for improvement. Across all six countries, there is an urgent obligation to reduce the prevalence of child and adolescent overweight and obesity, in order to avoid negative health outcomes and related health care costs. The implementation of strict, comprehensive government regulation prohibiting any marketing of unhealthy food and beverages to youth in all media and settings across all six countries investigated is warranted. Such regulations will yield positive change in

our current food environments to protect our young populations and will help to address the current global obesity epidemic amongst youth.

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