

**Loneliness during COVID-19 and its association with eating habits
and 24-hour movement behaviours in a sample of Canadian
adolescents**

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Thesis submitted to the University of Ottawa
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Master of Science degree in Epidemiology

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PREFACE

This thesis titled “Loneliness during COVID-19 and its association with eating habits and 24-hour movement behaviours in a sample of Canadian adolescents”, from initiation to completion, represents original work undertaken by me, Saniya Tandon, as a partial fulfillment of the requirements for the MSc degree in Epidemiology at the University of Ottawa. I chose the research topic, created the analysis-ready datasets and performed the statistical analyses for this thesis.

The data analysed were collected as a part of an existing prospective study called COMPASS (Cannabis use, Obesity, Mental health, Physical activity, Alcohol, Smoking and Sedentary behaviour), for which approvals to access and use the data for secondary analysis have been obtained. The study has obtained ethics approvals by the Human Research Ethics Board at the University of Waterloo (ORE #30118) and appropriate school board committees. We also received ethics approval from the University of Ottawa (Appendix 1).

My supervisor, Dr. Jean-Philippe Chaput, oversaw my work as first author and provided suggestions in terms of methodological rigour and variables of interest, reviewed and gave timely feedback for the manuscript and thesis. The other co-authors provided critical suggestions throughout, from the thesis proposal to the final thesis write-up and also revised the submitted manuscript.

A streamlined version of this work was submitted as a Short Communication to the journal Preventive Medicine Reports. I was responsible for data cleaning and analysis as well as writing of the first draft and any subsequent versions of the manuscript. The manuscript has been published in Preventive Medicine Reports – Volume 35 (<https://doi.org/10.1016/j.pmedr.2023.102287>).

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ABSTRACT

Background: Loneliness, a feeling of distress, has aggravated due to the COVID-19 pandemic lockdowns and reduced social interactions. The objective of this study was to explore whether increased loneliness due to the COVID-19 pandemic was associated with various eating and activity behaviours in adolescence, a critical period for the development of lasting lifestyle habits.

Methods: In this cross-sectional study, we used self-reported data from 43,588 and 40,521 Canadian adolescents aged 12-19 years (collected between November 2020 and June 2021) for eating habits and the 24-hour movement behaviours, respectively. Binary and multinomial logistic regression were used to predict the odds of various lifestyle behaviours among adolescents with increased loneliness due to the COVID-19 pandemic.

Results: We found higher odds of skipping breakfast [boys: OR 1.41 (95% CI: 1.33, 1.50), girls: OR 1.64 (95% CI: 1.56, 1.74)], fast food consumption [1-2 days in the past week: girls – OR: 1.14 (95% CI: 1.08, 1.21); ≥ 3 days in the past week: boys – 1.12 (95% CI: 1.02, 1.24), girls – OR: 1.42 (95% CI: 1.29, 1.57)], not meeting screen time [boys: OR 1.43 (95% CI: 1.24, 1.66), girls: OR 1.72 (95% CI: 1.54, 1.92)], and sleep duration guidelines [boys: OR 1.38 (95% CI: 1.28, 1.48), girls: OR 1.36 (95% CI: 1.27, 1.45)] among adolescents that reported increased loneliness due to the pandemic (versus those in the decreased/stayed the same loneliness group).

Conclusion: Future longitudinal studies in adolescents are needed to confirm the directionality of these associations. It is important to raise awareness of these findings among public health practitioners, policymakers, physicians, schools and parents to promote healthier eating habits and increase adherence to the 24-hour movement behaviours. Recovery efforts post-pandemic are

needed to reduce loneliness levels to support adolescent social health and establish healthy behavioural habits across the lifespan.

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LIST OF ABBREVIATIONS

BIPOC – Black Indigenous and Other people of colour

BMI – Body Mass Index

COMPASS – Cannabis use, Obesity, Mental health, Physical activity, Alcohol, Smoking and Sedentary behaviour

COVID-19 – Coronavirus disease 2019

CI – Confidence Interval

IQR – Interquartile Range

MVPA – Moderate-to-vigorous physical activity

OR – Odds Ratio

SARS-CoV-2 – Severe acute respiratory syndrome coronavirus 2

SES – Socio-economic status

SD – Standard Deviation

SSB – Sugar Sweetened Beverages

ST – Screen time

WHO – World Health Organization

CHAPTER 1

1. Literature review

1.1. Loneliness during COVID-19

Loneliness is defined as a feeling of distress that can arise from individuals' perceived inadequacy of the quantity and quality of their social relationships (e.g., lack of support, low-quality friendships, having limited social contacts) (1). Loneliness is a known public health concern and a significant risk factor for developing various chronic mental and physical health conditions (2). In the beginning of 2020, the World Health Organization (WHO) declared the COVID-19 outbreak as a global pandemic and various public health measures that followed to limit the spread of the virus disrupted the lives of many around the globe. The implementation of such measures may have put individuals at an increased risk of loneliness (3, 4). In a Canadian social survey conducted between August and September 2021, about 23% of 15-24 year old individuals reported feeling lonely (5).

1.2. Loneliness during adolescence

Evidence indicates a gradual increase in levels of loneliness across adolescence and young adulthood (6). Adolescence is a period of significant transition and is associated with increased vulnerability to risk-taking and impulsive behaviour, initiation of intimate relationships, greater autonomy from parental/family figures, figuring out their identity, and a heightened importance of peer acceptance (7). Public health measures used to tackle the ongoing COVID-19 pandemic have affected the daily routines of adolescents. Decreased social interactions with peers and conflicts with parents/guardians/family

members may lead to reduced communication and emotional support, enhancing feelings of loneliness in adolescents (8).

1.3. Eating habits

1.3.1. Eating habits during the pandemic

Studies have reported on various adolescent eating habits such as intake of fruits, vegetables, processed foods, and snacks during the pandemic in Canada and elsewhere (9-19) (see Table 1 for specific information on studies). A cross-sectional study conducted in Brazil including 720 adolescents (14-17 years) demonstrated irregular breakfast intake, replacement of larger meals for snacks and increased eating frequency of hamburgers, sweets, soft drinks, and sugar-sweetened beverages during the COVID-19 pandemic (9). A study analyzing data of adolescents aged 10-15 years reported increased intakes of ultra-processed foods (hamburger, ham, bologna, salami, sausage, instant noodles) and sugar sweetened beverages and snacks (chocolates, candies, chewing gum, lollipops) (13). In another study conducted in Italy, adolescents aged 10-14 years who gained body weight during the pandemic had a more sedentary lifestyle and increased consumption of comfort foods (chocolate, sweet snacks, ice cream and other desserts), milk/cheese/yoghurt, processed meat, bread/baked goods/rice/pasta, and soft drinks (10). In contrast, a study conducted in Korean adolescents (12-18 years) reported a decreased consumption of fast food, fruit, and soft drinks and higher breakfast intake during the pandemic (14). The reviewed studies were mostly cross-sectional, limiting the ability to determine cause and effect of associations reported, relied on self-reported data and differed in their methodology (i.e., the way fast-food, snacks or fruit and vegetable intake was assessed) (see Table 1 for further limitations). Factors such as increased sedentary behaviour,

screen time (ST), boredom, and disturbed sleep are all associated with increased intake of unhealthy foods (20-27). Additionally, food insecurity and/or disruption in food supplies, financial stress, and unemployment due to the COVID-19 pandemic may have shifted people's eating habits and increased consumption of ultra processed and highly caloric food items (28-30).

1.3.2. Pre-pandemic evidence: Associations between loneliness and various eating habits

Lockdown measures and reduced social interactions may have resulted in emotional distress and disordered eating (e.g., restrictive eating, skipping meals, etc.) in adolescents; however, no studies have examined the association between loneliness and breakfast skipping. Skipping breakfast is an unhealthy behaviour pattern that can transition from adolescence to adulthood with detrimental impacts on health (31). Habitual breakfast consumption is associated with better micro- and macronutrient intake, improved cognitive function and academic performance amongst children and adolescents (32). Many adolescents skip breakfast despite the benefits of regular breakfast consumption. In a nationally representative sample of Canadian adolescents, nearly 48.5% skipped breakfast at least once a week (33). Loneliness, when included as a covariate, was associated with lower odds of breakfast consumption in adolescents (pre-pandemic) (34). As breakfast consumption was not the primary independent variable in the model, the finding warrants further research to address this knowledge gap.

A few pre-pandemic studies suggest loneliness in adolescents is associated with an increase in sedentary behaviour, frequent soft drink/sugar sweetened beverage consumption, and an increased intake of snacks (sweet and salty) (21, 35-37) (**Table 1**). While one study found that not eating fruit and vegetables was associated with loneliness

(36), one other study found that higher loneliness levels were associated with lower fruit and vegetable intake (35). Another study found that adolescents eating 5 or more servings of fruits and vegetables per day (compared to those eating only on 1 serving/day) were less lonely (37). Loneliness in adolescents is associated with a small rise in cravings for sugar-sweetened beverages (SSB) after adjusting for negative emotions (38).

1.3.3. Implications of unhealthy eating habits

Persistent increased intake of unhealthy food items can lead to overweight/obesity in adolescents (39-41). The WHO defines overweight as BMI-for-age (BMI: body mass index) greater than 1 standard deviation (SD) and obesity as greater than 2 SD above the WHO growth reference median in adolescents (42). The rise of overweight/obesity in the adolescent population without appropriate interventions and policies can eventually have serious physical, economical and psychological impacts as obesity can track from adolescence to adulthood (43-46). If left untreated, overweight/obesity may lead to low grade systemic inflammation, which is one of the key drivers of developing chronic health conditions such as cardiovascular disease, type 2 diabetes, metabolic syndrome, hypertension, and hyperlipidemia in adulthood (45-50). Studies conducted in Croatia, Greece, Spain, Jordan, and Palestine during the lockdown reported an increased prevalence of overweight and obesity in children and adolescents (15-18). Additionally, a recent review evaluating obesity in children and adolescents during the COVID-19 pandemic reported changes in dietary behaviours with increased intake of highly caloric food items such as potatoes, bread, and sugary beverages, and a general increase in food intake promoting weight gain (49). A study in children with obesity during the COVID-19 lockdown displayed unfavorable lifestyle behaviours such as increased intake of chips, red

meat and sugary drinks, overall higher food intake and decreased physical activity levels (relative to pre-COVID-19) (12). Therefore, unhealthy changes in lifestyle behaviours in children and adolescents due to loneliness, especially in those living with obesity, might further exacerbate the level of health complications.

With many studies examining the impact of the SARS-CoV-2 pandemic on children's and adolescents' eating patterns, no studies have primarily looked at the association between loneliness due to the pandemic with eating habits amongst adolescents. Even the findings from a few pre-pandemic studies that have explored the association between loneliness with various eating habits (fruit and vegetable intake, fast food consumption, SSB, and snack food intake) have been inconsistent. None of the studies have been conducted in Canada. Given that loneliness in adolescents can lead to negative overall wellbeing and that their perceived levels of loneliness has been impacted by the pandemic (51), it is important to examine the association between loneliness due to COVID-19 and various eating habits amongst adolescents, a crucial period to establish healthy lifestyle related habits.

1.4. 24-hour movement guidelines

The Canadian 24-hour movement behaviour guidelines for children and youth (aged 5-17 years) are evidence-based recommendations that suggest ≥ 60 minutes/day of moderate-to-vigorous physical activity [MVPA], ≤ 2 hours/day of recreational ST, and 8-10 hours/night of sleep for adolescents (52). Adolescents who met the 24-hour movement behaviours (or a combination of the recommendations) have reported positive physical and mental health compared with those who met none of the recommendations (53). Those who met all 3

guidelines had the strongest association with positive self-reported physical and mental health compared to those who met one or two of the recommended guidelines (53). In another study, adolescents who met all 3 recommended guidelines were less likely to be stressed or have low self-esteem (54). Despite the health benefits associated with adhering to the 24-hour movement guidelines, many adolescents did not adhere to the guidelines prior to the pandemic (55, 56). Various lockdown measures imposed during the COVID-19 pandemic to limit the spread of the virus may have further negatively impacted 24-hour movement behaviours. A scoping review exploring the impact of COVID-19 on movement behaviours in children and adolescents reported a consistent decline in MVPA, significant increases in ST and sleep duration, and a decrease in sleep quality (57).

Increased feelings of loneliness in adolescents can lead to negative long-lasting mental and physical health issues affecting these movement behaviours (51). Two pre-pandemic cross-sectional studies in adolescents found that youth who were less physically active had higher loneliness (58, 59). However, in another pre-pandemic study of adolescents aged 14-19 years, being physically inactive was not associated with feelings of loneliness (60). Recreational ST is defined as watching/streaming TV shows or movies, playing video games, surfing the internet, and using cell phones (61). During the pandemic, 88.7% of children and adolescents did not meet the recommended ST guidelines in Canada (62). Adolescents who reported feeling lonely during the COVID-19 lockdown were more inclined to use social media due to a lack of social contact (63). Loneliness in adolescents assessed prior to the COVID-19 pandemic has been associated with increased ST in cross-sectional analyses (6, 64); however, this relationship was not supported when analysed longitudinally (6). Regarding loneliness and sleep duration, higher levels of loneliness were

associated with inadequate sleep at night in adolescents (65). Finally, in a longitudinal study that examined different trajectories of loneliness in children and adolescents, no significant differences in sleep duration amongst the various loneliness groups were found (66). However, these studies analysed data collected prior to the COVID-19 pandemic.

1.5. Summary of rationale

Loneliness, a recognized public health concern, has exacerbated during the COVID-19 pandemic due to the lockdowns and decreased social interactions (67). Many adolescents were following unhealthy dietary behaviours and not meeting movement behaviours during the pandemic. Loneliness, boredom and social isolation can increase the risk of eating disorders and sedentary behaviour, negatively impacting overall well-being (51, 68-71). With self-perceived heightened levels of loneliness during the pandemic and with limited and contradictory pre-pandemic evidence linking loneliness to eating habits and 24-hour movement behaviours in adolescents, it is important to explore associations that may negatively impact adolescent well-being. Loneliness is known to steadily increase across the lifespan with chronic detrimental health implications (2, 6). Our study is the first to examine self-perceived loneliness levels specifically due to the COVID-19 pandemic and its association with various eating habits (breakfast skipping, fruit, vegetable, and snack intake, and fast-food consumption) and adherence to the 24-hour movement guidelines (MVPA, ST and sleep duration) amongst a sample of Canadian adolescents. This information is important to highlight current gaps in research, guide intervention strategies during periods of lockdowns and reduced social interactions, promote healthier lifestyles and shape future public health policies that will support adolescent wellbeing.

1.6. Research question, objective, and hypothesis

Research question: What are the eating habits (fruit, vegetable, and snack intake, fast-food consumption, breakfast skipping) and movement behaviours (physical activity, screen time and sleep duration) of adolescents with self-perceived loneliness levels (increased, decreased, or stayed the same) due to the COVID-19 pandemic?

Objective: To examine the association between change in loneliness levels due to the COVID-19 pandemic with eating habits and 24-hour movement behaviours.

Hypothesis: We hypothesized that in comparison to those who decreased or stayed the same in loneliness during the COVID 19-pandemic, increased loneliness in adolescents due to COVID-19 would be associated with skipping breakfast, increased frequency of fast food and snack consumption, decreased frequency of fruit and vegetable intake, and lower likelihood of meeting MVPA, ST and sleep duration recommendations.

1.7. Category and format of thesis

This study falls under the **secondary analysis** category of thesis.

Table 1. Papers included in the literature review for impact of COVID-19 and pre-pandemic loneliness studies on eating habits and 24-hour movement behaviours amongst adolescents.

Author, Year	Topic	Study design	Study setting	Participants	Key findings
Andre de Araujo Pinto, 2021 (60)	Association between loneliness, physical activity, and participation in physical education among adolescents in Amazonas, Brazil	Cross-sectional	Brazil	N=2517 adolescents (1106 male, 1411 female) Age range: 14-19 years	<ul style="list-style-type: none"> - Those who were physically inactive and did not participate in physical education classes were more likely to feel lonely - Limitations: <ul style="list-style-type: none"> • Cross-sectional study design limits the ability to establish a causal relationship between the variables of interest • Use of self-report measures are subject to recall bias and social desirability • Some variables that may be associated with loneliness such as self-esteem, shyness, mental disorders and sedentary behaviours were not evaluated/added to the models as they were not available

<p>Alice M. Eccles, 2020 (66)</p>	<p>Loneliness in the lives of Danish adolescents: associations with health and sleep</p>	<p>Cross-sectional</p>	<p>Denmark</p>	<p>N=3,305 (48.2% male, 51.8% female)</p> <p>Ages included: 11, 13 and 15 years</p>	<ul style="list-style-type: none"> - Adolescents who were identified as lonely using a single-item measure were not classified as lonely when using a multi-item measure of loneliness - Loneliness was strongly associated with general health (headache, stomach-ache, backache, difficulty sleeping, tired in the morning) and sleep complaints - Adolescents reported adequate amount of sleep but also were tired in the morning - Associations between loneliness and general health complaints were consistent across the two loneliness measures (single-item and multi-item) - Limitations: <ul style="list-style-type: none"> • Cross-sectional study design limits the ability to determine causality • Self-report data may be subject to social desirability and recall bias • Different classifications using two loneliness scales might be a limitation • Validity of sleep measures are unknown • Confounding variables such as social media and use of
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					electronic devices not included in the study
Alice M. Eccles, 2020 (67)	Trajectories of early adolescent loneliness: implications for physical health and sleep	Longitudinal	Quebec	N=1214 adolescents (53% girls, 47% boys) Age range: 10-13 years	<ul style="list-style-type: none"> - There were 6 different trajectories of loneliness that were identified ('low increasing to high loneliness', 'high reducing loneliness', 'medium stable loneliness', 'medium reducing loneliness', 'low increasing to medium loneliness', 'low stable loneliness') - Insignificant differences were found between the loneliness trajectories and parent-reported health (physical health, health professional visits, antibiotic use) and sleep outcomes (sleep quality and quantity)

					<ul style="list-style-type: none"> - Increasing or maintained loneliness was not associated with poorer health outcomes - Overall levels of loneliness in the current sample were low - Limitations: <ul style="list-style-type: none"> • Cross-sectional data limits the ability to determine causal relationships between study variables • Standard and shortened versions of loneliness measures are needed to measure the impact of how loneliness is measured
Angelo Pietrobelli, 2020 (12)	Effects of COVID-19 lockdown on lifestyle behaviors in children with obesity living in Verona, Italy: a longitudinal study	Longitudinal study	Italy	<p>N=41 (22 males, 19 females)</p> <p>Age range – 6-18 years</p>	<ul style="list-style-type: none"> - Significant increase in intake of meals, potato chips, red meat, sugary drinks, screen time, and sleep time during the lockdown amongst children and adolescents - Significant decrease in time spent doing sports amongst children and adolescents during the lockdown - Insignificant but a small decrease in vegetable intake and slight increase in fruit intake - Limitations: <ul style="list-style-type: none"> • Small sample size • Parent reports and no quantitative measures of weight, height or activity levels

					<ul style="list-style-type: none"> • Baseline comparison was start of the study and not the beginning of the lockdown
David Lawrence, 2022 (65)	Reciprocal relationships between trajectories of loneliness and screen media use during adolescence	Longitudinal	Australia	<p>N=1919 (57% male, 43% female)</p> <p>Age range: 10-15 years</p>	<ul style="list-style-type: none"> - Adolescents reported an average of 3.8 hours of screen time per day - Limited evidence of association between screen time and loneliness factors such as having friends and isolation - Higher isolation loneliness scores were associated with an increase in gaming and passive screen time - Limitations: <ul style="list-style-type: none"> • Time spent for various screen activities and loneliness levels were based on retrospective self-reported data by adolescents • The study did not distinguish between screen time at school and outside of school time • There was no differentiation between electronic games played online with friends and other types/genres of electronic games that can lead to internet gaming disorder
Derek C. Paterson, 2021 (58)	Exploring the impact of COVID-19 on the movement behaviours of children and youth: A scoping review of	Review	40 countries (China, USA, multi-country, Canada, Italy, Spain,	<p>School age children: 5-11 years</p> <p>Youth age: 12-17 years</p>	<ul style="list-style-type: none"> - 150 articles included in the scoping review (110 empirical research studies, 103 original data sets, 6 reviews and 34 commentaries and editorials)

	evidence after the first year		India, Australia, Turkey, Brazil, Croatia, France, Portugal, Bangladesh, Saudi Arabia, Germany Japan, Kenya, Malaysia, Republic of Macedonia, The Netherlands, Singapore, Indonesia, Iran, Ireland)		<ul style="list-style-type: none"> - Findings from editorials, commentaries, and perspectives: discussed the potential pandemic related restriction impacts on health (changes in physical activity, screen time, sleep quantity, schedules, sleep quality, obesity risk). Commentaries also highlighted the importance of engaging in healthy lifestyle behaviours and inform future policies and practices - Two reviews that assessed changes in physical activity reported inconclusive results in both children and youth during the COVID-19 pandemic. One review also emphasised that children suffered from sleep disturbances - Original research: Majority of the studies were cross-sectional designs (74), some longitudinal (20), and 7 studies were qualitative in nature. - Cross-sectional and longitudinal designs reported a decrease in physical activity levels in children and youth, a few studies also reported stability or an increase in physical activity levels among children - Significant increases in screen time during the pandemic compared to pre-pandemic levels were reported through longitudinal, cross-sectional
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					<p>and qualitative study designs. Children and youth reported spending more time using cell phones, computers, gaming, online gaming, watching television and social media</p> <ul style="list-style-type: none"> - Commonly reported that sleep duration increased during the pandemic but still some studies reported no changes - Limitations: <ul style="list-style-type: none"> • The scoping review did not appraise the quality of evidence assessed • Inclusion of some articles that lacked peer review • Extent of COVID-19 restrictions varied across countries with different periods of data collection, and this was not accounted for
Giovanni Farello, 2022 (19)	Children and adolescents dietary habits and lifestyle changes during COVID-19 lockdown in Italy	Cross-sectional survey	Italy	N=402 children (5-11 years; 47.6% male, 52.4% female) and 563 adolescents (12-18 years; 60.3% male, 39.7% female)	<ul style="list-style-type: none"> - Sports activities decreased, sleep duration and screen time increased (to 4 hours a day) - Consumption of high carbohydrate foods, sweets and desserts increased significantly - Consumption of take-out of fast food significantly increased (12.9%) compared to consumption before the pandemic - Limitations:

					<ul style="list-style-type: none"> • Survey reflects data collected from parents – subject to recall bias and based on perception of parents • Questionnaire does not include the amount of different food intake
Gordana Kendel Jovanovic, 2021 (15)	The outcome of COVID-19 lockdown changes in body mass index and lifestyle among Croatian schoolchildren: A cross-sectional study	Cross-sectional	Croatia	<p>N=1370 (731 girls, 639 boys)</p> <p>Age range – 10 to 15 years</p>	<ul style="list-style-type: none"> - An increase in overweight and obesity amongst girls and boys during the COVID-19 lockdown compared to prior COVID-19 - Adolescents had significantly higher odds of overweight and obesity compared to those who reported less organized physical activity, more physical activity during the week, ate breakfast 4-6 times a week, ate more fruit and vegetables in a day, and fewer sweet and/or salty foods - Adolescents screen time significantly increased during the lockdown - Girls skipped breakfast more often but had healthier eating habits compared to boys - Many adolescents adhered to a Mediterranean diet - Limitations: <ul style="list-style-type: none"> • Cross-sectional study design limits the ability to determine causal relationships between variables of interest

					<ul style="list-style-type: none"> • Self-report data may be subject to recall bias and social desirability • Less than half of adolescents who entered the survey completed the questionnaire
Hala Allabadi, 2020 (18)	Impact of COVID-19 lockdown on dietary and lifestyle behaviours among adolescents in Palestine	Cross-sectional	Palestine	<p>N=600 (300 male, 300 female)</p> <p>Age range – 10-19 years</p>	<ul style="list-style-type: none"> - Increased intake of added-sugar beverages, vegetables and fruits, fried foods and sweets - 45% of adolescents reported no physical activity - Among the 21.8% of adolescents reporting some exercise, 18.8% reported a decrease in their physical activity levels - Many adolescents reported sleeping more during the lockdown - Food intake increased significantly in females than in males after the lockdown compared to before the lockdown - Females were more likely to be physically inactive than males before the lockdown, but during the lockdown, physical activity declined amongst males - The financial situation of many families led to an increased intake of energy dense foods - Limitations: <ul style="list-style-type: none"> • Phone interviews and self-report data might be subject to recall bias

					<ul style="list-style-type: none"> • Questions for dietary intake had response options as increased, decreased and no change; but no information regarding the actual intake or amount being consumed prior and during the lockdown • Cross-sectional design of the study limits the ability to establish causal relationships between variables of interest
Huda Al Hourani, 2021 (16)	Impact of COVID-19 lockdown on body weight, eating habits, and physical activity of Jordanian children and adolescents	Cross-sectional	Jordan	<p>N=384 (48.4% male, 51.6% female)</p> <p>Age range: 6 to 17 years</p>	<ul style="list-style-type: none"> - Significant increase in body weight and body mass index (BMI) after the 10 weeks lockdown period - Prevalence of overweight and obesity increased during the lockdown for adolescents - 70% of adolescents spent more than 3 hours in front of the screen during the lockdown - Significant increase amongst adolescents of following food items: bread, carbonated beverages, French fries, pizza, potato chips, sugar, ice cream, chocolates, Arabic sweets - Limitations: <ul style="list-style-type: none"> • Current study data was also collected during the Holy month of Ramadan – which could lead to a change in eating habits and shift in eating times

					<ul style="list-style-type: none"> • Cross-sectional study limits the ability to determine cause and effect • Self-report data is subject to social desirability and recall bias • Convenience sampling in this study – non inclusion of rural children and only including those who have access to technology limits generalizability of these study results beyond the current sample
Jerry L. Grenard et al., 2013 (21)	Sweetened drink and snacking cues in adolescents. A study using ecological momentary assessment	Ecological study	San Dimas, California, United States	<p>N=158 (43.04% male, 56.96% female)</p> <p>Age range – 14-17 years</p>	<ul style="list-style-type: none"> - Feeling lonely was associated with having a sweetened drink - Being physically active for 60 minutes or more on a day, was a cue associated with a greater likelihood of sweet drinks consumption, but not sweet or salty snacks - Watching television was only differentially associated with having a sweet snack, but not with other unhealthy snacks - The association between food related cues and eating behaviours was similar to previous studies (such as having chips or soda available in the home was associated with having salty snacks and sugar sweetened drinks, seeing snacks was also associated with consuming salty or sweet snacks)

					<ul style="list-style-type: none"> - Limitations: <ul style="list-style-type: none"> • Correlation between the cue and snack behaviours may be refutable (a third variable may be responsible for one or more of the associations) • Univariate and multiple regressions were unadjusted for potential confounding variables – such as time of day, day of the week • School hours were excluded, preventing collection of information about snack and beverage consumption during school hours • Findings might not be representative to other areas with adolescents living in low SES conditions
Kristi Baerg MacDonald, 2022 (6)	Loneliness and screen time usage over a year	Longitudinal	Canada	<p>N=20,903 (54% female, 46% male)</p> <p>Age range: Time point 1 – 12 to 19 years Time point 2 – 14 to 19 years</p>	<ul style="list-style-type: none"> - Girls were more likely to report spending time watching TV, use the internet, and texting; while boys were more likely to play video games - Girls were more likely to report higher loneliness levels - Over the year, adolescents’ loneliness levels remained stable but with a slight increase - Limitations: <ul style="list-style-type: none"> • Screen time was self-reported which may be subject to social desirability and recall bias

					<ul style="list-style-type: none"> • The COMPASS study uses a single item and direct item to measure loneliness levels and underreporting may result for those adolescents with stigma • The study did not account for other possible time-variant confounders such as stressful life events • COMPASS uses a convenience sample of schools and not designed to be representative
Katerina Maximova, 2022 (11)	Perceived changes in lifestyle behaviours and in mental health and wellbeing of elementary school children during the first COVID-19 lockdown in Canada	Cross-sectional	Canada	<p>N=1095 (boys: 538, girls: 557)</p> <p>Age range: 9-12 years</p>	<ul style="list-style-type: none"> - Children and adolescents were less physically active, spent more time playing video games (boys) and cellphones (girls) and had more snacks - Mental health and well-being were better during the lockdown - Children and adolescents had late bed/wake-up times during the lockdown - Limitations: <ul style="list-style-type: none"> • Cross-sectional study design limits the ability to establish a causal relationship between variables of interest • Surveys were administered a few months after the lockdown which could have affected participants ability to recall changes in lifestyle habits and mental well-being

<p>Maria Belen Ruiz-Roso, 2020 (13)</p>	<p>Changes of physical activity and ultra-processed food consumption in adolescents from different countries during COVID-19 pandemic: an observational study</p>	<p>Cross-sectional</p>	<p>Brazil, Chile, Colombia, Spain and Italy</p>	<p>N=734 adolescents (59.6% female, 39.8% male)</p> <p>[Brazil: N=115 (56.5% female, 43.5% male); Chile: N=170 (57.1% female, 42.4% male); Colombia: N=161 (56.5% female, 42.9% male); Spain: N=147 (59.2% female, 40.8% male); Italy: N=133 (69.9% female, 28.6% male)]</p> <p>Age range: 10-19 years</p>	<ul style="list-style-type: none"> - High prevalence of inactivity among adolescents – before and during the lockdown - Consumption of ultra-processed foods was higher during the lockdown - Brazil, Chile and Columbia – adolescents had lower levels of physical activity before and during the quarantine – aggravated by social isolation - Limitations: <ul style="list-style-type: none"> • Validating physical activity measurements is challenging • The questionnaire did not segregate what sort of ultra-processed foods were being consumed • Survey was based on convenience sampling which might not be representative of the behaviours of the entire populations • Cross-sectional design of the study limits the ability to determine cause and effect
<p>Michelle Teixeira Teixeira, 2021 (9)</p>	<p>Eating habits of children and adolescents during the COVID-19 pandemic: The impact of social isolation</p>	<p>Cross-sectional</p>	<p>Brazil</p>	<p>N=589 children and 729 adolescents</p> <p>Median age for</p>	<ul style="list-style-type: none"> - First study on food consumption patterns of Brazilian children and adolescents due to the pandemic social isolations - Breakfast consumption was significantly more regular among both children and adolescents of isolated families compared to non-isolated families

				<p>adolescents; 16 years (Interquartile range – 14.0-17.0 years)</p>	<ul style="list-style-type: none"> - A third of individuals, especially adolescents, replaced large meals with snacks (both isolated and non-isolated) - Watching television associated with high energy density foods high in fat and sugars - Soft drinks most frequently consumed by non-isolated families - Consumption of raw salad and vegetables was higher among isolated families - Participants had higher prevalence of screen time and physical activity - Limitations: <ul style="list-style-type: none"> • Short-term isolation consequences (8-12 weeks) may not be generalizable to longer periods of isolation • Using an online questionnaire, the sample size might be less representative of the general population and more representative of middle-classes and the Southeast region of Brazil <p>The cross-sectional design of the study limits the ability to establish a causal relationship between the study variables</p>
Paula Sol Ventura, 2021 (17)	Children's health habits and COVID-19 lockdown in Catalonia: Implications for	Cross-sectional	Spain	N=3464 children and adolescents (47.8% girls, 49.9% boys)	<ul style="list-style-type: none"> - The odds of inadequate physical activity was 5 times more likely and 2 times more likely than before the lockdown among boys and girls aged 11-16 years, respectively.

	obesity and non-communicable diseases			<p>N= 910 adolescents (26.3% girls 26.1% boys)</p> <p>Age range: <17 years</p>	<ul style="list-style-type: none"> - A significantly higher odds of television watching and using electronic devices amongst adolescents aged 11-16 years - Children and adolescents also reported delays in bedtime during the lockdown - Limitations: <ul style="list-style-type: none"> • Objective measures were not included – in terms of change in body weight before and after the lockdown • Measures may be subject to recall bias as parents were asked to report on children’s behaviours • Cross-sectional study design limits the ability to determine cause and effect
Randy M. Page, 2003 (59)	Physical activity and Psychosocial discomfort among high school students in Taipei, Taiwan	Cross-sectional	Taiwan	<p>N=2665 students</p> <p>Age range: 15-21 years</p>	<ul style="list-style-type: none"> - Boys were significantly more likely to engage in vigorous physical activity and muscle strengthening exercises compared to girls - Major barriers to frequent activity were noted as: quality and quantity of facilities, lack of support from peers, friends, teachers, and family income - Students who were physically inactive scored higher on three measures of psychosocial discomfort – loneliness, shyness and hopelessness compared to those who were more frequently physically active - Limitations:

					<ul style="list-style-type: none"> • The psychosocial discomfort measures were not validated for use in Taiwan • Self-report retrospective data may be subject to social desirability, under-reporting and over-reporting • Cross-sectional design of the study limits the ability to determine cause and effect • Team sports in Taiwan may be different compared to Western countries
Roberta Pujia, 2021 (10)	The effects of COVID-19 on the eating habits of children and adolescents in Italy: a pilot survey study	Pilot survey study	Italy	<p>N=439 (56% boys, 44% girls)</p> <p>Age range – 5-14 years</p>	<ul style="list-style-type: none"> - Children and adolescents reported an increased intake of chocolate, sweet snacks, ice cream and other desserts, bread, pasta, pizza - Weight gain in adolescents was positively associated with an increased consumption of bread, pizza, meat and bakery items - There was an increase in fruit, vegetable and fish consumption - Limitations: <ul style="list-style-type: none"> • Self-reported data could be subject to recall bias and social desirability • Parents were asked to fill out the questionnaire, but they may not always be aware of their child’s food consumption
Rosario Ferrer-	Low adherence to Mediterranean diet in	Cross-sectional	Spain	High school students	<ul style="list-style-type: none"> - A low adherence to Mediterranean diet and poor dietary habits was found in

Cascales et al., 2018 (35)	isolated adolescents: The Mediation effects of stress			(N=527; 54.5% female, 45.5% male) Age range - 12-17 years	individuals with high perceived loneliness in comparison to those individuals with medium and low perceived loneliness - No significant differences were found between the three loneliness groups for breakfast and sweets consumption. - The association between loneliness and poor eating habits is mediated by levels of stress in high school - Limitations: <ul style="list-style-type: none"> • Cross-sectional study designs limit the ability to establish causal relationships • Dietary information was self-reported which could be subject to underreporting, social desirability and recall bias • Socio-economic status, family structure, and body mass index variables not included in the analysis which might be potential confounders
Stacey N. Doan, 2021 (39)	Loneliness and cravings for sugar-sweetened beverages among adolescents	Ecological momentary assessment	California	Adolescent students (N=158, 43.04% male, 56.96% female) Age range: 14-18 years	<ul style="list-style-type: none"> - Loneliness influenced cravings of sugar sweetened beverages, independent of negative emotional states - Mood plays a role in affecting consumption and cravings - Using an EMA design reduced bias associated with previous studies using retrospective reports - Limitations: <ul style="list-style-type: none"> • Small sample size

					<ul style="list-style-type: none"> • Direction of causality cannot be established • Many students in the study were from socioeconomically disadvantaged backgrounds, thus results might not be generalizable to other adolescents
Simone Jose dos Santos, 2015 (61)	Association between physical activity, participation in physical education classes, and social isolation in adolescents	Cross-sectional	Brazil	<p>N=4207 (59.8% female, 40.2% male)</p> <p>Age range: 17 to 19 years</p>	<ul style="list-style-type: none"> - Crude analysis showed that feelings of loneliness and having few friends was associated with participation in physical education classes in girls - Crude odds ratios and after adjusting for confounders, the associations were not significant for feelings of loneliness and physical activity levels – this did not differ by gender - Limitations: <ul style="list-style-type: none"> • Variables are self-reported and subject to response bias • Time lag between data collection and study completion (8 years) • Cross-sectional study design limits the ability to determine cause and effect
So Young Kim, 2021 (14)	Changes in dietary habits and exercise pattern of Korean adolescents from prior to during the COVID-19 pandemic	Cross-sectional	Korea	<p>N=53,461 (52.0% male, 48.0% female - in 2019)</p> <p>52,139 (51.8% male, 48.2% female - in 2020)</p>	<ul style="list-style-type: none"> - Fast food, fruit and soda consumption was lower in 2020 than in 2019 - Breakfast consumption increased during the COVID-19 pandemic - Anaerobic exercise was higher and vigorous aerobic exercise was lower in the COVID-19 pandemic compared to pre-pandemic group.

				Age range: 12 to 18 years	<ul style="list-style-type: none"> - Self-reported data may be subject to recall bias - Amount of food consumption was not evaluated - Ethnic or regional differences might be present regarding dietary habits and exercise patterns
Supa Pengpid and Karl Peltzer, 2021a (36)	Prevalence and associated factors of loneliness among national samples of in-school adolescents in four Caribbean countries	Cross-sectional	Caribbean countries	<p>N=9,143 school adolescents (50.7% female, 49.3% male)</p> <p>Median age: 15 years, 3 years interquartile range (IQR)</p>	<ul style="list-style-type: none"> - Being female, older age increased the likelihood of loneliness - Parental emotional neglect, exposure to passive smoking among boys, experiencing hunger/food insecurity and low peer support among girls were found to be associated with loneliness - Not attending physical education classes and soft drink consumption (≥ 3 days) increased the likelihood of loneliness - Fruit and vegetable intake had a protective effect against loneliness - Limitations: <ul style="list-style-type: none"> • Cross-sectional study design limiting ability to establish causal relationships • Self-reported data may be subject to recall bias, social desirability, and underreporting • Inclusion of adolescents going to school only
Supa Pengpid and Karl Peltzer, 2022 (38)	Loneliness is associated with poor mental health, social-environmental factors, and health risk	Cross-sectional	Caribbean countries	N=9,143 school adolescents (50.7%	<ul style="list-style-type: none"> - Loneliness was significantly positively associated with poor mental health outcomes – having no close friends, anxiety-induced sleep disturbance, social

	behaviours among national samples of in-school adolescents in four Caribbean countries			female, 49.3% male) Median age: 15 years; interquartile range: 3 years	<p>ideation, suicide plan and suicide attempt.</p> <ul style="list-style-type: none"> - Girls had higher odds on the mental health outcomes compared to boys - Loneliness increased the odds of leisure-time sedentary behaviour and frequent soft drink consumption - There were no significant associations between loneliness and physical inactivity, fast-food consumption, and inadequate fruit and vegetable consumption - Limitations: <ul style="list-style-type: none"> • Only adolescents attending schools were included in the study • Self-reported measures are subject to recall bias, social desirability, and underreporting • Cross-sectional study design limits the ability to establish a causal relationship between the variables
Supa Pengpid and Karl Peltzer, 2021b (37)	Prevalence and associated factors of loneliness among a national sample of in-school adolescents in Morocco	Cross-sectional	Morocco	N = 6,745 (46.2% female, 53.8% male) Median age; 15 years; interquartile range: 3 years	<ul style="list-style-type: none"> - Older age, girls, anxiety induced sleep problems, ever bullied, not having close friends, victimisation, frequent involved in physical fights, frequently experiencing hunger, low peer support, sedentary behaviour, were associated with loneliness - Fruit and vegetable intake was negatively associated with loneliness - Limitations:

					<ul style="list-style-type: none"> • Cross-sectional study design limits the ability to establish a causal relationship between the variables being analyzed • The study design does not allow for evidence regarding loneliness trajectories of adolescents • Study sample only comprised of adolescents going to school • Self-report measures may be subject to underreporting, overreporting, and social desirability • The study did not include help-seeking behaviours for loneliness – adolescents with help-seeking behaviours would be different in loneliness statuses to those with no previous or on-going help
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Note: Key words searched on PubMed and Ovid Medline and paired with Boolean terms (and/or): Loneliness, breakfast skipping, adolescence, physical activity, moderate-to-vigorous physical activity, screen time, sleep, fruit intake, vegetable intake, snack intake, fast food, lockdown, COVID-19 pandemic.

CHAPTER 2

2. Methods

2.1. Study design, setting and participants

We used data from the COMPASS study (Cannabis, Obesity, Mental health, Physical activity, Alcohol, Smoking, and Sedentary behaviour), an ongoing prospective study, collecting annual health survey data (purposive sampling) from students in grades 9-12 (ages 12-19 years) attending participating secondary schools in Ontario, Alberta, British Columbia, and Quebec (secondary I-V), Canada (72). All study protocols have been approved by the Human Research Ethics Board at the University of Waterloo (ORE #30118) and appropriate school board committees. The questionnaire was filled out by students after consent from parents (passive consent) (73). Detailed information regarding the COMPASS design and methodology is available on the study website (<https://uwaterloo.ca/compass-system/>) and in print (72). This paper used a cross-sectional study design and post-pandemic onset student data collected from November 2020 – June 2021.

2.2. Variables of interest

We used adolescents' self-reported loneliness levels (i.e., increased versus decreased/stayed the same) due to COVID-19 as our independent variable. We pooled “decreased/stayed the same” loneliness groups due to the small sample size in the “decreased only” group (n=2,545 for eating habits dataset and n=2,225 for 24-hour movement behaviours dataset). Adolescents self-reported eating habits and 24-hour movement behaviours were used as outcomes.

For eating habits, adolescents were asked to report if they had breakfast everyday (yes/no). They were also asked to report on which days during the past week had they done the following: a) Eat food purchased at a fast-food place or restaurants; b) Eat snacks purchased from a vending machine, corner store, snack bar, or canteen; c) Eat fruit (fresh, canned, dried, frozen); and d) Eat vegetables (raw or cooked, fresh, canned, or frozen). We created appropriate categories for the frequency of consumption per week for each item (such as 0 days, 1 or 2 days, ≥ 3 days) to report prevalence estimates and odds ratios (based on distribution).

Variables were dichotomized (yes/no) for meeting the MVPA (≥ 60 min/day), recreational ST (≤ 2 h/day) and sleep duration (≥ 8 h/night) guideline recommendations. For MVPA, adolescents were asked to report the number of minutes they spent doing moderate (i.e., low intensity workouts such as walking, biking to school and recreational swimming) and hard physical activity (i.e., jogging, team sports, fast dancing, jump-rope, or other activities that increased heart rate) during the past week. The total was averaged to reflect the number of minutes spent doing MVPA per day. Regarding ST, adolescents were asked to report the number of hours per day they spent doing the following activities in the past week: a) watching/streaming TV shows or movies; b) playing video games/computer games; c) surfing the internet; and d) texting, messaging, and emailing. Total screen time per day was calculated by adding responses from questions a to d. The reliability and validity of these self-reported MVPA and ST measures have been tested (74). For sleep duration, adolescents were asked to report at what time they turned out the lights and went to sleep during the past week on weekdays and weekends, and at what time they woke up

on weekdays and weekends. An average was calculated for number of hours of sleep per night.

Covariates included age (years), gender (boy/girl/other), race/ethnicity (White/black indigenous and other people of colour [BIPOC]), province (Quebec, Ontario, British Columbia, Alberta), body weight category (BMI categories of underweight, normal weight, overweight, and obesity using the WHO growth curves), learning mode (in-person, online, hybrid/blended), and socioeconomic status (SES) score (a composite of six items: Income level (Less than median income level = 0, Greater than or equal to median income level = 1); Environment (Rural =0, Medium Urban=1, Large Urban =2); “In your house, do you have your own bedroom?” (1=Yes, 0=No); “Do you sometimes go to bed hungry because there is not enough money to buy food?” (1=No, 0=Yes); “Would you say that you and your family are more or less comfortable financially than the average student in your class?” (0=Less comfortable, 1=As comfortable, 2=More comfortable); “How true are the following statements about COVID-19 for you right now? I am worried about my family being able to pay bills and expenses” (1=Neutral/I do not know/Mostly false/False), 0=True/Mostly True)). SES scores can range from 0-9. We used the median value for SES score (i.e., ≥ 7 : High SES, < 7 : Low SES) in our analysis. Our choice of covariates to include in the analysis was influenced by the evidence from the literature (i.e., associations with included outcomes) and the availability of variables in COMPASS. The COMPASS student questionnaire has been attached in Appendix 2. Missing data for all covariates were re-coded as an unknown category to retain data points.

2.3. Statistical analysis

We used chi-squared tests to estimate the bivariate associations for categorical variables and t-tests for continuous variables. We conducted multivariable logistic regression models for all the outcomes. We conducted multinomial logistic regression for outcome categories with more than two categories. We tested for interactions between loneliness with gender and age in our models (a p-value of less than 0.05 was considered significant). The adjusted odds ratios are presented in tables. We conducted a sensitivity analysis by removing the “decreased only” loneliness group. Data analyses were performed using SAS version 9.4. We followed the STROBE guidelines (Strengthening the Reporting of Observational Studies in Epidemiology) for cross-sectional studies (<https://www.equator-network.org/reporting-guidelines/strobe/>). A description of our coding for all variables included has been added in Appendix 3.

CHAPTER 3

3. Results

3.1. Sample size

Our total sample size consisted of 53,469 adolescents from November 2020-June 2021 (Figure 1). Out of the 53,469 adolescents, we had data available for 46,401 adolescents for loneliness levels due to the COVID-19 pandemic. Adolescents who reported screen time greater than 24 hours per day, MVPA greater than 6 hours per day, or sleep duration greater than 13 hours per night were considered as inappropriate observations and were thus excluded from analysis. After removing missing/inappropriate observations for all outcome variables, we had a total of 41,927 and 45,322 adolescents with data available for 24-hour movement behaviours and eating habits, respectively. We estimated the prevalence of all our variables using this data. For gender, as we did not have a sufficient sample size in the “other” category (n=1,646 for eating habits and n=1,334 for 24-hour movement behaviours), we did not include these individuals in the analysis. Upon re-coding missing covariates as unknown categories and not including those in the “other” category for gender, we retained approximately 96% of our sample size (i.e., 43,588 for eating habits and 40,521 for 24-hour movement behaviours) to compute our prevalence estimates. As the interactions between loneliness and gender were significant ($p < 0.05$) for vegetable intake, fast food intake, breakfast skipping, and screen time, we decided to stratify our prevalence tables and logistic regression results by gender.

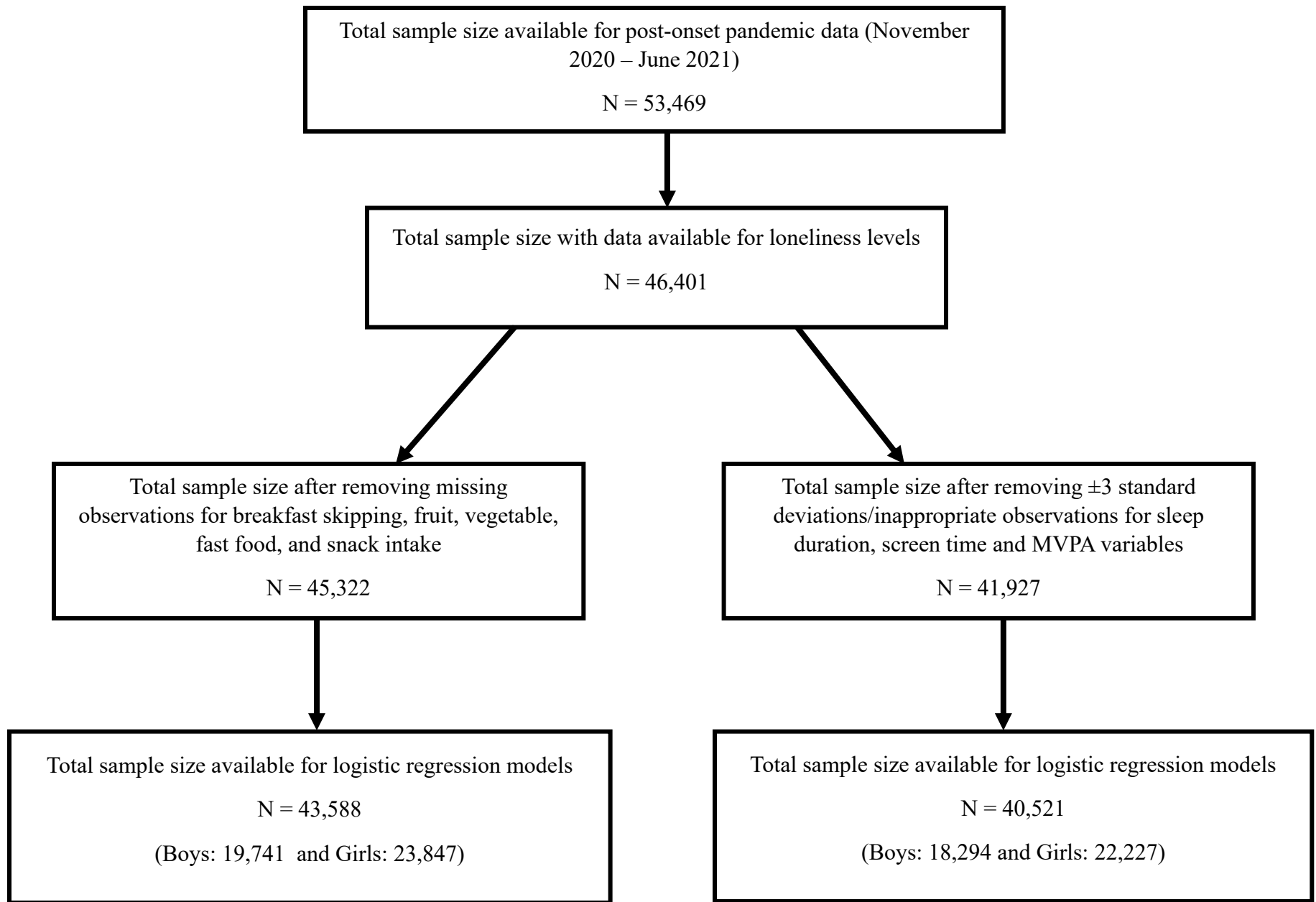


Figure 1: Flowchart of final sample size in analysis

3.2. Descriptive analysis

3.2.1. Eating habits

We had a total of 43,588 adolescents (19,741 boys and 23,847 girls) with data available for loneliness due to COVID-19 and their eating habits (Table 2). Out of the 43,588 adolescents, 24,830 (54.8%) were in the increased loneliness group and 19,758 (45.3%) were in the decreased/stayed the same loneliness group. In boys with increased loneliness, we found a higher prevalence of breakfast skipping, fast-food consumption (i.e., 1-2 days, ≥ 3 days), snack intake (≥ 3 days), and vegetable intake (≥ 5 days) in comparison to boys in the decreased/stayed the same loneliness group. In addition, for boys with increased loneliness, we found a higher prevalence of online learning and lower SES compared to boys with decreased/stayed the same loneliness.

In girls with increased loneliness, we found a higher prevalence of skipping breakfast and fast-food consumption (i.e., 1 or 2 days, ≥ 3 days) and a similar prevalence for vegetable, fruit and snack intake compared to girls in the decreased/stayed the same loneliness group. Additionally, for girls with increased loneliness, most of them were white, studied online and were in the lower SES category compared to those girls in the decreased/stayed the same loneliness group.

Table 2. Prevalence of eating habits and covariates among Canadian adolescents by loneliness levels and gender due to the COVID-19 pandemic, COMPASS study data 2020-2021 (n=43,588).

Characteristics	Boys (n=19,741)		Girls (n=23,847)	
	Loneliness increased	Loneliness decreased/stayed the same	Loneliness increased	Loneliness decreased/stayed the same
COVARIATES				
Age, years (mean, SD) *	15.1 (1.48)	14.7 (1.57)	15.0 (1.48)	14.8 (1.57)
SES category *				
High SES	64.4	67.3	62.5	67.0
Low SES	35.6	32.7	37.5	33.0
Province (%) *				
Quebec	59.7	63.1	60.5	61.2
Ontario	27.3	23.5	27.1	23.6
British Columbia	8.2	8.9	8.2	10.9
Alberta	4.8	4.5	4.2	4.30
Ethnicity (%) **				
White	77.2	77.1	79.1	73.7
BIPOC	22.8	22.9	20.9	26.3
Learning situation (%) *				
Online	49.2	44.0	50.9	44.4
In-person	28.6	34.5	26.6	35.0
Hybrid	22.2	21.3	22.6	20.6
Body weight category (%) *				
Underweight/Normal weight	75.1	75.2	83.4	83.9
Overweight/Obesity	24.5	24.8	16.6	16.1
OUTCOMES				
Ate breakfast everyday (%) *				
Yes	54.7	64.1	41.6	53.8
No	45.3	35.9	58.4	46.2
Fruit intake (%) ***				

≥5 days	58.0	58.4	62.5	64.4
3 or 4 days	17.1	15.5	17.7	16.3
1 or 2 days	10.7	11.5	11.3	10.7
0 days	14.2	14.6	8.5	8.6
Vegetable intake (%) ***				
≥5 days	66.1	64.3	68.8	69.2
3 or 4 days	14.4	13.6	14.7	14.3
1 or 2 days	8.3	10.2	8.9	9.3
0 days	11.2	11.8	7.6	7.2
Fast food intake (%) *				
≥3 days	12.4	10.9	10.5	8.5
1 or 2 days	47.0	46.3	52.7	51.1
0 days	17.8	42.8	36.7	40.4
Snack intake (%) ***				
≥3 days	8.4	7.9	6.3	6.5
1 or 2 days	20.2	22.2	22.5	22.7
0 days	71.4	69.9	71.2	70.8

Note: Data for 45,322 students were available for loneliness due to the COVID-19 pandemic and the outcome variables. We have presented data for 43,588 (19,741 boys and 23,847 girls) and excluded those in the “other” category for gender due to a small sample size (accounts for 3.8% of the total sample size). Data are presented as mean (SD) for continuous variables (age) and as percentages (%) for categorical data.

Missing data for covariates are: age (0.03%), SES category (31.8%), ethnicity (0.27%), body weight category (42.8%) and learning situation (0.29%). Missing data for covariates were re-coded as an unknown category to retain all data points. Those in the unknown category have not been reported in the prevalence estimates.

SES was evaluated by creating a sum SES score using six items: Income level (Less than median income level = 0, Greater than or equal to median income level = 1); Environment (Rural =0, Medium Urban=1, Large Urban =2); “In your house, do you have your own bedroom?” (1=Yes, 0=No); “Do you sometimes go to bed hungry because there is not enough money to buy food?” (1=No, 0=Yes); “Would you say that you and your family are more or less comfortable financially than the average student in your class?” (0=Less

comfortable, 1=As comfortable, 2=More comfortable); “How true are the following statements about COVID-19 for you right now? I am worried about my family being able to pay bills and expenses” (1=Neutral/I do not know/Mostly false/False), 0=True/Mostly True). Scores ranged from 0-9, with higher scores indicating higher SES. SES category was created using the median value for SES score (i.e., ≥ 7 : High SES, < 7 : Low SES).

* $p < 0.01$ for boys and girls, ** $p < 0.01$ for girls only *** $p < 0.01$ for boys for the comparison between increased loneliness and decreased/stayed the same loneliness.

Abbreviations: SES – Socioeconomic status; SD – Standard Deviation; BIPOC – black indigenous and other people of colour

3.2.2. 24-hour movement behaviours

We had a total of 40,521 adolescents (18,294 boys and 22,227 girls) with data available for loneliness due to COVID-19 and their adherence to the 24-hour movement behaviours (Table 3). Out of 40,521 adolescents, 22,149 (54.7%) were in the increased loneliness level group and 18,372 (45.3%) were in the decreased/stayed the same loneliness level group. In boys and girls with increased loneliness, we found a lower prevalence of meeting the guidelines for MVPA, ST and sleep duration in comparison to those in the decreased/stayed the same loneliness group. For girls and boys in the increased loneliness group, we found a higher prevalence of overweight/obesity, online learning, and lower SES compared to girls and boys in the decreased/stayed the same loneliness group.

Table 3. Prevalence of 24-hour movement behaviours and covariates among Canadian adolescents by loneliness levels and gender due to the COVID-19 pandemic, COMPASS study data 2020-2021 (n=40,521).

Characteristics	Boys (n=18,294)		Girls (n=22,227)	
	Loneliness increased	Loneliness decreased/stayed the same	Loneliness increased	Loneliness decreased/stayed the same
<i>Covariates</i>				
Age, years (mean, SD) *	15.1 (1.47)	14.7 (1.56)	15.0 (1.48)	14.8 (1.56)
SES category (%) *				
High SES	64.7	67.5	62.8	67.3
Low SES	35.3	32.5	37.2	32.7
Province (%) *				
Quebec	60.4	63.9	61.3	62.0
Ontario	26.8	23.1	26.6	23.1
British Columbia	8.1	8.8	8.0	10.7
Alberta	4.7	4.2	4.0	4.2
Ethnicity (%) *				
White	78.1	77.7	79.7	74.4
BIPOC	21.9	22.3	20.3	25.6
Learning situation (%) *				
Online	49.9	44.7	51.5	44.8
In-person	27.8	33.9	26.0	34.6
Hybrid	22.3	21.5	22.5	20.6
Body weight categories (%) *				
Underweight/normal weight	75.3	75.5	83.5	84.2
Overweight/obesity	24.7	24.5	16.5	15.8
<i>Outcomes</i>				
24-hour movement behaviours				
≥60 minutes of MVPA per day (%) *				
Yes	66.0	68.4	52.9	54.9

No	34.0	31.6	47.1	45.1
≤2 hours of screen time per day (%) *				
Yes	3.6	5.4	5.0	8.8
No	96.4	94.6	95.0	91.2
≥8 hours of sleep per night (%) *				
Yes	70.0	77.1	72.4	77.6
No	30.0	22.9	27.6	22.4

Note: Data for 41,927 students were available for loneliness levels due to the COVID-19 pandemic and the outcome variables. We have presented data for 40,521 students (18,294 boys and 22,227 girls) and excluded those in the “other” category for gender due to a small size (accounts for 3% of the total sample). Data are presented as mean (SD) for continuous variables and as percentages (%) for categorical data.

Missing data for covariates are: age (0.02%), SES category (31.3%), ethnicity (0.25%), body weight category (41.4%) and learning situation (0.25%). Missing data for covariates were re-coded as an unknown category to retain all data points. Those in the unknown category have not been reported in the prevalence estimates.

SES was evaluated by creating a sum SES score using six items: Income level (Less than median income level = 0, Greater than or equal to median income level = 1); Environment (Rural =0, Medium Urban=1, Large Urban =2); “In your house, do you have your own bedroom?” (1=Yes, 0=No); “Do you sometimes go to bed hungry because there is not enough money to buy food?” (1=No, 0=Yes); “Would you say that you and your family are more or less comfortable financially than the average student in your class?” (0=Less comfortable, 1=As comfortable, 2=More comfortable); “How true are the following statements about COVID-19 for you right now? I am worried about my family being able to pay bills and expenses” (1=Neutral/I do not know/Mostly false/False), 0=True/Mostly True). Scores ranged from 0-9, with higher scores indicating higher SES. SES category was created using the median value for SES score (i.e., ≥7: High SES, <7: Low SES).

Time spent in moderate physical activity (e.g., walking, biking to school) and vigorous physical activity (e.g., jogging, team sports, fast dancing) were collected and combined to calculate total time spent in MVPA. The total was averaged to reflect the number of minutes spent doing MVPA per day.

Screen time was assessed by asking adolescents how much time they spend doing the following activities – a) Watching/Streaming TV or movies; b) Playing video games; c) Surfing the internet; and d) Texting, messaging, and emailing. Total screen time per day was calculated by adding responses from questions a to d.

Sleep duration was assessed by asking adolescents at what time they went to sleep and woke up during the past week. An average was calculated for number of hours for sleep duration per night.

* $p < 0.01$ for the comparison between increased loneliness and decreased/stayed the same loneliness for both boys and girls.

Abbreviations: SD - standard deviation; SES - socioeconomic status; MVPA - moderate-to-vigorous physical activity; BIPOC – black indigenous and other people of colour

3.3. Logistic regression results

3.3.1. Eating habits

We had a total of 43,575 adolescents (19,735 boys and 23,840 girls) with data for loneliness and eating habits in our logistic regression models (missing 13 observations for age excluded in analysis) (Table 4). After adjusting for covariates, boys and girls with increased loneliness due to the COVID-19 pandemic were more likely to skip breakfast [boys: OR 1.41 (95% CI: 1.33, 1.50) and girls: OR 1.64 (95% CI: 1.56, 1.74)] than their peers that reported their loneliness to have decreased or stayed the same.

Relative to girls with decreased/stayed the same loneliness, girls with increased loneliness were more likely to report no vegetables consumed over the past week compared to those consuming vegetables at least 5 days/week [OR: 1.14 (95% CI: 1.02, 1.26)]. Relative to girls with decreased/stayed the same loneliness, girls with increased loneliness were more likely to consume fruits on 1-2 days [OR: 1.12 (95% CI: 1.04, 1.20)] or 3-4 days in the past week [OR: 1.11 (95% CI: 1.02, 1.21)] compared to consuming them on ≥ 5 days in the past week, and were more likely to report consumption of fast-food on 1-2 days [OR: 1.14 (95% CI: 1.02, 1.26)] and ≥ 3 days in the past week [OR: 1.42 (95% CI: 1.29, 1.57)] compared to not consuming fast food in the past week. The odds ratios for snack intake were not statistically significant in girls based on loneliness due to COVID-19.

Relative to those in the decreased/stayed the same loneliness group, boys with increased loneliness were more likely to consume fast-food on ≥ 3 days of the week [OR: 1.12 (95% CI: 1.02, 1.24)] and snacks on ≥ 3 days of the week [OR: 1.11 (95% CI: 1.00, 1.24)] compared to those who did not consume fast-food or snacks in the past week. Relative to those in the decreased/stayed the

same loneliness group, boys with increased loneliness were more likely to eat fruits on 3-4 days per week [OR: 1.12 (95% CI: 1.02, 1.20)] than ≥ 5 days in the past week.

In a sensitivity analysis, we found higher odds of skipping breakfast and fast-food consumption, regardless of age (Appendix 4, Tables 1-3). We reported the odds ratios for boys and girls with increased loneliness due to COVID-19 with covariates (see Appendix 4, Tables 1-11). We further conducted a sensitivity analysis by removing individuals who reported “decreased” loneliness levels due to the COVID-19 pandemic, which accounted for only 5.6% of our sample size and observed no changes in our odds ratios (data not shown).

3.3.2. 24-hour movement behaviours

We had a total sample size of 40,511 (18,290 boys and 22,221 girls) in our logistic regression models for 24-hour movement guidelines (10 observations were missing for the covariate age). After adjusting for covariates, adolescents with increased loneliness due to the COVID-19 pandemic were more likely to not meet ST guidelines [boys: OR 1.43 (95% CI: 1.24, 1.66) and girls: OR 1.72 (95% CI: 1.54, 1.92)] and sleep duration guidelines [boys: OR 1.38 (95% CI: 1.28, 1.48) and girls: OR 1.36 (95% CI: 1.27, 1.45)] compared to those with decreased/stayed the same loneliness (Table 5). The odds of not meeting MVPA guidelines was significantly associated with increased loneliness for boys [OR 1.07 (95% CI: 1.00, 1.14), however, these results lack clinical significance. In girls, the odds of not meeting MVPA guidelines was not significantly associated with increased loneliness.

In a sensitivity analysis, we found higher odds of not meeting the 24-hour movement guidelines regardless of age (Appendix 4, Tables 12-14). We also reported the odds ratios for adolescents with increased loneliness due to COVID-19 with covariates (Appendix 4, Tables 12-14). We performed another sensitivity analysis by removing those in the “decreased” loneliness

group, which accounted for 5% of the total sample size, but observed no change in the odds ratios (data not shown).

Table 4. Binary and multinomial logistic regression model results in adolescents with increased loneliness (versus decreased/stayed the same loneliness) due to COVID-19 for eating habits.

<i>Eating habits</i>	<i>Boys (n=19,735)</i>	<i>Girls (n=23,840)</i>
	OR (95% CI)	OR (95% CI)
<i>Loneliness increased versus decreased/stayed the same</i>		
Breakfast		
Eats breakfast daily	1.00 (reference)	1.00 (reference)
Does not eat breakfast daily	1.41 (1.33, 1.50)	1.64 (1.56, 1.74)
Fruit intake		
≥5 days	1.00 (reference)	1.00 (reference)
3 or 4 days	1.12 (1.02, 1.20)	1.12 (1.04, 1.20)
1 or 2 days	0.95 (0.86, 1.04)	1.11 (1.02, 1.21)
0 days	0.98 (0.90, 1.06)	1.05 (0.95, 1.16)
Vegetable intake		
≥5 days	1.00 (reference)	1.00 (reference)
3 or 4 days	1.04 (0.95, 1.13)	1.04 (0.97, 1.13)
1 or 2 days	0.81 (0.74, 0.90)	1.00 (0.91, 1.09)
0 days	0.96 (0.86, 1.05)	1.14 (1.02, 1.26)
Fast food intake		
0 days	1.00 (reference)	1.00 (reference)
1 or 2 days	1.05 (0.99, 1.12)	1.14 (1.08, 1.21)
≥3 days	1.12 (1.02, 1.24)	1.42 (1.29, 1.57)
Snack intake		
0 days	1.00 (reference)	1.00 (reference)
1 or 2 days	0.95 (0.89, 1.02)	1.05 (0.98, 1.12)
≥ 3 days	1.11 (1.00, 1.24)	1.07 (0.96, 1.19)

Abbreviations: OR – Odds ratios, CI – confidence interval

Note: “Decreased/stayed the same” loneliness was used as the reference category in the logistic regression models. All models were adjusted for age, ethnicity, province, body weight category, learning mode, and socioeconomic status (SES) category. The unknown categories to account for missing data were retained in the models but the odds ratios are not reported.

Table 5. Logistic regression model results in adolescents reporting increased loneliness (versus decreased/stayed the same loneliness) due to COVID-19 and its associations with the 24-hour movement behaviours.

<i>24-hour movement behaviours</i>	<i>Boys (n=18,290) OR (95% CI)</i>	<i>Girls (n=22,221) OR (95% CI)</i>
<i>Loneliness increased versus decreased/stayed the same</i>		
<i>MVPA (≥60 mins per day)</i>		
<i>Yes</i>	1.00 (reference)	1.00 (reference)
<i>No</i>	1.07 (1.00, 1.14)	1.06 (0.99, 1.12)
<i>Screen time (≤2 hours per day)</i>		
<i>Yes</i>	1.00 (reference)	1.00 (reference)
<i>No</i>	1.43 (1.24, 1.66)	1.72 (1.54, 1.92)
<i>Sleep (≥8 hours per night)</i>		
<i>Yes</i>	1.00 (reference)	1.00 (reference)
<i>No</i>	1.38 (1.28, 1.48)	1.36 (1.27, 1.45)

Abbreviations: MVPA – Moderate-to-vigorous physical activity, OR - Odds Ratio, CI - Confidence interval.

Note: “Decreased/stayed the same” loneliness was used as the reference category in the logistic regression models. All models were adjusted for age, ethnicity, province, body weight category, learning mode, and socioeconomic status (SES) category.

The unknown categories to account for missing data were retained in the models but the odds ratios are not reported.

CHAPTER 4

4. Discussion

4.1. Key findings

To our knowledge, this is the first study that examines the relationship between loneliness due to COVID-19 with eating habits and 24-hour movement behaviours in adolescents. This cross-sectional study found that adolescents with increased loneliness were more likely to skip breakfast and consume fast-food, and less likely to meet ST and sleep duration guideline recommendations compared to those who reported decreased/stayed the same loneliness. In boys and girls with increased loneliness, the odds of insufficient MVPA levels were not clinically significant compared with those that reported their loneliness to have decreased/stayed the same. Furthermore, girls with increased loneliness were more likely to not consume vegetables on all days of the week than ≥ 5 days and were more likely to consume fruits on 1-2 and 3-4 days a week than ≥ 5 days per week relative to girls in the decreased/stayed the same loneliness group. Boys with increased loneliness were more likely to consume snacks (on ≥ 3 days per week than those who did not report on consuming snacks on any day of the week), and consume fruits (1-2 days a week than ≥ 5 days a week), and were more likely to not consume vegetables (with reference to those who did ≥ 5 days a week), relative to boys who reported their loneliness as decreased/stayed the same. As this is the first study to examine loneliness in adolescence due to COVID-19 with eating habits and 24-hour movement behaviours, we do not have studies to directly compare our results to.

4.2. Comparison to pre-COVID-19 studies

4.2.1. Eating habits

A pre-pandemic study of 9,143 adolescents (median: 15 years, interquartile range (IQR): 3 years) from four Caribbean countries found no significant associations between loneliness with fruit and vegetable intake and associations did not differ by gender (36). In the study, adolescents loneliness was assessed in the past 12 months with response options from never to always, and fruit and vegetable intake (combined) was assessed based on number of servings per day (36). In another study of pre-pandemic study of 6,745 adolescents (median: 15 years, IQR: 3 years), higher fruit and vegetable consumption was associated with being less lonely (37). In a study of 158 adolescents, feeling lonely, energetic or bored had a relatively small effect size on snack intake amongst adolescents and played a minor role in unhealthy eating within the adolescent study population (21). In this ecological momentary assessment study, the researchers intended to recruit adolescents more likely to have overweight/obesity and those from lower SES families (21). The difference in our findings might be because of how loneliness was assessed; fruit, vegetable and/or snack intake were measured, the covariates included in logistic regression models, categorization of the variables included in the study, the sample size, and the timing of the data collection (pre-pandemic versus post-pandemic).

A recent review found an average increase of 83% in the number of hospital admissions due to eating disorders in the paediatric population during the pandemic (75). It also suggested that feelings of loneliness may have contributed to the worsening of eating disorder symptoms (75). Loneliness is known to mediate emotional dysregulation and predict post-prandial ghrelin in women leading to an increase in hunger, unhealthy eating behaviours and binge-eating (76, 77). In early to mid-adolescence, loneliness has been suggested to be longitudinally predictive of

disordered eating (78, 79). In girls, higher loneliness levels at age 12 was associated with higher BMI z-scores at age 13 (80), which may lead to breakfast skipping as a compensatory weight loss strategy (81). Loneliness in adolescents may lead to a loss of appetite, which may further lead to skipping meals. Breakfast skipping is also known to increase the risk of overweight/obesity in the paediatric population which may result in the development of non-communicable diseases in the future (82). A review highlighted that parental eating habits and living with both parents positively influence adolescent breakfast consumption (83). In addition, during the initial months of the pandemic, households with children reported higher levels of food insecurity compared to those without children (84). Adolescents living in financially insecure households, those from poorer SES backgrounds, and those whose parents have mental health difficulties may be influenced more severely than their peers. However, this assumption requires further research in this population. Longitudinal studies are needed to corroborate our findings and to better understand the mechanisms through which loneliness may lead to skipping breakfast and/or contribute to unhealthy eating habits in adolescents by gender.

4.2.2. 24-hour movement behaviours

4.2.2.1. Physical activity

In our sample, 34.0% of boys and 47.1% of girls in the increased loneliness group did not meet the recommended guidelines for MVPA (compared to 31.6% of boys and 45.1% of girls in the decreased/stayed the same loneliness group). We found that the odds of insufficient MVPA were statistically significant for boys but not girls in the increased loneliness group with reference to those in the decreased/stayed the same loneliness group. However, these results are not clinically meaningful. Previous pre-pandemic cross-sectional research that examined physical activity in association with loneliness as an outcome reported mixed findings in adolescents (58-60). Physical

activity can be obtained through different means (e.g., active play, sports, physical education, active transportation) and it is reassuring to note that increased loneliness was not unfavourably associated with physical activity levels in this study. It must be noted that we only assessed physical activity quantitatively and that our findings could have been different if we had been able to assess the association between loneliness and various means of physical activity.

4.2.2.2. Screen time

In this study, 96.4% of boys and 95.0% of girls with increased loneliness did not meet ST guidelines (compared to 94.6% of boys and 91.2% of girls in decreased/stayed the same loneliness group). In our regression analysis, the odds of not meeting ST guidelines were statistically significant in adolescents with increased loneliness compared to those who reported their loneliness levels as decreased/stayed the same. During the pandemic, social distancing measures and school closures resulted in significant changes to the daily routines of adolescents. To overcome/compensate feelings of increased loneliness, adolescents might have turned to texting and messaging friends/family, watching TV, playing video games, thereby increasing their ST levels (85). Girls tend to spend more time watching TV, communicating online and using social media compared to boys, while boys spend more time playing video games (86). MacDonald et al. (2022) assessed loneliness in Canadian adolescents using data collected in 2017-18 and one year later (2018-19) (6). The study found that loneliness was significantly associated with higher ST (watching TV, playing video games, texting) at a single time point (but not prospectively), with associations more pronounced in girls (6). Another pre-pandemic study by Lawrence et al. (2022) also found that higher isolation loneliness scores among adolescents were associated with increases in passive ST and gaming (cross-sectionally). However, over a period of 11 months, there was limited evidence of an association between loneliness factors and ST. The differences in

findings could be due to the different scales used to assess loneliness (levels of loneliness, loneliness factors such as friendship and isolation, etc.) in adolescents, the timing of data collection (pre-pandemic in comparison studies versus post-pandemic in this study), the categorization of study variables, sample size, and place. Therefore, the associations found in this study will benefit from a prospective analysis.

4.2.2.3. Sleep duration

In our sample, 30.0% of boys and 27.6% of girls with increased loneliness did not meet sleep duration guidelines (compared to 22.9% of boys and 22.4% of girls in the decreased/stayed the same loneliness group). We found that the odds of shorter sleep duration were statistically higher in adolescents with increased loneliness due to the pandemic relative to those that reported their loneliness to have decreased/stayed the same. A study of Danish adolescents (11-15 years old) prior to the COVID-19 pandemic found that a higher loneliness score was associated with lower odds of experiencing adequate sleep at night (65). The stronger associations observed in our study could be since we examined data during the pandemic, with adolescents reporting increased levels of loneliness and exceeding ST guidelines, which might have further impacted adolescents sleep duration at night. In a longitudinal study of 5,242 students from the Ontario Student Drug Use and Health Survey, increased social media use was associated with shorter sleep duration in adolescents (87). Lack of sleep amongst adolescents is known to interact with food intake, diet quality and sedentary behaviours, ultimately contributing towards obesity (88). It is also an important factor for proper cognitive function, mood, brain development and school performance (89-91). As a result, it is an important modifiable risk factor to consider when promoting healthier lifestyles in adolescents.

4.3. Limitations

The study has several limitations. First, this is a cross-sectional study design, which limits our ability to determine causality and temporality of the relationship between loneliness in adolescents with eating habits and 24-hour movement behaviours. Second, self-reported data might be subject to recall error and social desirability bias. Third, we measured perceived levels of loneliness due to the COVID-19 pandemic in this study, which is a very subjective measure, impacted by recall bias and how the participant might be feeling in the moment versus retrospectively. Fourth, we were limited in our ability to provide an in-depth assessment of eating habits regarding the number of fruit/vegetable servings per day or types of soft drink/snack consumption as these were not asked in the data collection questionnaire. Fifth, we assessed MVPA, ST, and sleep in terms of quantity and the quality of these measures was not assessed. Sixth, even though we have a large sample size in this study, it is not nationally representative thus impacting generalizability of the study findings. Finally, the psychometric properties of some questions are unknown (e.g., loneliness levels due to COVID-19, breakfast measure, sleep duration).

4.4. Implications and future research

While skipping breakfast is a common phenomenon amongst adolescents, no studies examined the association with increased loneliness. Findings from this study show for the first time that self-perceived increased loneliness in adolescents due to the COVID-19 pandemic was associated with breakfast skipping, higher fast-food consumption, and increased likelihood of not meeting ST and sleep duration guidelines. Increasing awareness of these study findings amongst public health practitioners, policy makers, physicians, schools, parents and adolescents themselves is necessary which may help with the uptake of healthy lifestyle habits. School-based prevention strategies aimed at promoting better eating habits, increasing adherence to the 24-hour movement guidelines

and reducing feelings of loneliness are required to build healthier lifestyles amongst the adolescent population.

Despite the limitations of our study, the findings from this study warrant further research. Studies are needed to better inform mechanisms through which loneliness in adolescence can lead to the establishment of unhealthy eating habits. Another area of research includes exploring associations between loneliness and the type of physical activity/screen-based activities/sleep quality amongst adolescents and not just quantity (as assessed in this study). The duration of loneliness and its correlation with other mental health issues may yield different findings with eating habits and movement behaviours in adolescents. This area of research would also benefit from understanding how associations differ between those who seek help versus those who do not. Future longitudinal studies in adolescents with gender-stratified results and objective measures are needed to build on these initial cross-sectional findings to provide more insight on directionality and determine whether gender identity impacts risk. Efforts to reduce loneliness and interventions to establish healthy lifestyle behaviours during adolescence are critical to preventing detrimental mental and physical health consequences across the lifespan.

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APPENDIX 1. Ethics Approval Certificate

04/05/2023

Université d'Ottawa

Bureau d'éthique et d'intégrité de la recherche

University of Ottawa

Office of Research Ethics and Integrity

CERTIFICAT D'APPROBATION ÉTHIQUE | CERTIFICATE OF ETHICS APPROVAL

Numéro du dossier / Ethics File Number

H-03-23-9133

Titre du projet / Project Title

Loneliness and its association with eating habits and 24-hour movement behaviours in a sample of Canadian adolescents

Type de projet / Project Type

Thèse de maîtrise / Master's thesis

Statut du projet / Project Status

Approuvé / Approved

Date d'approbation (jj/mm/aaaa) / Approval Date (dd/mm/yyyy)

04/05/2023

Date d'expiration (jj/mm/aaaa) / Expiry Date (dd/mm/yyyy)

03/05/2024

Équipe de recherche / Research Team

Chercheur / Researcher	Affiliation	Role
Saniya TANDON	Département d'épidémiologie et santé publique / Department of Epidemiology and Public Health	Chercheur Principal / Principal Investigator
Jean-Philippe CHAPUT	Département de pédiatrie / Department of Pediatrics	Superviseur / Supervisor
Karen PATTE	Brock University	Collaborateur / Collaborator
Gary GOLDFIELD	CHEO Research Institute	Collaborateur / Collaborator
SCOTT LEATHERDALE	UW	Chercheur principal - site d'examen primaire / Primary review site PI

Conditions spéciales ou commentaires / Special conditions or comments

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APPENDIX 2. COMPASS questionnaire

COMPASS 2020-21 Student Questionnaire



This is **NOT** a test. All of your answers are **anonymous** and your identity will be kept **confidential**. No one, not even your parents or teachers, will ever know what you answered. So, please be honest when you answer the questions.

Mark only **one option per question** unless the instructions tell you to do something else.

Choose the option that is the **closest** to what you think/feel is true for you. If you do not understand a question, or if you feel uncomfortable answering it, just leave it blank.

Note: The first five questions are **only used to link data** from one year to the next. They cannot be used to identify participants. Only University of Waterloo researchers have access to the responses, and they never have access to student names or other information. All responses are strictly anonymous.

Information collected during this survey is stored on a secure server at the University of Waterloo. Please note that when information is transmitted over the internet there remains a possibility of a third party gaining access to that information. That said, **because the survey does not ask for any identifying information (e.g. name), any information you provide will be anonymous.**

<p>QA. What is the first letter of your middle name? (If you have more than one middle name, use your first middle name; if you do not have a middle name, select the letter "Z"):</p>	<p>QB. In which month were you born: _____</p>	<p>QC. What is the last letter of your full last name: _____</p>	<p>QD. What is the second letter of your full first name: _____</p>	<p>QE. What is the first initial of your mother's first name? (Think about the mother you see the most.): _____</p>																																																																																																																																																																																																																																																												
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0. Did you attend this school last year?

- Yes, I attended the same school last year
- I am attending a new virtual school this year
- No, I was at another school last year

About You

1. What grade are you in?

- Grade 9
- Grade 10
- Grade 11
- Grade 12

2. What form of curriculum delivery are you currently participating in?

- 100% in-person (I physically go in to school every day)
- 100% online (I attend school remotely over the internet every day)
- Alternating in-person and online (Some days I go in to school, some days I attend online)

3. How old are you today?

- 12 years or younger
- 13 years
- 14 years
- 15 years
- 16 years
- 17 years
- 18 years
- 19 years or older

4. Are you female or male?

- Female
- Male
- I describe my gender in a different way
- I prefer not to say

5. How would you describe yourself? (Mark all that apply)

- Asian
- Black
- First Nations (status or non-status), Métis, Inuit
- Latin American/Hispanic
- White
- Other

6. About how much money do you usually get each week to spend on yourself or to save?

(Remember to include all money from allowances and jobs like babysitting, delivering papers, etc.)

- Zero
- \$1 to \$5
- \$6 to \$10
- \$11 to \$20
- \$21 to \$40
- \$41 to \$100
- More than \$100
- I do not know how much money I get each week

7. Where do you get money to spend on yourself or to save? *(Mark all that apply)*

- I do not usually get any money to spend on myself or to save
- My parents/guardians give me money (e.g., an allowance)
- I get a pay cheque from a job (working evenings or weekends at a restaurant, store, etc.)
- I get paid cash for occasional work (babysitting, mowing lawns, shovelling snow, etc.)

8. Including you, how many people are currently living at your home?

- One person
- Two people
- Three people
- Four people
- Five people
- Six or more people

9. In your house, do you have your own bedroom?

- Yes
- No

10. Do you sometimes go to bed hungry because there is not enough money to buy food?

- Yes
- No

11. Would you say that you and your family are more or less financially comfortable than the average student in your class?

- More comfortable
- As comfortable
- Less comfortable

Your Height and Weight

12. How tall are you without your shoes on? *(Please enter your height either in feet and inches OR in centimetres)*

- I do not know how tall I am
- I prefer not to say
- My height in feet and inches is... Feet: _____ Inches: _____
- My height in centimetres is... Centimetres: _____

13. How much do you weigh without your shoes on? *(Please enter your weight either in pounds OR in kilograms)*

- I do not know how much I weigh
- I prefer not to say
- My weight in pounds is... Pounds: _____
- My weight in kilograms is... Kilograms: _____

14. How do you describe your weight?

- Very underweight
- Slightly underweight
- About the right weight
- Slightly overweight
- Very overweight

15. Which of the following are you trying to do about your weight?

- Lose weight
- Gain weight
- Stay the same weight
- I am **not** trying to do anything about my weight

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Screen Time and Sleep

16. How much time per day do you usually spend doing the following activities? For example: If you spend about 3 and a half hours watching TV each day, you will need to enter '3' in the hour box and '30' in the minute box.

	Hours												Minutes				
a) Watching/streaming TV shows or movies	0	1	2	3	4	5	6	7	8	9	10	11	12	0	15	30	45
b) Playing video/computer games	0	1	2	3	4	5	6	7	8	9	10	11	12	0	15	30	45
c) Doing homework	0	1	2	3	4	5	6	7	8	9	10	11	12	0	15	30	45
d) Surfing the internet	0	1	2	3	4	5	6	7	8	9	10	11	12	0	15	30	45
e) Texting, messaging, emailing (note: 50 texts = 30 minutes)	0	1	2	3	4	5	6	7	8	9	10	11	12	0	15	30	45

17. During the past week, what time have you usually turned out the light and gone to sleep...
 (Select the time using the drop-down lists for hour, minutes and AM/PM)

	Hours												Minutes				AM/PM		
a) on weekdays?	0	1	2	3	4	5	6	7	8	9	10	11	12	0	15	30	45	AM	PM
b) on weekends?	0	1	2	3	4	5	6	7	8	9	10	11	12	0	15	30	45	AM	PM

18. During the past week, what time have you usually woken up in the morning...
 (Select the time using the drop-down lists for hour, minutes and AM/PM)

	Hours												Minutes				AM/PM		
a) on weekdays?	0	1	2	3	4	5	6	7	8	9	10	11	12	0	15	30	45	AM	PM
b) on weekends?	0	1	2	3	4	5	6	7	8	9	10	11	12	0	15	30	45	AM	PM

19. During the past week, how would you rate your sleep quality overall (how well you sleep)?

- Very good
- Fairly good
- Fairly bad
- Very bad

Physical Activity

HARD physical activities include jogging, team sports, fast dancing, jump-rope, and any other physical activities that increase your heart rate and make you breathe hard and sweat.

MODERATE physical activities include lower intensity activities such as walking, biking to school, and recreational swimming.

20. Mark how many minutes of HARD physical activity you did on each of the last 7 days. This includes physical activity during physical education class, lunch, after school, evenings, and spare time.

For example: If you did 45 minutes of hard physical activity on Monday, you will need to select the 0 hour option and the 45 minute option in the drop-down boxes next to Monday.

	Hours					Minutes			
Monday	0	1	2	3	4	0	15	30	45
Tuesday	0	1	2	3	4	0	15	30	45
Wednesday	0	1	2	3	4	0	15	30	45
Thursday	0	1	2	3	4	0	15	30	45
Friday	0	1	2	3	4	0	15	30	45
Saturday	0	1	2	3	4	0	15	30	45
Sunday	0	1	2	3	4	0	15	30	45

21. Mark how many minutes of MODERATE physical activity you did on each of the last 7 days. This includes physical activity during physical education class, lunch, after school, evenings, and spare time. Do not include time spent doing hard physical activities.

For example: If you did 1 hour and 30 minutes of moderate physical activity on Monday, you will need to select the 1 hour option and the 30 minute option in the drop-down boxes next to Monday.

	Hours					Minutes			
Monday	0	1	2	3	4	0	15	30	45
Tuesday	0	1	2	3	4	0	15	30	45
Wednesday	0	1	2	3	4	0	15	30	45
Thursday	0	1	2	3	4	0	15	30	45
Friday	0	1	2	3	4	0	15	30	45
Saturday	0	1	2	3	4	0	15	30	45
Sunday	0	1	2	3	4	0	15	30	45

22. On how many days in the last 7 days did you do exercises to strengthen or tone your muscles? (e.g., push-ups, sit-ups, or weight-training)

- 0 days
- 1 day
- 2 days
- 3 days
- 4 days
- 5 days
- 6 days
- 7 days

23. Do you participate in before-school, noon hour, or after-school physical activities organized by your school? (e.g., intramurals, non-competitive clubs)

- Yes
- No
- None offered at my school

24. Do you participate in competitive sports teams that compete against other schools? (e.g., junior varsity or varsity sports)

- Yes
- No
- None offered at my school

25. Do you participate in league or team sports outside of school?

- Yes
- No
- There are none available where I live

Healthy Eating

26. If you do not eat breakfast every day, why do you skip breakfast? (Mark all that apply)

- I eat breakfast every day
- I don't have time for breakfast
- The bus comes too early
- I sleep in
- I'm not hungry in the morning
- I feel sick when I eat breakfast
- I'm trying to lose weight
- There is nothing to eat at home
- Other

27. During the past week, on which days did you do the following? (Mark all that apply)

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
a) Eat food purchased at a fast food place or restaurant	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) Eat snacks purchased from a vending machine, corner store, snack bar, or canteen	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) Restrict/alter your food intake with the intention of changing your weight/shape	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) Drink water (plain)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e) Eat fruit (fresh, canned, dried, or frozen)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f) Eat vegetables (raw or cooked, fresh, canned, or frozen)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Your Experience with Smoking and Vaping

28. Have you ever tried cigarette smoking, even just a few puffs?

- Yes
- No

29. If one of your best friends was to offer you a cigarette, would you smoke it?

- Definitely yes
- Probably yes
- Probably not
- Definitely not

30. At any time during the next year do you think you will smoke a cigarette?

- Definitely yes
- Probably yes
- Probably not
- Definitely not

31. Do you think in the future you might try smoking cigarettes?

- Definitely yes
- Probably yes
- Probably not
- Definitely not

32. On how many of the last 30 days did you smoke one or more cigarettes?

- None
- 1 day
- 2 to 3 days
- 4 to 5 days
- 6 to 10 days
- 11 to 20 days
- 21 to 29 days
- 30 days (every day)

33. Have you ever tried to quit smoking cigarettes?

- I have never smoked
- I have only smoked a few times
- I have never tried to quit
- I have tried to quit once
- I have tried to quit 2 or more times

Vapes (or vaporizers) are devices that produce vapour instead of smoke. They are sometimes called “**e-cigarettes**”, “**e-cigs**”, or “**vape pens**”. Vapes can have pods or tanks and can look like USB drives or pens. *Some examples of vapes are JUUL, Vype, Suorin, and Smok*

34. Have you ever tried a vape, also known as an e-cigarette? (e.g., JUUL, Vype, Suorin, Smok)

- Yes
- No

35. Have you used a vape for any of the following reasons? (Mark all that apply)

- I have not used a vape
- Curiosity / to try something new
- It's cool / a lot of people I know use them
- I can vape in places where smoking is not allowed
- To help me quit smoking cigarettes
- To relax or relieve stress and anxiety
- For the nicotine high
- I really like the flavours
- I have vaped for some other reason

36. On how many of the last 30 days did you use a vape?

- None
- 1 day
- 2 to 3 days
- 4 to 5 days
- 6 to 10 days
- 11 to 20 days
- 21 to 29 days
- 30 days (every day)

37. Where do you *usually* get vapes (including pods, e-juice, or e-liquid)? (Choose only one)

- I buy them from a vape shop myself
- I buy them from a convenience store myself
- I buy them from another type of store myself
- I buy them on the Internet (including apps)
- I ask someone to buy them for me
- A family member gives them to me
- A friend gives them to me
- Someone else gives them to me
- I use someone's vape without their permission
- Other

38. When you vape, how often do you share the device with someone else or use someone else's vape?

- Never
- Rarely
- Sometimes
- Most of the time
- Always

39. In the last 30 days, did you use any of the following? (Mark all that apply)

- Cigarillos or little cigars (*plain or flavoured*)
- Cigars (not including cigarillos or little cigars, *plain or flavoured*)
- Loose tobacco mixed with marijuana
- Heated tobacco product (a device that heats tobacco instead of burning it, such as IQOS or Heatstick)
- Smokeless tobacco (chewing tobacco, pinch, snuff, or snus)
- Nicotine patches, nicotine gum, nicotine lozenges, or nicotine inhalers
- I have not used any of these things in the last 30 days

Alcohol and Drug Use

A DRINK means: 1 regular sized bottle, can, or draft of beer; 1 glass of wine; 1 bottle of cooler; 1 shot of liquor (rum, whisky, etc); or 1 mixed drink (1 shot of liquor with pop, juice, energy drink).
Please remember that we will keep your answers completely confidential.

40. In the last 12 months, how often did you have a drink of alcohol that was more than just a sip?

- I have never drunk alcohol
- I did not drink alcohol in the last 12 months
- I have only had a sip of alcohol
- Less than once a month
- Once a month
- 2 or 3 times a month
- Once a week
- 2 or 3 times a week
- 4 to 6 times a week
- Every day

41. How old were you when you first had a drink of alcohol that was more than just a sip?

- I have never drunk alcohol
- I have only had a sip of alcohol
- I do not know
- 8 years or younger
- 9 years
- 10 years
- 11 years
- 12 years
- 13 years
- 14 years
- 15 years
- 16 years
- 17 years
- 18 years or older

42. In the last 12 months, how often did you have 5 drinks of alcohol or more on one occasion?

- I have never done this
- I did not have 5 or more drinks on one occasion in the last 12 months
- Less than once a month
- Once a month
- 2 to 3 times a month
- Once a week
- 2 to 5 times a week
- Daily or almost daily

43. In the last 12 months, how often did you use marijuana or cannabis? (*a joint, pot, weed, hash*)

- I have never used marijuana
- I have used marijuana but not in the last 12 months
- Less than once a month
- Once a month
- 2 or 3 times a month
- Once a week
- 2 or 3 times a week
- 4 to 6 times a week
- Every day

44. If you have used marijuana or cannabis in the last 12 months, how did you use it? (Mark all that apply)

- I have used it by smoking it (e.g., in a joint, a pipe, a bong)
- I have used it by vaping it
- I have used it by eating or drinking it (e.g., in brownies, cookies, candies, tea)
- I have not used marijuana or cannabis in the last 12 months

45. How old were you when you first used marijuana or cannabis?

- I have never used marijuana
- I do not know
- 8 years or younger
- 9 years
- 10 years
- 11 years
- 12 years
- 13 years
- 14 years
- 15 years
- 16 years
- 17 years
- 18 years or older

46. Do you think it would be difficult or easy for you to get marijuana if you wanted some?

- Difficult
- Easy
- I do not know

47. In the last 30 days, how many times have you done the following?

	Never	Once	Twice	3 or more times	I do not know
a) Rode in/on a vehicle when the driver (you or someone else) had been drinking alcohol	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) Rode in/on a vehicle when the driver (you or someone else) had been using marijuana or cannabis	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) Drank alcohol when you were all by yourself	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) Used marijuana or cannabis when you were all by yourself	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

48. Have you used or tried any of the following medications TO GET HIGH?

	NO, I have never done this	YES, I have done this in the last 12 months	YES, I have done this but NOT in the last 12 months
a) Oxycodone (oxy, OC, APO, OxyContin®, percs, roxies, OxyNEO®)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) Fentanyl (china white, synthetic heroin, china girl)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) Other prescription pain relievers (codeine, morphine, Tylenol 3)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

49. Do you think it would be difficult or easy to get pain relievers (Oxycodone, Fentanyl, codeine, etc.) if you wanted some?

- Difficult
- Easy
- I do not know

50. For each of the following behaviours, please indicate the extent to which you believe an individual would be exposed to risks to his or her physical or other health:

	No Risk	Low Risk	Medium Risk	High Risk	I do not know
a) S/he has tried e-cigarettes a few times	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) S/he smokes e-cigarettes regularly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) S/he has tried cannabis (marijuana, hashish) a few times	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) S/he smokes cannabis (marijuana, hashish) regularly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Mental Health

51. How much do you agree or disagree with the following statements?

	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
a) I have a happy home life	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) My parents/guardians expect too much of me	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) I can talk about my problems with my family	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) I can talk about my problems with my friends	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

52. How much do you agree or disagree with the following statements?

	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
a) I lead a purposeful and meaningful life	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) My social relationships are supportive and rewarding	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) I am engaged and interested in my daily activities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) I actively contribute to the happiness and well-being of others	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e) I am competent and capable in the activities that are important to me	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f) I am a good person and live a good life	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g) I am optimistic about my future	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h) People respect me	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i) I generally recover from setbacks quickly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

53. Choose the answer that best describes how you feel.

	True	Mostly true	Sometimes true, sometimes false	Mostly false	False
a) In general, I like the way I am	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) Overall, I have a lot to be proud of	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) A lot of things about me are good	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) When I do something, I do it well	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e) I like the way I look	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

54. Over the last 2 weeks, how often have you been bothered by the following problems?

	Not at all	Several days	Over half the days	Nearly every day
a) Feeling nervous, anxious, or on edge	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) Not being able to stop or control worrying	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) Worrying too much about different things	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) Trouble relaxing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e) Being so restless that it is hard to sit still	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f) Becoming easily annoyed or irritable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g) Feeling afraid as if something awful might happen	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

55. Please indicate how often the following statements apply to you:

	Almost Never	Sometimes	About half the time	Most of the time	Almost always
a) I have difficulty making sense out of my feelings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) I pay attention to how I feel	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) When I'm upset, I have difficulty concentrating	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) When I'm upset, I believe there is nothing I can do to make myself feel better	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e) When I'm upset, I lose control over my behaviour	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f) When I'm upset, I feel ashamed for feeling that way	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

56. On how many of the last 7 days did you feel the following ways?

	None or less than 1 day	1 to 2 days	3 to 4 days	5 to 7 days
a) I was bothered by things that usually don't bother me	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) I had trouble keeping my mind on what I was doing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) I felt depressed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) I felt that everything I did was an effort	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e) I felt hopeful about the future	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f) I felt fearful	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g) My sleep was restless	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h) I was happy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i) I felt lonely	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
j) I could not get "going"	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

57. In general, how would you rate your mental health?

- Excellent
- Very good
- Good
- Fair
- Poor

Note. If you are a young person in Canada who needs support, you can reach out to Kids Help Phone's professional counsellors by calling 1-800-668-6868 or visiting kidshelpphone.ca. Their service is free, anonymous, confidential, and available 24/7/365.

Kids Help Phone 

1-800-668-6868

Your School and You

58. How strongly do you agree or disagree with each of the following statements?

	Strongly Agree	Agree	Disagree	Strongly Disagree
a) I feel close to people at my school.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) I feel I am part of my school.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) I am happy to be at my school.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) I feel the teachers at my school treat me fairly.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e) I feel safe in my school.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f) Getting good grades is important to me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

The following question is about bullying. **Bullying** can take many forms and usually involves intimidating, threatening, or otherwise hurtful behaviour. Bullying includes any sort of harassment related to sexual orientation, gender identity, gender expression, or sexual harassment.

59. In the last 30 days, in what ways were you bullied by other students? (Mark all that apply)

- I have not been bullied in the last 30 days
- Physical attacks (e.g., getting beaten up, pushed, or kicked)
- Verbal attacks (e.g., getting teased, threatened, or having rumours spread about you)
- Cyber-attacks (e.g., being sent mean text messages or having rumours spread about you on the internet)
- Social bullying (e.g., being purposefully excluded from a group, being humiliated by others with gestures or graffiti)
- Had someone steal from you or damage your things

60. On average, what marks do you usually get in school? (Choose only one)

- 90% - 100% (Mostly A+)
- 80% - 89% (Mostly As or A-)
- 70% - 79% (Mostly Bs)
- 60% - 69% (Mostly Cs)
- 50% - 59% (Mostly Ds)
- Below 50% (Mostly Fs)

61. What is the highest level of education you would like to get? (Choose only one)

- Some high school or less
- High school diploma or graduation equivalency
- College/trade/vocational certificate
- University Bachelor's degree
- University Master's / PhD / law school / medical school / teachers' college degree
- I don't know

The COVID-19 Pandemic

The following questions deal with the COVID-19 pandemic. **COVID-19** is the infectious disease that is currently active in Canada and globally and is the reason why governments in Canada have introduced policies designed to protect the health of the population (e.g., promoting social/physical distancing, wearing a mask, banning large gatherings, telling people to stay home, etc.). **We are interested to know how you feel about this situation and what effects it is having on your daily life.**

62. How would you describe your current level of concern regarding COVID-19?

- Not at all concerned
- Somewhat concerned
- Very concerned

63. How true are the following statements about COVID-19 for you right now?

	True	Mostly True	Neutral / I don't know	Mostly False	False
a) I am nervous when I think about current circumstances	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) I am calm and relaxed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) I am worried about my health	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) I am worried about the health of my family members	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e) I feel stressed about leaving my house	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f) I am getting along well with my family	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g) I don't like having to stay home	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h) I am worried about getting behind in school work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i) I am upset about missing events/activities (sports, concerts, parties)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
j) I am worried about my family being able to pay bills and expenses	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
k) I am concerned about the future	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
l) I think that COVID-19 represents very little risk to young people	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
m) I am supportive of wearing a mask in indoor public spaces	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

64. How seriously are you taking the new rules laid out by governments to reduce the spread of COVID-19?

- I take them very seriously (e.g. I wear a mask where I am supposed to, I do not go within 2 metres of people)
- I take them somewhat seriously (e.g. I sometimes wear a mask, I sometimes stay a full 2 metres away from people)
- I do not take them seriously (e.g. I don't wear a mask, I do not worry about staying 2 meters away from people)

65. How has your life changed because of COVID-19?

	Increased	Stayed the same / Not applicable	Decreased
My stress has...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
My boredom has...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
My loneliness has...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
My anxiety has...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Time spent with my friends in person has...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Time spent communicating with my friends online has...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Time spent watching TV/movies or playing video games has...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
My time spent surfing/posting on social media has...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
My consumption of salty snack (e.g., chips) and sweet foods (e.g., candy, ice cream, cake) has...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
My physical activity has...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
My sleep has...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
My cigarette use has...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
My vaping has...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
My alcohol use has...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
My cannabis use has...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

66. Where have you been getting information/news about COVID-19? (Mark all that apply)

- News sources (TV news, news websites, newspapers)
- Social media (Twitter, Facebook, etc.)
- My school (teachers, principals, school staff)
- My parent(s)/guardian(s)
- My friends
- Government or Public Health websites
- I have been trying to limit my exposure to news about COVID-19

67. How have you been coping with changes related to COVID-19? (Mark all that apply)

- Staying connected with friends online
- Meeting up with my friends outside
- Getting exercise (e.g., getting outside to go for a walk or bike ride, working out at home)
- Keeping to a regular schedule (e.g., waking up, eating meals, and going to bed around the same time as usual)
- Spending time with my family (e.g., playing games, eating meals together, hanging out)
- Spending time with my dog/cat or other pet
- Spending time alone
- Studying or working on school work
- Reading, writing, playing music, or working on arts and crafts
- Playing video games, watching TV or movies, surfing the internet/social media
- Learning something new (painting, playing a musical instrument, a new language)
- Connecting with mental health professionals
- Eating junk food
- Cooking/baking
- Trying to help others
- Meditating or praying
- Using cannabis/marijuana
- Drinking alcohol
- Smoking cigarettes
- Vaping

68. Please indicate which of the following statements about COVID-19 you think are true. (Mark all that apply)

- Hand washing for at least 20 seconds (with soap and water) helps prevent the transmission of COVID-19
- The use of hand sanitizer (e.g., Purell) helps prevent the transmission of COVID-19.
- When a person coughs, the use of a mask can reduce the droplet transmission of COVID-19.
- COVID-19 is only found in individuals who show symptoms and signs of disease.
- COVID-19 is only dangerous for the elderly population.

69. Since the beginning of the COVID-19 pandemic, have you done the following?

	Always	Sometimes	Never
a) I cancelled or postponed meetings with friends, eating-out, and sports events	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) I clean and disinfect items that can be easily touched with hands (i.e. door handles and surfaces)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) I washed my hands more often	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) I avoided coughing around people	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e) I discussed measures to prevent infection with family, friends and/or health care professionals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f) I discussed what to do in case of infection, with family, friends or health care providers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g) I avoided places with a large number of people gathered (public spaces, grocery stores, etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

70. How supportive are you of the safety precautions your school has taken to protect against COVID-19?

	Supportive	Neutral	Unsupportive	My school does not do this
a) Requiring students to wear masks	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) Separating students into cohorts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) Limiting interactions with classmates	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) Increasing availability of cleaning products like hand sanitizer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e) Changes to school sports activities (intramurals, varsity sports)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

71. How strongly do you agree or disagree with the following statements?

	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly Disagree
a) If a vaccine against COVID-19 was offered to me, I would take it	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) It is important for everyone to get the COVID-19 vaccine	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) I believe that, in general, vaccines are safe	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) I believe that, in general, vaccines are effective	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

APPENDIX 3. Coding of variables

Variables	Code
<i>Independent Variable</i>	
Loneliness levels	
Increased loneliness	1
Decreased/stayed the same loneliness (reference category)	0
<i>Dependent Variables</i>	
Eating habits	
<i>Fruit intake</i>	
0 days	3
1 or 2 days	2
3 or 4 days	1
≥5 days (reference category)	0
<i>Vegetable intake</i>	
0 days	3
1 or 2 days	2
3 or 4 days	1
≥5 days (reference category)	0
<i>Fast food intake</i>	
0 days (reference category)	3
1 or 2 days	2
≥3 days	1
<i>Snack intake</i>	
0 days (reference category)	3
1 or 2 days	2
≥3 days	1
24-hour movement guidelines	
<i>Meets screen time guidelines (≤2 hours per day)</i>	
Yes (reference category)	0
No	1
<i>Meets sleep duration guidelines (≥8 hours/night)</i>	
Yes (reference category)	1
No	0
<i>Moderate-to-vigorous activity guidelines (≥60 hours per day)</i>	
Yes (reference category)	1
No	0

Covariates	
<i>Ethnicity</i>	
Whites (reference category)	1
Non-Whites	0
Unknown category	2
<i>SES category</i>	
≥7 (reference category)	1
<7	0
Unknown category	2
<i>Body weight category</i>	
Underweight/Normal weight (reference category)	1
Overweight/Obese	2
Unknown category	3
<i>Province</i>	
Quebec (reference category)	1
Ontario	2
British Columbia	3
Alberta	4
<i>Learning situation</i>	
In-person (reference category)	1
Online	2
Hybrid	3
Unknown category	4
<i>Gender</i>	
Girl	1
Boy	0
Unknown category	2

APPENDIX 4. Logistic regression model results for various covariates

Table 1. Logistic regression model results for adolescents with increased loneliness (versus decreased/stayed the same loneliness) due to COVID-19 with covariates for breakfast skipping

Covariates	Boys (n=19,735) OR (95% CI)	Girls (n=23,840) OR (95% CI)
Loneliness increased versus decreased/stayed the same		
Age, years		
12	1.73 (1.49, 2.00)	2.14 (1.87, 2.46)
12-13	1.70 (1.52, 1.90)	2.01 (1.81, 2.23)
13-14	1.67 (1.53, 1.81)	1.88 (1.74, 2.03)
14-15	1.63 (1.54, 1.74)	1.76 (1.66, 1.86)
15-16	1.61 (1.51, 1.71)	1.65 (1.55, 1.75)
16-17	1.58 (1.45, 1.72)	1.54 (1.43, 1.66)
17-18	1.55 (1.38, 1.74)	1.44 (1.30, 1.60)
18-19	1.52 (1.31, 1.77)	1.35 (1.18, 1.55)
SES category		
High SES	1.00 (reference)	1.00 (reference)
Low SES	1.42 (1.26, 1.61)	1.61 (1.44, 1.80)
Ethnicity		
White	1.00 (reference)	1.00 (reference)
BIPOC	1.43 (1.27, 1.61)	1.59 (1.43, 1.78)
Province		
Quebec	1.00 (reference)	1.00 (reference)
Ontario	1.52 (1.36, 1.71)	1.56 (1.40, 1.74)
British Columbia	1.29 (1.06, 1.57)	1.57 (1.32, 1.86)
Alberta	1.19 (0.92, 1.56)	1.38 (1.05, 1.81)
Learning situation		
In-person	1.00 (reference)	1.00 (reference)
Online	1.45 (1.33, 1.59)	1.53 (1.42, 1.66)
Hybrid	1.30 (1.15, 1.47)	1.70 (1.51, 1.91)
Body weight category		
Underweight/Normal weight	1.00 (reference)	1.00 (reference)
Overweight/Obesity	1.41 (1.21, 1.64)	1.51 (1.26, 1.82)

Abbreviations: OR – Odds Ratio; CI – Confidence Intervals, SES – Socioeconomic status, BIPOC – black indigenous and other people of colour

Note: For age, odds ratios are estimated and presented for every change in age in years. For missing data coded as an unknown category, the odds ratio is not added in the tables.

Table 2: Logistic regression model results with increased loneliness (versus decreased/stayed the same loneliness) due to COVID-19 with covariates for fast food intake (1 or 2 days compared to the reference category (0 days) in the past week)

		Boys (n=19,735) OR (95% CI)	Girls (n=23,840) OR (95% CI)
	<i>Covariates</i>	<i>Loneliness increased versus decreased/stayed the same</i>	
Fast food intake [1-2 days compared to the reference category (0 days) in the past week]	Age, years		
	12	1.21 (0.95, 1.55)	1.15 (0.89, 1.48)
	12-13	1.62 (1.31, 2.00)	1.58 (1.25, 1.99)
	13-14	1.60 (1.36, 1.88)	1.69 (1.42, 2.01)
	14-15	1.57 (1.40, 1.77)	1.81 (1.59, 2.05)
	15-16	1.55 (1.40, 1.72)	1.93 (1.74, 2.15)
	16-17	1.53 (1.35, 1.74)	2.07 (1.82, 2.35)
	17-18	1.51 (1.26, 1.80)	2.22 (1.86, 2.63)
	18-19	1.49 (1.18, 1.88)	2.37 (1.88, 2.99)
	SES category		
	High SES	1.00 (reference)	1.00 (reference)
	Low SES	1.01 (0.81, 1.26)	1.35 (1.09, 1.66)
	Ethnicity		
	White	1.00 (reference)	1.00 (reference)
	BIPOC	1.22 (1.02, 1.47)	1.31 (1.09, 1.56)
	Province		
	Quebec	1.00 (reference)	1.00 (reference)
	Ontario	1.23 (1.03, 1.47)	1.47 (1.23, 1.76)
	British Columbia	1.37 (1.04, 1.82)	1.76 (1.35, 2.29)
	Alberta	1.03 (0.72, 1.49)	1.09 (0.75, 1.58)
	Learning situation		
In-person	1.00 (reference)	1.00 (reference)	
Online	1.25 (1.05, 1.49)	1.31 (1.10, 1.56)	
Hybrid	0.99 (0.81, 1.22)	1.31 (1.06, 1.61)	
Body weight category			
Underweight/Normal weight	1.00 (reference)	1.00 (reference)	
Overweight/Obesity	1.36 (1.06, 1.74)	1.37 (0.99, 1.89)	

Abbreviations: OR – Odds Ratio; CI – Confidence Intervals, SES – Socioeconomic status, BIPOC – black indigenous and other people of colour

Note: For age, odds ratios are estimated and presented for every change in age in years. For missing data coded as an unknown category, the odds ratio is not added in the tables.

Table 3. Logistic regression model results with increased loneliness (versus decreased/stayed the same loneliness) due to COVID-19 with covariates for fast food intake (≥ 3 days compared to the reference category (0 days) in the past week)

		Boys (n=19,735) OR (95% CI)	Girls (n=23,840) OR (95% CI)
	<i>Covariates</i>	<i>Loneliness increased versus decreased/stayed the same</i>	
Fast food intake ≥ 3 days compared to the reference category (0 days) in the past week]	Age, years		
	12	1.02 (0.89, 1.16)	1.00 (0.86, 1.12)
	12-13	1.05 (0.94, 1.17)	1.05 (0.96, 1.17)
	13-14	1.06 (0.98, 1.15)	1.10 (1.02, 1.19)
	14-15	1.08 (1.01, 1.15)	1.16 (1.09, 1.23)
	15-16	1.09 (1.02, 1.17)	1.22 (1.14, 1.29)
	16-17	1.10 (1.01, 1.21)	1.28 (1.18, 1.39)
	17-18	1.12 (0.99, 1.27)	1.34 (1.20, 1.50)
	18-19	1.13 (0.96, 1.34)	1.40 (1.21, 1.63)
	SES category		
	High SES	1.00 (reference)	1.00 (reference)
	Low SES	1.09 (0.97, 1.24)	1.06 (0.94, 1.19)
	Ethnicity		
	White	1.00 (reference)	1.00 (reference)
	BIPOC	0.94 (0.83, 1.08)	1.17 (1.04, 1.32)
	Province		
	Quebec	1.00 (reference)	1.00 (reference)
	Ontario	1.14 (1.00, 1.29)	1.23 (1.09, 1.34)
	British Columbia	0.99 (0.80, 1.24)	1.13 (0.93, 1.38)
	Alberta	0.86 (0.63, 1.18)	1.08 (0.79, 1.47)
	Learning situation		
In-person	1.00 (reference)	1.00 (reference)	
Online	1.07 (0.98, 1.17)	1.17 (1.08, 1.27)	
Hybrid	1.16 (1.01, 1.32)	1.07 (0.95, 1.22)	
Body weight category			
Underweight/Normal weight	1.00 (reference)	1.00 (reference)	
Overweight/Obesity	1.04 (0.89, 1.22)	1.25 (1.03, 1.52)	

Abbreviations: OR – Odds Ratio; CI – Confidence Intervals, SES – Socioeconomic status, BIPOC – black indigenous and other people of colour

Note: For age, odds ratios are estimated and presented for every change in age in years. For missing data coded as an unknown category, the odds ratio is not added in the tables.

Table 4. Logistic regression model results with increased loneliness (versus decreased/stayed the same) due to COVID-19 with covariates for snack intake (**1 or 2 days compared to the reference category (0 days) in the past week**)

		Boys (n=19,735) OR (95% CI)	Girls (n=23,840) OR (95% CI)
	<i>Covariates</i>	<i>Loneliness increased versus decreased/stayed the same</i>	
Snack intake [1 or 2 days compared to the reference category (0 days) in the past week]	Age, years		
	12	1.15 (0.89, 1.47)	0.98 (0.78, 1.24)
	12-13	1.20 (0.97, 1.48)	0.91 (0.74, 1.12)
	13-14	1.17 (1.01, 1.37)	0.95 (0.81, 1.10)
	14-15	1.15 (1.02, 1.29)	0.98 (0.87, 1.11)
	15-16	1.13 (1.01, 1.26)	1.02 (0.90, 1.15)
	16-17	1.11 (0.96, 1.29)	1.05 (0.89, 1.24)
	17-18	1.09 (0.88, 1.33)	1.09 (0.88, 1.36)
	18-19	1.07 (0.82, 1.39)	1.14 (0.86, 1.51)
	SES category		
	High SES	1.00 (reference)	1.00 (reference)
	Low SES	1.12 (0.87, 1.39)	1.07 (0.85, 1.35)
	Ethnicity		
	White	1.00 (reference)	1.00 (reference)
	BIPOC	1.16 (0.95, 1.40)	0.87 (0.72, 1.06)
	Province		
	Quebec	1.00 (reference)	1.00 (reference)
	Ontario	1.09 (0.91, 1.36)	1.13 (0.91, 1.39)
	British Columbia	1.25 (0.86, 1.42)	1.17 (0.87, 1.58)
	Alberta	0.93 (0.62, 1.39)	0.95 (0.62, 1.47)
Learning situation			
In-person	1.00 (reference)	1.00 (reference)	
Online	1.24 (1.02, 1.51)	1.12 (0.92, 1.36)	
Hybrid	0.78 (0.62, 0.98)	0.94 (0.74, 1.21)	
Body weight category			
Underweight/Normal weight	1.00 (reference)	1.00 (reference)	
Overweight/Obesity	0.95 (0.71, 1.26)	1.09 (0.74, 1.60)	

Abbreviations: OR – Odds Ratio; CI – Confidence Intervals, SES – Socioeconomic status, BIPOC – black indigenous and other people of colour

Note: For age, odds ratios are estimated and presented for every change in age in years. For missing data coded as an unknown category, the odds ratio is not added in the tables.

Table 5: Logistic regression model results with increased loneliness (versus decreased/stayed the same) due to COVID-19 with covariates for snack intake (≥ 3 days compared to the reference category (0 days) in the past week)

		Boys (n=19,735) OR (95% CI)	Girls (n=23,840) OR (95% CI)
	<i>Covariates</i>	<i>Loneliness increased versus decreased/stayed the same</i>	
Snack intake ≥ 3 days compared to the reference category (0 days) in the past week]	Age, years		
	12	0.99 (0.85, 1.15)	1.12 (0.98, 1.28)
	12-13	0.94 (0.97, 1.48)	1.05 (0.93, 1.18)
	13-14	0.92 (0.84, 1.01)	1.03 (0.94, 1.13)
	14-15	0.90 (0.84, 0.97)	1.01 (0.94, 1.08)
	15-16	0.89 (0.82, 0.96)	0.99 (0.92, 1.06)
	16-17	0.87 (0.78, 0.97)	0.97 (0.88, 1.06)
	17-18	0.85 (0.74, 0.99)	0.95 (0.83, 1.07)
	18-19	0.84 (0.70, 1.01)	0.93 (0.78, 1.09)
	SES category		
	High SES	1.00 (reference)	1.00 (reference)
	Low SES	0.99 (0.86, 1.16)	1.06 (0.93, 1.22)
	Ethnicity		
	White	1.00 (reference)	1.00 (reference)
	BIPOC	0.94 (0.81, 1.09)	0.96 (0.84, 1.09)
	Province		
	Quebec	1.00 (reference)	1.00 (reference)
	Ontario	0.84 (0.73, 0.97)	1.05 (0.92, 1.20)
	British Columbia	1.12 (0.88, 1.42)	1.04 (0.85, 1.26)
	Alberta	0.97 (0.71, 1.33)	1.20 (0.88, 1.64)
Learning situation			
In-person	1.00 (reference)	1.00 (reference)	
Online	0.94 (0.85, 1.05)	1.06 (0.96, 1.17)	
Hybrid	1.02 (0.88, 1.19)	1.08 (0.94, 1.25)	
Body weight category			
Underweight/Normal weight	1.00 (reference)	1.00 (reference)	
Overweight/Obesity	0.86 (0.72, 1.03)	1.13 (0.90, 1.41)	

Abbreviations: OR – Odds Ratio; CI – Confidence Intervals, SES – Socioeconomic status, BIPOC – black indigenous and other people of colour

Note: For age, odds ratios are estimated and presented for every change in age in years. For missing data coded as an unknown category, the odds ratio is not added in the tables.

Table 6. Logistic regression model results with increased loneliness (versus decreased/stayed the same loneliness group) due to COVID-19 with covariates for vegetable intake (**0 days compared to the reference category (≥ 5 days) in the past week**)

		Boys (n=19,735) OR (95% CI)	Girls (n=23,840) OR (95% CI)
	<i>Covariates</i>	<i>Loneliness increased versus decreased/stayed the same</i>	
Vegetable intake [0 days compared to the reference category (≥ 5 days) in the past week]	Age, years		
	12	1.02 (0.85, 1.23)	1.08 (0.92, 1.28)
	12-13	1.05 (0.90, 1.23)	1.09 (0.94, 1.27)
	13-14	1.06 (0.94, 1.18)	1.07 (0.96, 1.20)
	14-15	1.06 (0.97, 1.16)	1.05 (0.97, 1.15)
	15-16	1.06 (0.97, 1.16)	1.04 (0.95, 1.13)
	16-17	1.06 (0.94, 1.20)	1.02 (0.92, 1.14)
	17-18	1.07 (0.90, 1.26)	1.01 (0.87, 1.16)
	18-19	1.07 (0.86, 1.33)	0.99 (0.82, 1.20)
	SES category		
	High SES	1.00 (reference)	1.00 (reference)
	Low SES	0.97 (0.82, 1.16)	1.06 (0.90, 1.23)
	Ethnicity		
	White	1.00 (reference)	1.00 (reference)
	BIPOC	1.05 (0.88, 1.24)	1.06 (0.91, 1.24)
	Province		
	Quebec	1.00 (reference)	1.00 (reference)
	Ontario	0.95 (0.81, 1.11)	1.09 (0.94, 1.26)
	British Columbia	1.11 (0.83, 1.49)	1.53 (1.18, 2.00)
	Alberta	1.14 (0.79, 1.64)	1.23 (0.86, 1.75)
	Learning situation		
	In-person	1.00 (reference)	1.00 (reference)
Online	1.03 (0.91, 1.17)	0.98 (0.88, 1.10)	
Hybrid	1.01 (0.84, 1.20)	0.98 (0.83, 1.15)	
Body weight category			
Underweight/Normal weight	1.00 (reference)	1.00 (reference)	
Overweight/Obesity	1.04 (0.84, 1.29)	1.09 (0.82, 1.44)	

Abbreviations: OR – Odds Ratio; CI – Confidence Intervals, SES – Socioeconomic status, BIPOC – black indigenous and other people of colour

Note: For age, odds ratios are estimated and presented for every change in age in years. For missing data coded as an unknown category, the odds ratio is not added in the tables.

Table 7. Logistic regression model results with increased loneliness (versus decreased/stayed the same loneliness group) due to COVID-19 with covariates for vegetable intake (1-2 days compared to the reference category (≥ 5 days) in the past week)

		Boys (n=19,735) OR (95% CI)	Girls (n=23,840) OR (95% CI)
	<i>Covariates</i>	<i>Loneliness increased versus decreased/stayed the same</i>	
Vegetable intake [1-2 days compared to the reference category (≥ 5 days) in the past week]	Age, years		
	12	0.80 (0.65, 1.00)	1.04 (0.85, 1.27)
	12-13	0.82 (0.68, 0.98)	1.04 (0.87, 1.24)
	13-14	0.81 (0.71, 0.93)	1.02 (0.89, 1.16)
	14-15	0.81 (0.73, 0.89)	0.99 (0.90, 1.10)
	15-16	0.80 (0.71, 0.89)	0.98 (0.88, 1.08)
	16-17	0.80 (0.68, 0.93)	0.96 (0.84, 1.09)
	17-18	0.79 (0.65, 0.97)	0.94 (0.78, 1.12)
	18-19	0.79 (0.60, 1.03)	0.92 (0.73, 1.16)
	SES category		
	High SES	1.00 (reference)	1.00 (reference)
	Low SES	0.72 (0.58, 0.88)	0.99 (0.82, 1.20)
	Ethnicity		
	White	1.00 (reference)	1.00 (reference)
	BIPOC	0.73 (0.60, 0.89)	1.11 (0.93, 1.33)
	Province		
	Quebec	1.00 (reference)	1.00 (reference)
	Ontario	0.80 (0.66, 0.97)	1.01 (0.84, 1.22)
	British Columbia	0.65 (0.43, 1.00)	1.27 (0.92, 1.76)
	Alberta	1.06 (0.68, 1.65)	1.40 (0.90, 2.20)
	Learning situation		
In-person	1.00 (reference)	1.00 (reference)	
Online	0.76 (0.66, 0.88)	0.96 (0.84, 1.11)	
Hybrid	0.82 (0.65, 1.02)	0.99 (0.81, 1.23)	
Body weight category			
Underweight/Normal weight	1.00 (reference)	1.00 (reference)	
Overweight/Obesity	0.71 (0.53, 0.93)	0.98 (0.71, 1.34)	

Abbreviations: OR – Odds Ratio; CI – Confidence Intervals, SES – Socioeconomic status, BIPOC – black indigenous and other people of colour

Note: For age, odds ratios are estimated and presented for every change in age in years. For missing data coded as an unknown category, the odds ratio is not added in the tables.

Table 8. Logistic regression model results with increased loneliness (versus decreased/stayed the same loneliness group) due to COVID-19 with covariates for vegetable intake (3-4 days compared to the reference category (≥ 5 days) in the past week)

		Boys (n=19,735) OR (95% CI)	Girls (n=23,840) OR (95% CI)
	<i>Covariates</i>	<i>Loneliness increased versus decreased/stayed the same</i>	
Vegetable intake [3-4 days compared to the reference category (≥ 5 days) in the past week]	Age, years		
	12	0.95 (0.78, 1.17)	1.03 (0.82, 1.28)
	12-13	1.04 (0.97, 1.24)	1.09 (0.89, 1.34)
	13-14	1.03 (0.91, 1.17)	1.12 (0.96, 1.30)
	14-15	1.02 (0.93, 1.13)	1.15 (1.02, 1.29)
	15-16	1.01 (0.92, 1.12)	1.19 (1.06, 1.33)
	16-17	1.00 (0.88, 1.14)	1.22 (1.06, 1.41)
	17-18	0.99 (0.83, 1.18)	1.25 (1.03, 1.53)
	18-19	0.98 (0.78, 1.24)	1.29 (1.00, 1.66)
	SES category		
	High SES	1.00 (reference)	1.00 (reference)
	Low SES	0.98 (0.80, 1.18)	1.26 (1.02, 1.56)
	Ethnicity		
	White	1.00 (reference)	1.00 (reference)
	BIPOC	1.07 (0.89, 1.28)	1.17 (0.97, 1.41)
	Province		
	Quebec	1.00 (reference)	1.00 (reference)
	Ontario	0.91 (0.77, 1.09)	1.28 (1.05, 1.58)
	British Columbia	1.23 (0.89, 1.70)	1.97 (1.39, 2.78)
	Alberta	1.14 (0.77, 1.68)	0.99 (0.64, 1.54)
	Learning situation		
In-person	1.00 (reference)	1.00 (reference)	
Online	1.01 (0.88, 1.17)	1.04 (0.89, 1.22)	
Hybrid	0.84 (0.68, 1.03)	1.28 (1.01, 1.61)	
Body weight category			
Underweight/Normal weight	1.00 (reference)	1.00 (reference)	
Overweight/Obesity	1.12 (0.89, 1.43)	1.17 (0.81, 1.69)	

Abbreviations: OR – Odds Ratio; CI – Confidence Intervals, SES – Socioeconomic status, BIPOC – black indigenous and other people of colour

Note: For age, odds ratios are estimated and presented for every change in age in years. For missing data coded as an unknown category, the odds ratio is not added in the tables.

Table 9. Logistic regression model results with increased loneliness (versus decreased/stayed the same loneliness) due to COVID-19 with covariates for fruit intake (0 day compared to the reference category (≥ 5 days) in the past week)

		Boys (n=19,735) OR (95% CI)	Girls (n=23,840) OR (95% CI)
	<i>Covariates</i>	<i>Loneliness increased versus decreased/stayed the same</i>	
Fruit intake [0 day compared to the reference category (≥ 5 days) in the past week]	Age, years		
	12	1.14 (0.96, 1.36)	1.09 (0.93, 1.28)
	12-13	1.20 (1.04, 1.40)	1.17 (1.01, 1.35)
	13-14	1.18 (1.06, 1.32)	1.18 (1.06, 1.31)
	14-15	1.17 (1.07, 1.27)	1.18 (1.09, 1.28)
	15-16	1.15 (1.05, 1.26)	1.18 (1.09, 1.28)
	16-17	1.14 (1.01, 1.28)	1.19 (1.07, 1.32)
	17-18	1.12 (0.96, 1.31)	1.19 (1.04, 1.37)
	18-19	1.10 (0.89, 1.35)	1.20 (0.82, 1.26)
	SES category		
	High SES	1.00 (reference)	1.00 (reference)
	Low SES	1.08 (0.92, 1.27)	1.03 (0.89, 1.19)
	Ethnicity		
	White	1.00 (reference)	1.00 (reference)
	BIPOC	1.00 (0.85, 1.18)	1.23 (1.07, 1.43)
	Province		
	Quebec	1.00 (reference)	1.00 (reference)
	Ontario	1.26 (1.08, 1.47)	1.26 (1.10, 1.46)
	British Columbia	0.89 (0.68, 1.16)	1.50 (1.19, 1.89)
	Alberta	1.07 (0.75, 1.51)	1.05 (0.75, 1.47)
	Learning situation		
	In-person	1.00 (reference)	1.00 (reference)
	Online	1.11 (0.99, 1.25)	1.08 (0.97, 1.21)
Hybrid	1.04 (0.88, 1.23)	1.15 (0.98, 1.34)	
Body weight category			
Underweight/Normal weight	1.00 (reference)	1.00 (reference)	
Overweight/Obesity	0.94 (0.77, 1.16)	1.55 (1.20, 2.01)	

Abbreviations: OR – Odds Ratio; CI – Confidence Intervals, SES – Socioeconomic status, BIPOC – black indigenous and other people of colour

Note: For age, odds ratios are estimated and presented for every change in age in years. For missing data coded as an unknown category, the odds ratio is not added in the tables.

Table 10. Logistic regression model results with increased loneliness (versus decreased/stayed the same loneliness) due to COVID-19 with covariates for fruit intake (1-2 days compared to the reference category (≥ 5 days) in the past week)

		Boys (n=19,735) OR (95% CI)	Girls (n=23,840) OR (95% CI)
	<i>Covariates</i>	<i>Loneliness increased versus decreased/stayed the same</i>	
Fruit intake [1-2 days compared to the reference category (≥ 5 days) in the past week]	Age, years		
	12	1.01 (0.82, 1.24)	1.21 (1.00, 1.46)
	12-13	1.08 (0.91, 1.29)	1.25 (1.05, 1.48)
	13-14	1.05 (0.92, 1.20)	1.21 (1.06, 1.37)
	14-15	1.02 (0.93, 1.13)	1.16 (1.06, 1.28)
	15-16	0.99 (0.89, 1.00)	1.13 (1.03, 1.24)
	16-17	0.96 (0.84, 1.11)	1.09 (0.96, 1.88)
	17-18	0.94 (0.78, 1.13)	1.05 (0.89, 1.24)
	18-19	0.91 (0.72, 1.16)	1.02 (0.82, 1.26)
	SES category		
	High SES	1.00 (reference)	1.00 (reference)
	Low SES	0.91 (0.75, 1.09)	1.13 (0.94, 1.34)
	Ethnicity		
	White	1.00 (reference)	1.00 (reference)
	BIPOC	0.89 (0.74, 1.08)	1.13 (0.96, 1.34)
	Province		
	Quebec	1.00 (reference)	1.00 (reference)
	Ontario	0.99 (0.82, 1.19)	1.42 (1.19, 1.70)
	British Columbia	0.88 (0.64, 1.22)	1.15 (0.87, 1.51)
	Alberta	1.21 (0.79, 1.86)	1.35 (0.88, 2.04)
	Learning situation		
In-person	1.00 (reference)	1.00 (reference)	
Online	0.92 (0.80, 1.05)	0.96 (0.84, 1.09)	
Hybrid	0.94 (0.77, 1.15)	1.42 (1.16, 1.72)	
Body weight category			
Underweight/Normal weight	1.00 (reference)	1.00 (reference)	
Overweight/Obesity	0.93 (0.72, 1.19)	1.01 (0.75, 1.36)	

Abbreviations: OR – Odds Ratio; CI – Confidence Intervals, SES – Socioeconomic status, BIPOC – black indigenous and other people of colour

Note: For age, odds ratios are estimated and presented for every change in age in years. For missing data coded as an unknown category, the odds ratio is not added in the tables.

Table 11. Logistic regression model results with increased loneliness (versus decreased/stayed the same loneliness) due to COVID-19 with covariates for fruit intake (3-4 days compared to the reference category (≥ 5 days) in the past week)

		Boys (n=19,735) OR (95% CI)	Girls (n=23,840) OR (95% CI)
	<i>Covariates</i>	<i>Loneliness increased versus decreased/stayed the same</i>	
Fruit intake [3-4 days compared to the reference category (≥ 5 days) in the past week]	Age, years		
	12	0.95 (0.79, 1.16)	0.97 (0.78, 1.20)
	12-13	1.12 (0.95, 1.32)	1.06 (0.88, 1.29)
	13-14	1.12 (0.99, 1.26)	1.09 (0.94, 1.25)
	14-15	1.12 (1.02, 1.22)	1.10 (0.99, 1.24)
	15-16	1.16 (1.02, 1.22)	1.13 (1.02, 1.25)
	16-17	1.11 (0.99, 1.25)	1.15 (1.01, 1.32)
	17-18	1.11 (0.94, 1.31)	1.18 (0.98, 1.41)
	18-19	1.12 (0.89, 1.37)	1.20 (0.95, 1.52)
	SES category		
	High SES	1.00 (reference)	1.00 (reference)
	Low SES	0.99 (0.83, 1.19)	1.15 (0.94, 1.39)
	Ethnicity		
	White	1.00 (reference)	1.00 (reference)
	BIPOC	1.04 (0.88, 1.24)	1.17 (0.97, 1.40)
	Province		
	Quebec	1.00 (reference)	1.00 (reference)
	Ontario	1.05 (0.89, 1.24)	1.16 (0.96, 1.40)
	British Columbia	0.78 (0.58, 1.05)	1.51 (1.12, 2.03)
	Alberta	1.57 (1.08, 2.28)	0.96 (0.65, 1.42)
	Learning situation		
	In-person	1.00 (reference)	1.00 (reference)
	Online	0.97 (0.85, 1.10)	1.07 (0.92, 1.24)
Hybrid	0.91 (0.76, 1.09)	1.06 (0.86, 1.31)	
Body weight category			
Underweight/Normal weight	1.00 (reference)	1.00 (reference)	
Overweight/Obesity	0.99 (0.80, 1.24)	1.06 (0.77, 1.46)	

Abbreviations: OR – Odds Ratio; CI – Confidence Intervals, SES – Socioeconomic status, BIPOC – black indigenous and other people of colour

Note: For age, odds ratios are estimated and presented for every change in age in years. For missing data coded as an unknown category, the odds ratio is not added in the tables.

Table 12. Logistic regression model results for adolescents with increased loneliness (versus decreased/stayed the same loneliness) due to COVID-19 with covariates for moderate-to-vigorous physical activity (MVPA)

Covariates	Boys (n=18,290) OR (95% CI)	Girls (n=22,221) OR (95% CI)
<i>Loneliness increased versus decreased/stayed the same</i>		
Age		
12	1.25 (1.07, 1.46)	1.30 (1.13, 1.50)
12-13	1.23 (1.09, 1.39)	1.29 (1.15, 1.43)
13-14	1.21 (1.11, 1.32)	1.26 (1.16, 1.37)
14-15	1.19 (1.11, 1.27)	1.24 (1.17, 1.32)
15-16	1.17 (1.09, 1.25)	1.22 (1.15, 1.30)
16-17	1.15 (1.05, 1.26)	1.20 (1.11, 1.30)
17-18	1.13 (0.99, 1.28)	1.18 (1.06, 1.31)
18-19	1.11 (0.94, 1.30)	1.16 (1.00, 1.34)
SES category		
High SES	1.00 (reference)	1.00 (reference)
Low SES	1.10 (0.96, 1.25)	1.07 (0.95, 1.20)
Ethnicity		
White	1.00 (reference)	1.00 (reference)
BIPOC	1.04 (0.91, 1.19)	0.96 (0.86, 1.08)
Province		
Quebec	1.00 (reference)	1.00 (reference)
Ontario	1.09 (0.96, 1.23)	0.98 (0.87, 1.10)
British Columbia	0.92 (0.74, 1.15)	0.96 (0.79, 1.15)
Alberta	0.95 (0.70, 1.29)	1.12 (0.84, 1.48)
Learning situation		
In-person	1.00 (reference)	1.00 (reference)
Online	1.12 (1.02, 1.23)	1.05 (0.97, 1.14)
Hybrid	1.04 (0.91, 1.19)	1.15 (1.02, 1.30)
Body weight category		
Underweight/Normal weight	1.00 (reference)	1.00 (reference)
Overweight/Obesity	1.10 (0.93, 1.29)	1.04 (0.86, 1.25)

Abbreviations: OR – Odds Ratio; CI – Confidence Intervals, SES – Socioeconomic status, BIPOC – black indigenous and other people of colour

Note: For age, odds ratios are estimated and presented for every change in age in years. For missing data coded as an unknown category, the odds ratio is not added in the tables.

Table 13. Logistic regression model results for adolescents with increased loneliness (versus decreased/stayed the same loneliness group) due to COVID-19 with covariates for sleep duration

Covariates	Boys (n=18,290) OR (95% CI)	Girls (n=22,221) OR (95% CI)
<i>Loneliness increased versus decreased/stayed the same</i>		
Age		
12	2.43 (1.99, 2.95)	1.96 (1.63, 2.37)
12-13	2.25 (1.93, 2.62)	1.85 (1.59, 2.14)
13-14	2.08 (1.86, 2.34)	1.74 (1.56, 1.93)
14-15	1.93 (1.78, 2.09)	1.63 (1.51, 1.77)
15-16	1.78 (1.65, 1.93)	1.53 (1.43, 1.65)
16-17	1.65 (1.51, 1.82)	1.44 (1.32, 1.57)
17-18	1.53 (1.34, 1.75)	1.35 (1.20, 1.53)
18-19	1.42 (1.19, 1.69)	1.27 (1.08, 1.49)
SES category		
High SES	1.00 (reference)	1.00 (reference)
Low SES	1.42 (1.22, 1.65)	1.48 (1.28, 1.70)
Ethnicity		
White	1.00 (reference)	1.00 (reference)
BIPOC	1.32 (1.16, 1.52)	1.43 (1.26, 1.62)
Province		
Quebec	1.00 (reference)	1.00 (reference)
Ontario	1.39 (1.23, 1.58)	1.40 (1.24, 1.57)
British Columbia	1.33 (1.07, 1.65)	1.31 (1.10, 1.58)
Alberta	1.10 (0.82, 1.46)	1.02 (0.78, 1.34)
Learning situation		
In-person	1.00 (reference)	1.00 (reference)
Online	1.42 (1.27, 1.59)	1.45 (1.30, 1.62)
Hybrid	1.25 (1.09, 1.44)	1.27 (1.11, 1.45)
Body weight category		
Underweight/Normal weight	1.00 (reference)	1.00 (reference)
Overweight/Obesity	1.28 (1.08, 1.51)	1.35 (1.08, 1.67)

Abbreviations: OR – Odds Ratio; CI – Confidence Intervals, SES – Socioeconomic status, BIPOC – black indigenous and other people of colour

Note: For age, odds ratios are estimated and presented for every change in age in years. For missing data coded as an unknown category, the odds ratio is not added in the tables.

Table 14. Logistic regression model results for adolescents with increased loneliness (versus decreased/stayed the same) due to COVID-19 with covariates for screen time

Covariates	Boys (n=18,290) OR (95% CI)	Girls (n=22,221) OR (95% CI)
<i>Loneliness increased versus decreased/stayed the same</i>		
Age		
12	1.59 (1.14, 2.20)	2.30 (1.79, 2.95)
12-13	1.61 (1.26, 2.05)	2.20 (1.82, 2.66)
13-14	1.63 (1.36, 1.95)	2.11 (1.83, 2.42)
14-15	1.65 (1.42, 1.92)	2.02 (1.81, 2.46)
15-16	1.67 (1.39, 2.01)	1.94 (1.70, 2.20)
16-17	1.69 (1.32, 2.17)	1.85 (1.55, 2.21)
17-18	1.72 (1.24, 2.39)	1.78 (1.41, 2.24)
18-19	1.74 (1.14, 2.65)	1.70 (1.26, 2.29)
SES category		
High SES	1.00 (reference)	1.00 (reference)
Low SES	1.42 (1.05, 1.92)	1.61 (1.28, 2.01)
Ethnicity		
White	1.00 (reference)	1.00 (reference)
BIPOC	1.43 (1.05, 1.94)	1.55 (1.22, 1.97)
Province		
Quebec	1.00 (reference)	1.00 (reference)
Ontario	1.61 (1.18, 2.20)	2.18 (1.73, 2.76)
British Columbia	1.09 (0.67, 1.75)	1.39 (0.97, 1.97)
Alberta	1.03 (0.49, 2.18)	1.44 (0.84, 1.78)
Learning situation		
In-person	1.00 (reference)	1.00 (reference)
Online	1.31 (1.06, 1.62)	1.69 (1.44, 1.98)
Hybrid	1.87 (1.30, 2.69)	1.73 (1.36, 2.20)
Body weight category		
Underweight/Normal weight	1.00 (reference)	1.00 (reference)
Overweight/Obesity	1.17 (0.78, 1.75)	1.65 (1.07, 2.54)

Abbreviations: OR – Odds Ratio; CI – Confidence Intervals, SES – Socioeconomic status, BIPOC – black indigenous and other people of colour

Note: For age, odds ratios are estimated and presented for every change in age in years. For missing data coded as an unknown category, the odds ratio is not added in the tables.