School nutrition policy and diet quality of children and youth: A quasi-experimental study from Canada

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Abstract

Objective: We investigated the impact of mandatory school nutrition policy on diet quality of Canadian school children using a quasi-experimental study design.

Methods: Using 24-hour dietary recall data from the 2004 Canadian Community Health Survey (CCHS) Cycle 2.2 and 2015 CCHS-Nutrition, we constructed the Diet Quality Index (DQI). We used multivariable difference-in-differences regressions to quantify the DQI scores associated with school nutrition policy. We conducted stratified analyses by sex, school grade, household income and food security status to gain additional insights into the impact of nutrition policy.

Results: We found that mandatory school nutrition policy was associated with an increased DQI score by 3.44 points (95% CI: 1.1, 5.8) during school-hours in intervention provinces relative to control provinces. DQI score was higher among males (3.8 points, 95% CI: 0.6, 7.1) than females (2.9 points, 95% CI: -0.5, 6.3), and the score among children in elementary schools was higher (5.1 points, 95% CI: 2.3, 8.0) compared to the score in high schools (0.4 points, 95% CI: -3.6, 4.5). We also found that DQI scores were higher for middle-high income and food secure households.

Conclusion: Provincial mandatory school nutrition policy was associated with better diet quality among children and youth in Canada. Our findings suggest that other jurisdictions may consider implementing mandatory school nutrition policy.

Key Words: School Nutrition Policy; Diet Quality; difference-in-differences; Children; Youth; Canada

Résumé

Objectif : Nous avons étudié l'effet des politiques nutritionnelles en milieu scolaire sur la qualité du régime des enfants canadiens d'âge scolaire à l'aide d'un protocole d'étude quasi expérimental.

Méthode : En utilisant les données des rappels alimentaires de 24 heures du cycle 2.2 de l'Enquête sur la santé dans les collectivités canadiennes (ESCC) de 2004 et de l'ESCC – Nutrition de 2015, nous avons construit un « indice de qualité du régime » (IQR). Au moyen de régressions multivariées de la différence dans les différences, nous avons chiffré les valeurs de l'IQR associées aux politiques nutritionnelles en milieu scolaire. Nous avons mené des analyses stratifiées selon le sexe, le niveau scolaire, le revenu du ménage et l'état de sécurité alimentaire pour en savoir plus sur l'effet des politiques nutritionnelles.

Résultats : Nous avons constaté que les politiques nutritionnelles obligatoires en milieu scolaire étaient associées à des valeurs d'IQR de 3,44 points plus élevées (IC de 95 % : 1,1, 5,8) pendant les heures de classe dans les provinces ayant de telles politiques par rapport aux provinces témoins. La valeur d'IQR était plus élevée chez les garçons (3,8 points, IC de 95 % : 0,6, 7,1) que chez les filles (2,9 points, IC de 95 % : -0,5, 6,3), et la valeur chez les élèves des écoles primaires était plus élevée (5,1 points, IC de 95 % : 2,3, 8,0) que celle chez les élèves des écoles secondaires (0,4 point, IC de 95 % : -3,6, 4,5). Nous avons aussi constaté que les valeurs d'IQR étaient supérieures pour les ménages de revenu moyen à élevé et pour les ménages à l'abri de l'insécurité alimentaire.

Conclusion : Les politiques nutritionnelles provinciales obligatoires en milieu scolaire étaient associées à un régime de meilleure qualité chez les enfants et les jeunes au Canada. Nos constatations indiquent que d'autres provinces et territoires pourraient envisager la mise en œuvre de politiques nutritionnelles en milieu scolaire.

Mots-clés Politiques nutritionnelles en milieu scolaire; qualité du régime; différence dans les différences; enfants; jeunes; Canada

INTRODUCTION

Nutrition and physical activity are important lifestyle behaviours with major impact on population health worldwide.(1) School nutrition environment is an important public policy initiative because the foods children are exposed to at school may not only affect eating behaviours at school but may also contribute to healthy habit formation over the lifecycle. However, the evidence on the impact of school nutrition policy on diet quality is mixed in the literature. Although a number of systematic reviews found that school nutrition policy is associated with higher intake of fruits and vegetables (FV), the impact on overall diet quality remains uncertain.(2–8)

A few Canadian studies investigated the impact of school nutrition policy on consumption of different foods.(9–13) For example, consumption of FV increased in British Columbia,(9) Nova Scotia(10,12) and Prince Edward Island(13) following the implementation of school nutrition policy. In Europe, a systematic review of the effectiveness of school-based nutrition policies also found improvements in dietary behaviour of children.(3) Two studies from Nova Scotia found increases in diet quality scores by about 2 points, measured by the diet quality index (DQI), following implementation of provincial school nutrition policy.(10,12) However, none of the above studies used a control group to tease out the impact of school nutrition policy on diet quality. It is important to account for the trends in dietary behaviour driven by increased awareness of healthy eating by having a control group to assess the impact of school nutrition policy.

In Canada, health and education are under the jurisdiction of provinces and territories. Consequently, different provinces develop their own school nutrition policies, leading to variations in the policies.(14) Specifically, six provinces have implemented mandatory school nutrition policies (British Columbia, Quebec, New Brunswick, Nova Scotia, Prince Edward Island and Ontario). Note that Prince Edward Island has a nutrition policy that is mandatory for schools, though not legislated. The rest of the provinces (Alberta, Saskatchewan, Manitoba and Newfoundland and Labrador) have voluntary nutrition policy/guidelines for schools.(15) A detailed overview of the varying provincial school nutrition policies implemented across in the country, is provided in Supplemental Table 1. It should be noted that very recently, in November2022, the Government of Canada opened consultations with Canadians for the implementation of a pan-Canadian school food policy, through an online questionnaire and planned discussions with key stakeholders.(17)

Note that six provinces implemented policies at different times between 2005 and 2011, providing us with the opportunity to undertake a quasi-experimental study to evaluate the contribution of the mandatory school nutrition policy on diet quality in Canadian children and youth. The primary objective of our study was to estimate the change in DQI score of school children in Canada in provinces with mandatory school nutrition policy relative to the control provinces. We also estimated the change in diet quality measured by healthy eating index (HEI) score to compare with a previously published study.(16) The secondary objective was to estimate the change in DQI scores among school children in Canada in provinces with mandatory school nutrition policy by sex, school grade, household income and household food security status.

METHODS

Data Source

Data came from the 2004 Canadian Community Health Survey (CCHS) Cycle 2.2 and 2015 CCHS – Nutrition. Both cross-sectional surveys are nationally representative and collected detailed 24-hour dietary recall data along with information on socio-economic characteristics.(18) Children under the age of 11 completed the survey by proxy or with the assistance of a parent or guardian.(18) In the 2004 CCHS, the response rate was 76.5% (n = 35,107), while in the 2015 CCHS, the response rate was 61.6% (n = 20,487).(18)

Study Population

Individuals aged 6 to 18 were included in our main analysis. For individuals aged 6 at the time of the interview, only those who completed the dietary recall during or after September were included to ensure they were attending school at the time. Likewise, for individuals aged 18 at the time of the interview, only those who completed the dietary recall before or during June were included. Observations with missing data were excluded from our analyses (Supplemental Table 5). After removing observations with missing data, the final sample size was 12,142 (Supplemental Table 4).

Measurement Instruments

24-Hour Dietary Recall

The 24-hour dietary recall data were collected face-to-face using a computer-assisted personal interview, based on the United States Department of Agriculture Automated Multiple-Pass

Method (AMPM).(18) The AMPM is designed to guide interviewers in getting accurate recall of foods consumed by the respondents consisting of five steps:(18) (1) quick list, (2) forgotten foods, (3) time and occasion, (4) detail cycle, and (5) final review. Step 1 involved the respondent listing all foods consumed in the 24-hour period. In step 2, respondents were asked probing questions about commonly forgotten foods. In step 3, respondents reported the time that each food was consumed. Step 4 involved obtaining specific details about the foods consumed. Finally, step 5 collected information on forgotten foods/drinks. The 2015 CCHS made minor modifications to the AMPM method by updating food categories and/or imposing limits on specific foods, but the main structure of the AMPM remained unchanged. For the main analysis, time of day that a food was consumed was used to determine whether that food was consumed during or outside school-hours. Since school-hours may differ across jurisdictions in Canada, a standard of 9:00 to 14:00 was used as school-hours.(19)

Diet Quality

The DQI(20) and the HEI(21) are the two popular diet quality indices used in the literature. The DQI is more comprehensive as it consists of four components (variety, adequacy, moderation and overall balance), while the HEI contains only two components (adequacy and moderation).(21) The DQI captures overall food group variety, within-group variety from protein, macronutrient ratio (carbohydrates-protein-fat) and fatty acid ratios, while the HEI only looks at adequacy and moderation.(20,21) With regards to scoring, the HEI provides points for each item on a continuous scale of 0 to 5 or 0 to 10 (Supplemental Table 2). The DQI on the other hand awards a certain number of points for meeting a recommendation (Supplemental

Table 3). Since DQI is more comprehensive, we have chosen it as our preferred measure of diet quality. However, HEI was used to compare the results with a previously published study.(16)

Construction of Diet Quality Index and Healthy Eating Index Scores

The DQI scores were calculated for each respondent using the 24-hour dietary recall data. Scoring criteria are presented in Supplemental Table 3 and were adopted from Tur et al. (2005).(22) Points are achieved by eating a variety of foods, adequate amounts of food from each group and vitamin/mineral recommendations, eating less fat, cholesterol, sodium and empty calorie foods, and having a balanced intake of macronutrients and fatty acids. DQI scores range from 0 to 100, with higher scores indicating better diet quality.(22) For respondents who completed the dietary recall on a weekday while school was in session, three DQI scores were calculated: school-hour DQI for foods consumed during school-hours; non-school DQI for foods consumed outside school-hours; and whole-day DQI for foods consumed any time throughout the day. For respondents who completed the recall on a weekend or on a weekday while school was not in session, national statutory holidays, between June 21 to September 7, and December 25 to January 7, a non-school-hour DQI score was calculated. Note that school-hour DQI and non-school-hour DQI scores were calculated using time-of-day information from the dietary recall data to measure consumption during and outside school-hours, respectively.

Similar to the DQI, the HEI score was calculated for each respondent based on the criteria presented in Supplemental Table 2. The HEI-2015 (21) was used for this study, but criteria were adapted to meet the recommendations of the 2007 Canada Food Guide.(23) HEI scores range

from 0 to 100, with higher scores indicating better diet quality.(21) Like DQI, three corresponding HEI scores were calculated.(19)

Statistical Analyses

Multivariable difference-in-differences (DID) regression analyses were conducted to estimate the impact of mandatory school nutrition policy on diet quality. The DID equation was:

$$Y_{ipt} = \beta_0 + (\beta_1 \times Treatment) + (\beta_2 \times Period) + (\beta_3 \times Treatment \times Period) + X_{ipt} + \varepsilon_{ipt}$$

In the above equation, Y_{ipt} represents the diet quality for individual i in province p in year t; β_0 is the intercept (the mean value of the outcome in the control group at baseline); β_1 is a dummy variable taking a value of one if province p has a mandatory school nutrition policy, otherwise zero; β_2 is a dummy variable for the period equal to one after the introduction of the nutrition policy, zero otherwise; β_3 is a dummy variable for the interaction of treatment and period representing DID estimate; X_{ipt} is a vector of control variables (age, age-squared, sex, elementary vs. high school grade, post-secondary degree awarded or not in the household, immigrant status, white, province, rural/urban location and household income quintiles); and ε_{ipt} is the error term. To account for clustering within provinces, wild cluster bootstrapping(24) was used rather than normal clustered approach due to the clustering of a large number of individuals within a small number of provinces. Here normal clustered standard errors would be downward biased, leading to over-rejection of the null hypothesis. The wild cluster bootstrapping was clustered by province and used equal Rademacher weights over 100 iterations. The user-written Stata program "boottest" was used to conduct wild-cluster bootstrapping.(24)

Survey sampling weights provided by Statistics Canada were applied to all analyses to ensure the results are representative of the population of children and youth aged 6 to 18 in Canada.(18) Stata was used to conduct all analyses.

Stratified Analyses

Stratified analyses by sex, school grade (elementary and high school students), household income group (bottom two vs. top three income quintiles), and household food security status (food secure, moderately food insecure and severely food insecure)(25) were conducted as a priori hypothesis based on previous literature. For household food security status, the marginal food insecure group was combined with the food secure group.

RESULTS

Descriptive Results

The mean diet quality scores in the study population in 2004 and 2015 are reported in **Table 1**. The mean whole-day DQI score increased from 55.0 to 55.8 points ($p = 0.033$). However, the mean school-hour DQI score increased from 51.7 to 55.3 points ($p = 0.000$), while the mean non-school-hour DQI score did not change (54.9 vs 55.0 points, $p = 0.77$). **Table 2** presents the mean diet quality scores across the intervention and control groups. In the intervention group, the mean whole-day DQI score increased from 55.3 to 56.1 points ($p = 0.041$). The mean school-hour DQI score increased from 51.7 to 55.9 points ($p = 0.000$), while the increase in mean non-school-hour DQI score was statistically non-significant (55.3 vs. 55.3 points. $p = 0.90$). In the control group,

the mean whole-day DQI score, school-hour DQI score and non-school-hour DQI score did not differ between 2004 and 2015.

Difference-in-Differences Results

The estimated change in whole-day, school-hours, and non-school-hours DQI scores in the intervention provinces relative to the control provinces (i.e., DID estimates) are presented in **Table 3**. Whole-day DQI score did not change (β = 0.8, 95% CI: -0.6, 2.2). DQI score during school-hours increased by 3.4 points (95% CI: 1.1, 5.8), but the increase in DQI score during non-school-hours was statistically non-significant (β = 0.1, 95% CI: -1.4, 1.5).

Stratified Analysis by Sex

The stratified estimates on whole-day, school-hours, and non-school-hours DQI scores by sex are presented in **Table 4**. Among males, whole-day DQI score did not change (β = 1.2, 95% CI: -0.8, 3.1), but DQI score during school-hours increased by 3.8 points (95% CI: 0.6, 7.1). Non-school-hours DQI did not change (β = 0.4, 95% CI: -1.6, 2.4). Among females, whole-day DQI score (β = 0.3, 95% CI: -1.7, 2.3), DQI scores during school-hours (β = 2.9, 95% CI: -0.5, 6.3) and outside of school-hours (β = -0.4, 95% CI: -2.5, 1.6) did not change.

Stratified Analysis by School Grade

The stratified estimates on whole-day, school-hours, and non-school-hours DQI scores by school grade are reported in **Table 5**. Among elementary school students, whole-day DQI score did not change (β = 0.6, 95% CI: -1.3, 2.4). DQI score during school-hours increased by 5.1 points (95% CI: 2.3, 8.0). DQI score during non-school-hours did not change (β = -0.3, 95% CI: -2.2, 1.6).

Among high school students, DQI scores were statistically non-significant during school- and non-school-hours.

Stratified Analysis by Household Income

The stratified estimates on whole-day, school-hours, and non-school-hours DQI scores by income group are presented in **Table 6**. The bottom two quintiles were grouped as the low-income group. The top three quintiles were grouped as the middle-high income group. Among the low income group, whole-day DQI score (β = 1.7, 95% CI: -0.7, 4.0), school-hours DQI score (β = 3.7, 95% CI: -0.2, 7.5) and non-school-hours DQI score (β = 0.7, 95% CI: -1.7, 3.0) did not change. Among the middle-high-income group, whole-day DQI score did not change (β = 0.1, 95% CI: -1.7, 1.8). DQI score during school-hours increased by 3.0 points (95% CI: 0.1, 6.0), but non-school-hours DQI score did not change (β = -0.5, 95% CI: -2.3, 1.3).

Stratified Analysis by Food Security Status

The estimates on whole-day, school-hours, and non-school-hours DQI scores by food security status are presented in **Table 7**. Among the food secure group, whole-day DQI score did not change (β = 0.8, 95% CI: -0.7, 2.22). DQI score during school-hours increased by 3.2 points (95% CI: 0.7, 5.6). DQI score during non-school-hours did not change (β = 0.2, 95% CI: -1.3, 1.6). Among the moderately food insecure group, whole-day DQI score (β = -0.5, 95% CI: -6.0, 5.0) school-hours DQI (β = 0.8, 95% CI: -6.9, 8.5) and non-school-hours DQI (β = -2.7, 95% CI: -8.4, 3.1) did not change. Similarly, among the severely food insecure group, whole-day DQI score (β = -6.8, 95% CI: -10.8, 15.1), school-hours DQI (β = 18.6, 95% CI: -14.3, 51.5) and non-school-hours DQI (β = 2.3, 95% CI: -10.6, 15.3) did not change.

When comparing the DID estimates in DQI and HEI scores across the overall population and subgroups, the general trends were qualitatively similar. However, there were some differences in the magnitude of the associations and significance levels. While there was a significant increase in DQI scores during school-hours (Table 3), school-hour HEI did not reach statistical significance (Supplemental Table 7). When looking at school-hour scores by sex, both DQI (Table 4a) and HEI (Supplemental Table 8a) scores increased during school-hours among males. In the school grade subgroup analysis, school-hour DQI scores increased among elementary school students (Table 5a), while school-hour HEI scores did not (Supplemental Table 9a). Differences in how the DQI and HEI are measured likely account for differences in the results. The HEI measures adequacy and moderation, while the DQI measures variety and overall balance, in addition to adequacy and moderation. In addition, the HEI awards points on a continuous scale, based on the proportion of the criteria for maximum score that is met. The DQI awards points based on a category for each criterion, rather than on a continuous scale.

DISCUSSION

We found that diet quality scores during school-hours increased between 2004 and 2015: DQI and HEI scores increased by 3.6 and 7.2 points, respectively. Our finding on HEI is consistent with a previous study by Tugault-Lafleur et al.,(16) who reported that mean HEI scores during school-hours increased from 51.3 to 58.0 points during this period. The discrepancy is likely due to differences in the study sample: our study included all respondents aged 6 to 18, while Tugault-Lafleur et al. only included respondents aged 6 to 18 who completed a weekday dietary recall.(16) After excluding respondents who completed a recall on a weekend, our results were

qualitatively similar. When excluding respondents who completed the dietary recall on the weekend, we found that mean HEI scores during school-hours increased from 51.8 to 57.6 (Table 8).

We investigated whether mandatory school nutrition policy could improve diet quality of children. We found that mandatory school nutrition policy had no impact on whole-day diet quality measured by the DQI or HEI. However, the DQI score during school-hours was associated with an increase in the intervention group by 3.4 points relative to the control group. Previous literature has reported improvements in diet quality following implementation of school nutrition policy in Nova Scotia: McIsaac et al.(2015) found that students in 2011 had a higher DQI score than students in 2003 by 2.2 points;(12) similarly, Fung et al.(10) found that DQI score increased by 1.8 points between 2003 and 2011.(10) Another Nova Scotia study found that students in schools with a health-promoting intervention program had better diet quality than students at schools without the program.(26) A systematic review of the effectiveness of school-based nutrition policies in Europe found that approximately 75% of studies reported improvements in dietary behaviour of children.(3) Our findings suggest that school nutrition policy is associated with an increased diet quality during school-hours in Canada, but is not associated with behavioural changes leading to improved diet quality outside the school-hours. Possible explanations could be due to the lack of education on food literacy, proper nutrition habit of children and their parents and financial constraints. Beyond simply restricting the types of foods provided or sold in schools, diet quality among children and youth could be improved by targeted initiatives to increase food literacy among children and their parents.

Stratified analyses by sex, school grade, and household income and food security status revealed some interesting results. HEI and DQI scores during school-hours among males in the intervention group were higher by 4.3 and 3.8 points, respectively compared to the control group. In contrast, increases in diet quality among females were no longer statistically significant. One possible explanation for this finding could be that higher diet quality among female adolescents may have produced a ceiling effect preventing any additional significant change in their diet quality scores. This is consistent with a previous study,(27) but inconsistent with a few others.(28–30) Although sex differences in diet quality exist, the reported associations in the literature were heterogeneous.(27,30,31)

We found that DQI scores during school-hours were higher among elementary school children than older children in the intervention group by 5.1 points compared to the control group. One possible explanation for why elementary school children had better dietary quality could be that they are unable to leave the school property at lunch time to purchase foods at restaurants or other establishments. A previous study found that grade 6 students had higher odds of meeting recommended FV servings compared to grade 8-12 students.(32) Our results are consistent with previous research suggesting that younger children may have better diet quality than older children.(19,28)

Finally, stratified analysis by household income and food security status revealed that diet quality scores during school-hours were higher for middle-high income and food secure groups. This is likely because middle-high income households have the ability to purchase and provide foods of greater nutritional quality for their children at school, while low-income and food

insecure households may not have the financial means to do so. Previous literature indicates that individuals with lower income tend to have poorer diet quality compared to middle-high income counterparts.(33) This is because lower-income households tend to purchase foods of lower nutrition quality, consume fewer FV servings and have lower intake of micronutrients, likely due to cost. (33,34) Conversely, middle-high income households consume more FV servings and whole grains.(28,35) Previous literature also found that food-insecure children have a lower proportion of energy intake from protein, consume fewer servings of milk products, and have inadequate calcium and vitamin B12 intake.(36) In addition, a significantly higher proportion of individuals in food-insecure households had inadequate intake of vitamin A, vitamin C and magnesium.(37)

The implementation of a nationwide school food policy by the Government of Canada could ensure that there are consistent standards adhering to school nutrition guidelines across the country. This would particularly benefit children and youth in provinces that do not currently have a mandatory school nutrition policy. Even in provinces that currently have a mandatory school nutrition policy, it is difficult to measure enforcement of the policy. The results of our study suggest that school nutrition policy could be tailored to the needs of different groups of children and youth, for example by targeting elementary and high school students differently (Supplemental Table 1). The results of our study show that the existing school nutrition policies did not lead to an improvement in diet quality among high school students, demonstrating the need for focused strategies for this group. For example, a mandatory food literacy component to educate students on how to make healthy food choices and a change in their eating behaviours may improve diet quality outside school-hours (Supplemental Table 1).

The results of this study and those of Tugault-Lafleur et al.(16) indicate that children from food insecure households did not experience an improvement in diet quality from the existing provincial school nutrition policies. Thus, it is important to provide support for children in food insecure households to prevent gaps in diet quality from widening. Improving access to healthy foods in schools combined with mitigating financial barriers would be useful policy options to consider; these avenues have been identified as part of current pan-Canadian school nutrition food policy, a step in the right direction(38).

Strengths

We examined the impact of school nutrition policy on diet quality using DQI in Canada using a difference-in-differences framework. The data from the CCHS provided a representative sample of Canadians, as well as detailed information on food consumption through the 24-hour dietary recall data. Specifically, we compared changes in diet quality between provinces with and without mandatory school nutrition policies, while controlling for potential confounders. Finally, we conducted important stratified analyses to understand the contribution of school nutrition policy on different student populations.

Limitations

There are some limitations of our study. First, only two years of survey data were available for our analysis. However, the use of a control group removes the effect of any common trend that may affect both groups and should provide a better measure of the effectiveness of policy. Second, our study is limited by the 24-hour recall data. Compared to other dietary measurement

instruments, such as food frequency questionnaires, the 24-hour dietary recall captures all items that an individual consumed.(39) However, the 24-hour dietary recall data are subject to recall bias and social desirability bias.(40) Another limitation of the 24-hour recall data is that information on whether the foods consumed during school-hours were purchased on or off school property or brought from home were not available.

While the DQI is a useful cross-cultural measure of diet quality(20), the limitation in the context of this study is that it is not specific to Canadian dietary guidelines. However, our study showed a valuable comparison of changes in diet quality between the treatment and control provinces.

Another potential limitation is that even though policies are implemented at the provincial level, there may be considerable variations between schools and school boards. For instance, some schools may have greater compliance with the nutrition policy or guidelines. Since it was not possible to measure the actual implementation of school nutrition policies in each school, it is conceivable that variations in compliance rates may influence the effectiveness of the mandatory nutrition policy. The scope of this study also did not allow for assessment on a province-by-province basis. Different school boards may vary in terms of the specific policy/guidelines they choose to implement in their schools. This was not possible to evaluate using the data available for this study.

High-school students are able to leave school property and may do so if only healthier options are available in school cafeterias. A limitation of this study is that data were not available on whether foods consumed during school-hours were purchased or consumed (on or off school

property). Although typical holidays were accounted for as being outside school-hours, there may have been additional days that students were not in school for various reasons that were not captured. Furthermore, the data did not distinguish whether students attended private or public schools.

CONCLUSION

We found that mandatory school nutrition policy had no impact on whole-day diet quality scores, but it improved school-hours diet quality of elementary school children. Mandatory school nutrition policy had no impact on diet quality during non-school-hours. We also found that school-hours diet quality scores were higher among male students, elementary school children, and food secure and middle-high income household groups.

Our findings demonstrate that mandatory school nutrition policies may be useful in improving diet quality of children during school-hours, especially among elementary school children. Our results suggest that jurisdictions with school nutrition guidelines may consider implementing mandatory school nutrition policies to improve the diet quality of children and youth at school. A combination of healthy lifestyle interventions is likely necessary to produce long-lasting effects to improve the health of children. In order to improve overall diet quality, barriers to healthy eating outside the school environment, including food insecurity and marketing unhealthy foods to children need to be addressed. The efforts on encouraging healthy habits in children at a young age may prevent the development of chronic conditions later in life. By improving diet quality among children, we can improve the health of future generations.

Contributions to knowledge

- What does this study add to existing knowledge?

Using 24-hour dietary recall data from nationally representative surveys, this quasi-experimental evaluation study demonstrates that provincial-level mandatory school nutrition policy improves diet quality of children in Canada during school-hours. This result is driven by the improvement in the diet quality scores among elementary school children, male students, and middle-high income and food-secure households. This study also found that mandatory school nutrition policy did not improve diet quality of children outside the school-hours.

- What are the key implications for public health interventions, practice or policy?

There are several policy implications of this study. Provinces without mandatory school nutrition policy should consider implementing such a policy as this is likely to improve diet of quality of children. Provinces with mandatory nutrition policy may consider strengthening their policies to achieve high degree of compliance. Policy makers may consider implementing food literacy programs for children and their parents on making healthy food choices in children's daily lives. Improving access to healthy foods in schools and mitigating financial barriers for children from low-income and food insecure households would be useful policies to consider.

Declarations:

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Conflict of interest: None of the authors have any conflicts of interest to declare.

Ethics approval: Not applicable as this study was conducted using secondary survey data. However, access to the confidential survey data was based on approval by Statistics Canada to conduct research at the Research Data Centre and only the results are released following Statistics Canada's strict vetting process adhering to respondents' privacy.

Consent to participate: Not applicable to us as this was handled by Statistics Canada.

Consent for publication: Statistics Canada approved the results to share the findings in the public domain.

Availability of data and material: The data used in this manuscript are available through Statistics Canada's approval in any Research Data Centres across Canada.

Code availability: Stata codes will be available upon request.

Author contributions: Victoria Gaudin and Sisira Sarma conceived the idea, developed the proposal to access data, conducted the study design and analysis plan and statistical analysis. Victoria Gaudin conducted literature review and wrote the first draft and Sisira Sarma revised it for manuscript purpose. Sisira Sarma, Saverio Stranges and Piotr Wilk critically revised the draft through several iterations and polished the manuscript suitable for journal submission. All authors approved the final manuscript.

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Tables

Table 1. Mean Diet Quality Scores among Children Aged 6 to 18 in 2004 and 2015

Variable	2004		2015		
	Mean	SD	Mean	SD	p-value
HEI	50.63	13.34	52.48	13.16	0.000
School-hour HEI	42.61	14.75	49.84	12.41	0.000
Non-School-hour HEI	49.96	13.44	52.10	12.49	0.000
DQI	55.00	10.09	55.75	11.17	0.033
School-hour DQI	51.73	11.96	55.30	12.88	0.000
Non-School-hour DQI	54.92	10.04	55.03	11.42	0.765

Table 2. Mean Diet Quality Scores in the Intervention and Control Groups in 2004 and 2015

	Intervention Group					Control Group				
	Year					Year				
	2004		2015			2004		2015		
Variable	Mean	SD	Mean	SD	p-value	Mean	SD	Mean	SD	p-value
HEI	50.99	13.26	52.81	13.25	0.000	49.11	13.57	51.24	12.73	0.006
School-Hour HEI	42.65	14.67	50.29	12.50	0.000	42.43	15.09	48.19	11.94	0.000
Non-School-Hour HEI	50.36	13.36	52.42	12.57	0.000	48.32	13.65	50.85	12.09	0.001
DQI	55.29	10.06	56.14	11.05	0.041	53.77	10.14	54.30	11.51	0.411
School-Hour DQI	51.73	11.89	55.94	12.99	0.000	51.74	12.24	52.98	12.25	0.229
Non-School-Hour DQI	55.27	9.98	55.32	11.40	0.901	53.48	10.19	53.93	11.41	0.488

Table 3. Whole-Day School-Hour and Non-School-Hour DQI Scores among Canadian Children and Youth Aged 6 to 18: Difference-in-Differences Estimates

	Whole-Day DQI			School-Hour DQI			Non-School-Hour DQI		
Variable	β	p-value	95% CI	β	p-value	95% CI	β	p-value	95% CI
Intercept	66.03	0.000	61.61,70.44	60.25	0.000	52.97, 67.53	64.23	0.000	60.00, 68.45
Intervention	0.59	0.223	-0.44, 1.61	-0.96	0.338	-2.94, 1.01	0.81	0.132	-0.24, 1.87
Post	0.01	0.992	-1.19, 1.20	0.90	0.385	-1.13, 2.93	-0.11	0.850	-1.31, 1.08
DID	0.82	0.252	-0.59, 2.23	3.44	0.004	1.07, 5.80	0.07	0.927	-1.36, 1.49
Age	-1.50	0.000	-2.29, -0.71	-0.92	0.160	-2.22, 0.36	-1.29	0.001	-2.02, -0.55
Age^2	0.03	0.071	-0.00, -0.07	0.02	0.529	-0.04, 0.07	0.025	0.135	-0.01, 0.06
Female	-0.12	0.024	-0.78, 0.54	0.92	0.083	-0.12, 1.96	0.16	0.628	-0.51, 0.84
High School	-0.75	0.295	-2.14, 0.65	-2.19	0.046	-4.34, -0.03	0.27	0.690	-1.06, 1.61
Some post-secondary	1.28	0.003	0.44, 2.10	0.01	0.987	-1.24, 1.26	1.20	0.004	0.37, 1.02
Rural	-0.08	0.096	-1.71, 1.40	0.35	0.605	-0.98, 1.69	-1.17	0.014	-1.61, 1.41
White	-0.66	0.210	-1.68, 0.37	-0.28	0.724	-1.85, 1.29	-1.03	0.071	-1.95, 0.94
Immigrant	1.13	0.108	-0.24, 2.51	0.94	0.488	-1.72, 3.60	1.23	0.086	-0.17, 2.64
NL	-0.02	0.984	-1.63, 1.59	-2.30	0.046	-4.56, -0.03	-0.10	0.893	-1.61, 1.41
PEI	-0.42	0.535	-1.73, 0.90	-0.03	0.973	-2.26, 2.18	-0.56	0.494	-1.95, 0.94
NS	-1.85	0.02	-3.04, -0.64	-1.64	0.078	-3.47, 0.18	-1.29	0.033	-2.49, -0.10
NB	-1.86	0.04	-3.13, -0.58	-1.43	0.145	-3.35, 0.49	-1.04	0.116	-2.34, 0.25
QC	1.36	0.05	0.40, 2.32	1.53	0.045	0.03, 3.03	1.36	0.006	0.39, 2.33
MB	0.36	0.659	-1.23, 1.95	-0.45	0.679	-2.61, 1.70	-0.84	0.236	-2.24, 0.55
SK	0.84	0.244	-0.57, 2.24	-0.78	0.508	-3.09, 1.53	-0.79	0.915	-1.54, 1.38
BC	0.59	0.245	-0.40, 1.59	0.23	0.686	-1.26, 1.191	1.51	0.005	-.45, 2.57
Quintile 2	0.06	0.911	-1.02, 1.15	0.11	0.890	-1.56, 1.80	0.28	0.690	-0.81, 1.39
Quintile 3	0.67	0.107	-0.18, 1.92	0.54	0.514	-1.09, 2.19	0.79	0.158	-0.30, 1.89
Quintile 4	1.25	0.032	0.10, 2.38	0.33	0.699	-1.36, 2.03	1.25	0.039	0.06, 2.44
Quintile 5	1.12	0.042	0.04, 2.38	0.55	0.579	-1.39, 2.49	1.40	0.020	0.21, 2.59

Table 4. Whole-Day, School-Hour and Non-School-Hour DQI Scores among Canadian Children and Youth Aged 6 to 18 by Sex: Difference-in-Differences Estimates

a) Males

Variable	**Whole-Day DQI**			School-Hour DQI			Non-School-Hour DQI		
	β	p-value	95% CI	β	p-value	95% CI	β	p-value	95% CI
Intercept	68.37	0.000	62.59, 74.14	64.26	0.000	55.26, 73.27	66.00	0.000	60.27, 71.73
Intervention	1.24	0.149	-0.44, 2.92	-0.72	0.589	-3.37, 1.91	0.20	0.792	-1.30, 1.71
Post-Intervention	0.04	0.956	-1.60, 1.69	1.31	0.369	-1.55, 4.18	0.04	0.962	-1.61, 1.69
DID	1.16	0.244	-0.79, 3.11	3.84	0.021	0.59, 7.09	0.41	0.688	-1.57, 2.38
Age	-2.19	0.000	-3.20, -1.17	-1.60	0.048	-3.19, -0.01	-1.62	0.001	-2.62, -0.63
Age^2	0.05	0.011	0.01, 0.10	0.04	0.207	-0.02, 0.12	0.03	0.133	-0.01, 0.08
High School	0.27	0.758	-1.45, 1.99	-1.55	0.260	-4.25, 1.15	1.34	0.130	-0.39, 3.09
Some post-secondary	0.35	0.016	0.26, 2.51	-0.71	0.410	-2.39, 0.97	1.32	0.027	0.14, 2.49
Rural	-0.15	0.814	-1.41, 1.10	-0.72	0.925	-1.81, 1.66	-0.62	0.348	-1.93, 0.68
White	-0.33	0.633	-1.70, 1.03	-0.23	0.820	-2.24, 1.78	-0.97	0.184	-2.41, 0.46
Immigrant	1.36	0.101	-0.26, 2.99	0.69	0.686	-2.67, 4.07	1.23	0.126	-0.34, 2.82
Province of residence									
NL	0.35	0.766	-1.96, 2.66	-1.77	0.250	-4.80, 1.25	-0.24	0.822	-2.40, 1.91
PEI	-1.65	0.061	-3.39, 0.07	-1.54	0.329	-4.65, 1.56	-1.48	0.158	-3.55, 0.57
NS	-2.56	0.003	-4.25, -0.86	-3.74	0.000	-5.73, -1.75	-1.09	0.213	-2.82, 0.62
NB	-2.18	0.018	-3.99, -0.37	-2.63	0.071	-5.50, 0.23	-1.05	0.277	-2.94, 0.84
QC	1.71	0.009	0.43, 3.00	0.58	0.553	-1.35, 2.53	2.05	0.002	0.72, 3.37
MB	0.16	0.868	-1.81, 2.15	-0.24	0.986	-2.88, 2.83	-0.78	0.439	-2.76, 1.19
SK	0.69	0.488	-1.26, 2.64	-2.72	0.073	-5.71, 0.25	-0.74	0.420	-2.54, 1.06
BC	1.18	0.098	-0.21, 2.58	0.38	0.693	-1.52, 2.28	2.14	0.006	0.61, 3.67
Income									
Quintile 2	-0.58	0.422	-2.00, 0.83	-0.63	0.572	-2.85, 1.57	-0.10	0.889	-1.58, 1.37
Quintile 3	1.50	0.034	0.11, 2.89	0.68	0.507	-1.34, 2.72	1.84	0.016	0.34, 3.35
Quintile 4	1.86	0.014	0.37, 3.36	0.67	0.518	-1.37, 2.72	1.79	0.029	0.18, 3.41
Quintile 5	1.01	0.218	-0.60, 2.63	-0.01	0.997	-2.48, 2.47	1.41	0.091	-0.22, 3.05

b) Females

Variable	**Whole-Day DQI**			School-Hour DQI			Non-School-Hour DQI		
	β	p-value	95% CI	β	p-value	95% CI	β	p-value	95% CI
Intercept	61.95	0.000	55.42, 68.48	57.17	0.000	-2.75, 5.06	62.67	0.000	56.60, 68.74
Intervention	1.71	0.064	-0.09, 3.52	-1.23	0.409	-4.16, 1.69	1.45	0.053	-0.02, 2.92
Post-Intervention	0.08	0.920	-1.61, 1.78	0.58	0.694	-2.31, 3.48	-0.17	0.845	-1.88, 1.54
DID	0.28	0.780	-1.70, 2.27	2.87	0.098	-0.53, 6.28	-0.44	0.668	-2.48, 1.59
Age	-0.84	0.170	-2.05, 0.36	-0.25	0.803	-2.29, 1.77	-0.96	0.082	-2.05, 0.12
Age^2	0.01	0.701	-0.05, 0.06	-0.01	0.865	-0.10, 0.08	0.02	0.468	-0.03, 0.06
High School	-1.91	0.087	-4.10, 0.27	-2.92	0.081	-6.19, 0.35	-0.96	0.353	-2.99, 1.06
Some post-secondary	1.06	0.069	-0.08, 2.22	0.73	0.413	-1.02, 2.48	-0.95	0.095	0.16, 2.06
Rural	-1.42	0.032	-2.73, -0.12	0.83	0.413	-1.17, 2.84	-1.73	0.010	-3.05, -0.41
White	-1.01	0.189	-2.53, 0.50	-0.28	0.817	-2.69, 2.09	-1.09	0.208	-2.79, 0.61
Immigrant	0.84	0.454	-1.37, 3.06	1.15	0.563	-2.75, 5.06	1.24	0.293	-1.08, 3.57
Province of residence									
NL	-0.27	0.817	-2.57, 2.03	-2.96	0.077	-6.26, 0.32	0.03	0.971	-2.10, 2.18
PEI	0.88	0.382	-1.09, 2.85	1.34	0.414	-1.87, 4.56	0.59	0.563	-1.43, 2.63
NS	-1.03	0.230	-2.71, 0.65	0.47	0.761	-2.56, 3.50	-1.42	0.092	-3.09, 0.23
NB	1.56	0.080	-3.32, 0.18	-0.40	0.748	-2.91, 2.09	-1.10	0.215	-2.84, 0.64
QC	1.02	0.154	-0.38, 2.43	2.50	0.030	0.24, 4.77	0.68	0.342	-7.21, 2.08
MB	0.61	0.631	-1.89, 3.12	-1.02	0.530	-4.25, 2.19	-1.03	0.295	-2.97, 0.90
SK	1.09	0.291	-0.93, 3.12	1.46	0.400	-1.95, 4.88	0.50	0.665	-1.77, 2.77
BC	-0.05	0.934	-1.47, 1.35	0.284	0.827	-2.27, 2.84	0.79	0.280	-0.65, 2.23
Income									
Quintile 2	0.76	0.355	-0.85, 2.37	0.87	0.471	-1.50, 3.25	0.77	0.350	-0.84, 2.39
Quintile 3	0.12	0.878	-1.43, 1.67	0.48	0.697	-1.96, 2.93	-0.33	0.679	-1.90, 1.24
Quintile 4	0.56	0.507	-1.10, 2.23	-0.22	0.864	-2.75, 2.31	0.72	0.413	-1.01, 2.44
Quintile 5	1.44	0.089	-0.21, 3.10	1.09	0.454	-1.77, 3.97	1.46	0.091	-0.23, 3.17

Table 5. Whole-Day, School-Hour and Non-School-Hour DQI Scores among Canadian Children and Youth Aged 6 to 18 by School Grade: Difference-in-Differences Estimates

a) Elementary School

Variable	**Whole-Day DQI**			School-Hour DQI			Non-School-Hour DQI		
	β	p-value	95% CI	β	p-value	95% CI	β	p-value	95% CI
Intercept	65.59	0.000	57.19, 73.98	53.63	0.000	40.25, 67.00	69.12	0.000	60.58, 77.67
Intervention	2.06	0.013	0.44, 3.69	-1.05	0.347	-3.26, 1.14	0.68	0.321	-0.67, 2.04
Post-Intervention	0.68	0.389	-0.87, 2.25	0.60	0.618	-1.77, 2.97	0.19	0.805	-1.37, 1.77
DID	0.55	0.554	-1.27, 2.37	5.14	0.000	2.30, 7.97	-0.28	0.763	-2.16, 1.58
Age	-1.79	0.051	-3.58, 0.01	0.71	0.631	-2.20, 3.63	-2.44	0.009	-4.29, -0.60
Age^2	0.05	0.301	-0.04, 0.14	-0.06	0.375	-0.22, 0.08	0.08	0.076	-0.01, 0.18
Female	0.31	0.448	-0.49, 1.11	1.49	0.018	0.25, 2.74	0.43	0.312	-0.40, 1.27
Some post-secondary	0.86	0.114	-0.20, 1.92	-0.53	0.475	-2.00, 0.93	0.75	0.174	-0.33, 1.84
Rural	-1.25	0.022	-2.32, -0.18	0.25	0.761	-1.38, 1.89	-1.82	0.001	-2.93, -0.70
White	-0.58	0.353	-1.80, 0.64	-0.48	0.596	-2.29, 1.31	-0.35	0.601	-1.70, 0.98
Immigrant	1.21	0.151	-0.44, 2.87	0.41	0.812	-2.96, 3.78	1.47	0.114	-0.35, 3.29
Province of residence									
NL	0.19	0.858	-1.96, 2.35	-2.10	0.145	-4.92, 0.72	-0.60	0.538	-2.52, 1.31
PEI	-0.34	0.679	-0.19, 1.29	0.56	0.719	-2.51, 3.65	-0.66	0.498	-2.57, 1.25
NS	-0.91	0.230	-2.40, 0.57	-0.44	0.703	-2.75, 1.85	-0.60	0.407	-2.02, 0.82
NB	-1.50	0.068	-3.13, 0.11	0.65	0.596	-3.05, 1.75	-0.45	0.583	-2.09, 1.17
QC	1.36	0.019	0.22, 2.51	2.09	0.025	0.25, 3.93	1.30	0.032	0.11, 2.50
MB	1.40	0.202	-0.75, 3.55	0.66	0.634	-2.08, 3.42	-1.56	0.111	-3.48, 0.35
SK	1.66	0.086	-0.23, 3.57	-0.64	0.637	-3.30, 2.02	0.30	0.753	-1.59, 2.20
BC	0.99	0.117	-0.24, 2.24	0.31	0.766	-1.75, 2.37	1.95	0.004	0.62, 3.27
Income									
Quintile 2	0.20	0.760	-1.08, 1.49	-0.68	0.476	-2.55, 1.19	0.28	0.685	-1.09, 1.67
Quintile 3	0.92	0.147	-0.32, 2.16	0.56	0.560	-2.43, 1.32	0.81	0.245	-0.55, 2.18
Quintile 4	1.14	0.091	-0.18, 2.46	-1.30	0.168	-3.17, 0.55	1.32	0.064	-0.07, 2.79
Quintile 5	1.07	0.129	-0.31, 2.45	-0.32	0.786	-2.70, 2.04	1.48	0.050	-0.33, 1.84

b) High School

Variable	**Whole-Day DQI**			School-Hour DQI			Non-School-Hour DQI		
	β	p-value	95% CI	β	p-value	95% CI	β	p-value	95% CI
Intercept	107.65	0.012	24.15, 191.15	178.24	0.005	53.62, 302.87	65.03	0.061	-3.10, 133.17
Intervention	0.44	0.643	-1.42, 2.31	-0.52	0.781	-4.25, 3.20	1.13	0.195	-0.58, 2.86
Post-Intervention	-0.99	0.284	-2.81, 0.82	1.67	0.367	-1.96, 5.31	-0.59	0.522	-2.42, 1.22
DID	1.16	0.291	-0.99, 3.33	0.43	0.836	-3.63, 4.49	0.56	0.614	-1.61, 2.72
Age	-7.01	0.214	-18.08, 4.05	-17.11	0.044	-33.76, -0.46	-1.24	0.786	-10.23, 7.74
Age^2	0.21	0.249	-0.15, 0.57	0.55	0.050	0.00, 1.10	0.02	0.885	-0.27, 0.31
Female	-0.81	0.163	-1.97, 0.33	0.19	0.821	-1.50, 1.90	-0.24	0.670	-1.38, 0.89
Some post-secondary	1.93	0.004	0.62, 3.25	1.27	0.262	-0.95, 3.49	1.85	0.004	0.60, 3.10
Rural	0.01	0.993	-1.68, 1.69	0.64	0.566	-1.55, 2.85	-0.19	0.819	-1.84, 1.45
White	-0.80	0.393	-2.69, 1.04	-0.27	0.840	-3.00, 2.44	-2.13	0.031	-4.07, -0.18
Immigrant	0.89	0.448	-1.42, 3.21	0.89	0.657	-3.04, 4.83	0.65	0.566	-1.58, 2.90
Province of residence									
NL	-0.37	0.755	-2.74, 1.99	-2.95	0.131	-6.79, 0.87	0.78	0.531	-1.67, 3.24
PEI	-0.77	0.486	-2.97, 1.41	-1.27	0.350	-3.95, 1.39	-0.43	0.694	-2.61, 1.73
NS	3.32	0.001	-5.27, -1.36	-3.38	0.020	-6.23, -0.53	2.38	0.024	-4.45, -0.31
NB	-2.48	0.019	-4.56, -0.40	-2.74	0.085	-5.86, 0.38	-1.97	0.069	-4.10, 0.15
QC	1.28	0.137	-0.40, 2.98	0.35	0.774	-2.08, 2.79	1.50	0.071	-0.13, 3.14
MB	-1.32	0.263	-3.63, 0.99	-2.16	0.229	-5.68, 1.36	0.40	0.687	-1.55, 2.35
SK	-0.61	0.552	-2.63, 1.40	-0.86	0.698	-5.20, 3.48	-0.51	0.655	-2.77, 1.74
BC	-0.04	0.962	-1.73, 1.65	0.25	0.840	-2.23, 2.75	0.83	0.346	-0.89, 2.56
Income									
Quintile 2	-0.19	0.842	-2.14, 1.75	1.82	0.238	-1.20, 4.84	0.25	0.783	-1.55, 2.06
Quintile 3	0.76	0.423	-1.10, 2.63	2.32	0.113	-0.55, 5.19	0.77	0.399	-1.02, 2.58
Quintile 4	1.30	0.223	-0.79, 3.41	2.89	0.067	-0.20, 5.99	1.02	0.345	-1.09, 3.14
Quintile 5	1.34	0.202	-0.72, 3.42	2.34	0.148	-0.83, 5.51	1.22	0.222	-0.73, 3.18

Table 6. Whole-Day, School-Hour and Non-School-Hour DQI Scores among Canadian Children and Youth Aged 6 to 18 by Household Income Status: Difference-in-Differences Estimates

a) Low Income Household (Bottom Two Income Quintiles)

Variable	**Whole-Day DQI**			School-Hour DQI			Non-School-Hour DQI		
	β	p-value	95% CI	β	p-value	95% CI	β	p-value	95% CI
Intercept	64.47	0.00	54.47, 71.46	60.83	0.000	49.07, 72.58	62.37	0.000	55.85, 68
Intervention	2.02	0.035	0.14, 3.90	-1.94	0.258	-5.32, 1.42	-0.42	0.618	-2.07, 1.23
Post-Intervention	-1.00	0.330	-3.01, 1.01	0.66	0.691	-2.63, 3.96	-0.79	0.430	-2.77, 1.18
DID	1.66	0.161	-0.66, 3.98	3.65	0.062	-0.18, 7.49	0.67	0.573	-1.66, 3.00
Age	-1.56	0.021	-2.88, -0.23	-0.74	0.516	-2.99, 1.50	-0.85	0.146	-2.00, 0.29
Age^2	0.04	0.198	-0.02, 0.10	0.01	0.854	-0.09, 0.12	0.01	0.648	-0.04, 0.06
Female	0.88	0.096	-0.16, 1.91	1.38	0.095	-0.24, 3.01	1.18	0.027	0.13, 2.27
High School	-1.71	0.129	-3.93, 0.50	-3.43	0.079	-7.26, 0.39	-0.23	0.822	-2.32, 1.84
Some post-secondary	0.60	0.281	-0.49, 1.70	-1.09	0.224	-2.66, 0.62	0.68	0.241	-0.46, 1.83
Rural	-1.11	0.197	-2.78, 0.57	0.26	0.803	-1.82, 2.35	-1.83	0.022	-3.41, -0.26
White	-0.37	0.599	-1.75, 1.01	0.35	0.744	-1.74, 2.44	-1.29	0.072	-2.70, 0.11
Immigrant	1.72	0.060	-0.07, 3.51	2.20	0.204	-1.19, 5.59	1.49	0.108	-0.32, 3.31
Province of residence									
NL	0.11	0.929	-2.29, 2.51	-5.23	0.003	-8.65, -1.81	-0.81	0.462	-3.00, 1.36
PEI	-0.35	0.756	-2.56, 1.86	0.49	0.768	-2.77, 3.76	0.50	0.652	-1.68, 2.69
NS	-1.35	0.184	-3.34, 0.64	-2.82	0.047	-5.61, -0.33	-0.44	0.659	-2.44, 1.54
NB	-3.01	0.006	-5.17, -0.85	-3.69	0.029	-7.01, -0.38	-1.44	0.187	-3.58, 0.70
QC	1.02	0.168	-0.43, 2.47	1.43	0.233	-0.92, 3.78	1.47	0.048	0.011, 2.94
MB	0.22	0.880	-2.67, 3.12	-2.60	0.132	-5.99, 0.78	-2.29	0.032	-4.39, -0.19
SK	1.95	0.075	-0.20, 4.09	-2.52	0.235	-6.70, 1.64	-1.98	0.160	-4.76, 0.78
BC	1.31	0.096	-0.23, 2.86	-0.13	0.921	-2.86, 2.58	2.59	0.002	0.96, 4.22

b) Middle-High Income Household (Top Three Income Quintiles)

Variable	**Whole-Day DQI**	School-Hour DQI	Non-School-Hour DQI

	β	p-value	95% CI	β	p-value	95% CI	β	p-value	95% CI
Intercept	66.55	0.000	60.95, 72.16	59.69	0.000	50.39, 68.99	66.50	0.000	60.81, 72.19
Intervention	0.92	0.254	-0.66, 2.50	-0.16	0.887	-2.42, 2.10	1.73	0.013	0.36, 3.10
Post-Intervention	0.80	0.280	-0.65, 2.25	1.15	0.364	-1.34, 3.66	0.42	0.581	-1.08, 1.92
DID	0.05	0.952	-1.68, 1.78	3.03	0.041	0.12, 5.95	-0.52	0.573	-2.32, 1.28
Age	-1.48	0.002	-2.44, -0.53	-1.02	0.187	-2.54, 0.49	-1.62	0.001	-2.57, -0.67
Age^2	0.03	0.191	-0.01, 0.07	0.02	0.515	-0.45, 0.08	0.03	0.111	-0.01, 0.07
Female	-0.84	0.050	-1.68, 0.00	0.72	0.276	-0.57, 2.02	-0.58	0.193	-1.45, 0.29
High School	0.06	0.947	-1.72, 1.85	-0.92	0.465	-3.39, 1.55	0.75	0.395	-0.98, 2.49
Some post-secondary	2.32	0.000	1.24, 3.39	1.47	0.121	-0.38, 3.33	1.84	0.001	0.74, 2.95
Rural	-0.60	0.277	-1.68, 0.48	0.49	0.577	-1.23, 2.22	-0.81	0.170	-1.98, 0.35
White	-0.89	0.242	-2.39, 0.61	-1.15	0.318	-3.41, 1.10	-0.66	0.466	-2.56, 1.13
Immigrant	0.03	0.974	-1.89, 1.96	-1.55	0.313	-4.58, 1.46	0.49	0.624	-1.47, 2.45
Province of residence									
NL	-0.41	0.710	-2.58, 1.76	-0.52	0.737	-3.56, 2.52	0.40	0.703	-1.66, 2.47
PEI	-0.51	0.534	-2.12, 1.10	-0.34	0.815	-3.25, 2.56	-1.15	0.234	-3.05, 0.74
NS	-2.13	0.005	-3.63, -0.63	-0.86	0.474	-3.22, 1.49	-1.73	0.024	-3.23, -0.23
NB	-1.12	0.168	-2.70, 0.47	0.074	0.949	-2.18, 2.32	-0.70	0.402	-2.34, 0.94
QC	1.57	0.016	0.29, 2.84	1.51	0.121	-0.40, 3.43	1.32	0.043	0.04, 2.60
MB	0.08	0.935	-1.80, 1.95	1.42	0.288	-1.20, 4.06	0.25	0.787	-1.57, 2.08
SK	-0.08	0.933	-1.87, 1.72	0.22	0.874	-2.57, 3.02	1.04	0.224	-0.64, 2.72
BC	0.02	0.980	-1.28, 1.31	0.73	0.439	-1.12, 2.59	0.69	0.325	-0.68, 2.06

Table 7. Whole-Day, School-Hour and Non-School-Hour DQI Scores among Canadian Children and Youth Aged 6 to 18 by Food Security Status: Difference-in-Differences Estimates

a) Food secure

Variable	Whole-day DQI			School-Hour DQI			Non-School-Hour DQI		
	β	p-value	95% CI	β	p-value	95% CI	β	p-value	95% CI
Intercept	65.26	0.000	60.55, 69.97	59.83	0.000	52.01, 67.65	63.85	0.000	59.38, 68.33
Intervention	0.86	0.107	-0.18, 1.91	-0.47	0.647	-2.53, 1.57	0.97	0.084	-0.13, 2.08
Post-Intervention	0.12	0.841	-1.10, 1.35	1.23	0.249	-0.86, 3.33	-0.08	0.888	-1.33, 1.15
DID	0.77	0.297	-0.67, 2.22	3.16	0.012	0.70, 5.62	0.15	0.848	-1.34, 1.63
Age	-1.39	0.001	-2.24, -0.54	-0.94	0.186	-2.34, 0.45	-1.19	0.003	-1.97, -0.40
Age^2	0.29	0.150	-0.01, 0.06	0.02	0.560	-0.046, 0.08	0.02	0.255	-0.01, 0.05
Female	-0.13	0.698	-0.82, 0.55	0.96	0.084	-0.12, 2.05	0.12	0.848	-0.57, 0.82
High School	-0.61	0.410	-2.07, 0.84	-1.94	0.092	-4.21, 0.31	0.34	0.628	-1.05, 1.74
Some post-secondary	1.47	0.001	0.59, 2.35	-2.10	0.946	-1.37, 1.28	1.28	0.004	0.41, 2.15
Rural	-0.85	0.079	-1.81, 0.09	0.16	0.814	-1.22, 1.56	-1.11	0.024	-2.09, -0.14
White	-0.61	0.264	-1.69, 0.46	-0.18	0.824	-1.85, 1.48	-0.82	0.172	-1.99, 0.03
Immigrant	0.80	0.281	-0.65, 2.26	0.53	0.714	-2.33, 3.40	1.15	0.131	-0.34, 2.64
Province of residence									
NL	-0.86	0.272	-2.42, 0.68	-2.19	0.080	-4.46, 0.24	-0.26	0.740	-1.84, 1.31
PEI	-0.50	0.458	-1.84, 0.83	-0.34	0.763	-2.58, 1.89	-0.75	0.321	-2.25, 0.73
NS	-1.79	0.005	-3.05, -0.53	-1.69	0.093	-3.66, 0.28	-1.46	0.020	-2.70, -0.23
NB	-1.60	0.018	-2.97, -0.27	-1.04	0.305	-3.03, 0.94	-0.92	0.183	-2.29, 0.43
QC	1.30	0.010	0.30, 2.29	1.54	0.054	-0.02, 3.11	1.16	0.023	0.16, 2.16
MB	-0.50	0.507	-1.99, 0.98	-0.20	0.857	-2.45, 2.04	-0.66	0.377	-2.15, 0.81
SK	-0.45	0.535	-1.89, 0.98	-0.64	0.598	-3.04, 1.75	-0.30	0.672	-1.72, 1.11
BC	0.39	0.462	-0.65, 1.43	0.36	0.673	-1.31, 2.03	1.30	0.020	0.20, 2.39
Income									
Quintile 2	-0.09	0.872	-1.26, 1.07	0.27	0.773	-1.59, 2.14	-0.055	0.926	-1.23, 1.12
Quintile 3	0.60	0.292	-0.52, 1.74	0.51	0.580	-1.30, 2.33	0.34	0.561	-0.82, 1.51
Quintile 4	1.03	0.095	-0.18, 2.24	0.46	0.624	-1.65, 2.55	0.83	0.190	-0.41, 2.09
Quintile 5	0.88	0.162	-0.35, 2.13	0.44	0.676	-1.37, 1.28	0.90	0.159	-0.35, 2.15

b) Food insecure, moderate

Variable	**Whole-Day DQI**			School-Hour DQI			Non-School-Hour DQI		
	β	p-value	95% CI	β	p-value	95% CI	β	p-value	95% CI
Intercept	72.47	0.000	58.07, 86.86	65.92	0.000	38.98, 92.86	67.57	0.000	52.38, 82.75
Intervention	-1.84	0.387	-6.03, 2.34	-3.75	0.315	-11.08, 3.58	-0.19	0.918	-3.88, 3.49
Post-Intervention	-0.11	0.961	-4.77, 4.54	2.66	0.399	-3.54, 8.87	0.51	0.820	-3.91, 4.94
DID	-0.52	0.853	-6.05, 5.01	0.82	0.832	-6.86, 8.52	-2.66	0.265	-8.43, 3.10
Age	-2.14	0.141	-4.99, 0.71	-1.54	0.549	-6.60, 3.51	-1.75	0.246	-4.72, 1.21
Age^2	0.05	0.409	-0.07, 0.19	0.05	0.641	-0.18, 0.29	0.04	0.505	-0.09, 0.18
Female	0.84	0.483	-1.52, 3.22	1.88	0.336	-1.96, 5.72	1.15	0.388	-1.47, 3.78
High School	-2.50	0.429	-8.71, 3.70	-5.26	0.257	-14.37, 3.84	-0.62	0.843	-6.82, 5.57
Some post-secondary	-1.29	0.301	-3.73, 1.15	-1.60	0.930	-3.72, 3.40	-1.02	0.487	-3.92, 1.86
Rural	3.00	0.031	0.26, 5.75	2.91	0.284	-2.42, 8.26	0.92	0.575	-2.31, 4.15
White	-0.75	0.681	-4.34, 2.84	-1.49	0.513	-5.98, 2.99	-2.66	0.180	-6.57, 1.23
Immigrant	5.07	0.011	1.18, 8.97	5.86	0.054	-0.09, 11.81	2.08	0.318	-2.00, 6.16
Province of residence									
NL	-1.43	0.653	-7.67, 4.80	-5.86	0.170	-14.24, 2.52	1.79	0.562	-4.28, 7.88
PEI	1.14	0.682	-4.33, 6.62	1.92	0.650	-6.41, 10.25	3.70	0.198	-1.94, 9.36
NS	-1.93	0.403	-6.49, 2.61	-1.77	0.549	-7.61, 4.06	1.18	0.649	-3.91, 6.28
NB	-4.31	0.060	-8.81, 0.19	-7.43	0.026	-13.96, -0.9	-1.18	0.563	-5.21, 2.84
QC	2.42	0.200	-1.29, 6.14	-0.13	0.961	-5.67, 5.39	4.59	0.033	0.36, 8.82
MB	-5.09	0.013	-9.10, -1.07	-3.29	0.359	-10.37, 3.77	-3.35	0.080	-7.10, 0.40
SK	-0.83	0.853	-9.69, 7.99	-4.44	0.314	-13.10, 4.22	2.63	0.530	-5.61, 10.88
BC	3.52	0.054	-0.05, 7.11	0.64	0.806	-4.47, 5.75	3.73	0.062	-0.18, 7.65
Income									
Quintile 2	-0.43	0.789	-3.59, 2.72	-1.72	0.493	-6.68, 3.22	0.55	0.740	-2.72, 3.83
Quintile 3	-1.55	0.722	-5.18, 4.07	2.69	0.419	-3.85, 9.24	-1.90	0.411	-6.45, 2.64
Quintile 4	-0.89	0.243	-5.87, 4.07	-5.53	0.146	-13.00, 1.93	-0.24	0.932	-5.97, 5.47
Quintile 5	5.33	0.301	-3.63, 14.31	6.01	0.716	-26.54, 38.58	4.24	0.170	-1.81, 10.31

c) Food insecure, severe

Variable	**Whole-Day DQI**			School-Hour DQI			Non-School-Hour DQI		
	β	p-value	95% CI	β	p-value	95% CI	β	p-value	95% CI

Intercept	89.67	0.000	49.07, 130.27	46.94	0.194	-26.70, 120.59	91.04	0.000	53.31, 128.76
Intervention	-2.29	0.659	-12.74, 8.14	-14.99	0.313	-45.63, 15.63	0.30	0.959	-11.66, 12.27
Post-Intervention	-1.98	0.690	-11.98, 8.01	-14.25	0.301	-41.61, 14.10	-1.31	0.815	-12.64, 10.00
DID	-6.76	0.736	-10.77, 15.13	18.61	0.246	-14.27, 51.49	2.31	0.720	-10.63, 15.26
Age	0.30	0.061	-13.85, 0.33	2.10	0.703	-9.45, 13.67	-7.34	0.042	-14.42, -0.27
Age^2	-6.76	0.069	-0.02, 0.63	0.02	0.927	-0.47, 0.51	0.34	0.037	0.02, 0.66
Female	-3.53	0.290	-10.18, 3.12	-2.54	0.768	-20.63, 15.53	-2.16	0.543	-9.30, 4.97
High School	-0.68	0.933	-16.97, 15.61	-15.85	0.117	-36.15, 4.45	-3.43	0.682	-20.25, 13.38
Some post-secondary	2.24	0.535	-5.01, 9.51	-6.00	0.365	-19.71, 7.70	3.08	0.264	-2.42, 8.59
Rural	-11.86	0.015	-21.31, -2.41	-2.97	0.437	-10.90, 4.95	-12.01	0.014	-21.46, -2.57
White	-2.48	0.517	-10.18, 5.20	-1.83	0.686	-11.33, 7.66	-4.64	0.243	-12.57, 3.28
Immigrant	1.18	0.870	-13.32, 15.69	11.46	0.360	-14.43, 37.37	-0.34	0.959	-13.55, 12.87
Province of residence									
NL	10.96	0.032	1.02, 20.90	-10.36	0.395	-35.62, 14.88	12.23	0.040	0.60, 23.87
PEI	32.70	0.000	16.70, 48.71	21.29	0.183	-11.21, 53.81	30.42	0.000	14.69, 46.15
NS	5.93	0.384	-7.70, 19.57	-5.71	0.439	-21.05, 9.61	8.57	0.259	-6.55, 23.71
NB	5.33	0.450	-8.81, 19.49	12.94	0.084	-1.96, 27.85	1.14	0.855	-11.41, 13.69
QC	-5.65	0.708	-17.31, 6.01	10.30	0.271	-8.93, 29.53	-11.70	0.027	-21.99, -1.41
MB	2.35	0.373	-10.27, 14.99	-10.72	0.431	-38.93, 17.39	4.77	0.477	-8.67, 18.22
SK	5.50	0.260	-6.85, 17.86	9.69	0.276	-8.57, 27.96	4.86	0.438	-7.68, 17.40
BC	-4.51	0.373	-12.52, 3.48	1.83	0.863	-20.47, 24.15	1.12	0.811	-8.31, 10.57
Income									
Quintile 2	-0.19	0.964	-8.95, 8.55	-4.15	0.716	-28.02, 19.71	-2.82	0.539	12.06, 6.40
Quintile 3	1.44	0.821	-11.36, 14.25	-17.43	0.031	-32.99, -1.87	2.06	0.759	-11.45, 15.58

Table 8. Mean School-HEI Scores from 2004 to 2015, Excluding Respondents Who Completed the Questionnaire on a Weekend

	Tugault-Lafleur(16)	Our study
2004	51.3	51.8
2015	58.0	57.6

Supplemental Table 1. Provincial School Nutrition Policy

Province	Implemented mandatory school nutrition policy (Y/N)	Elementary school year implemented	High school year implemented	Policy specifics
British Columbia[31]	Y	January 2008	September 2008	• Defines minimum nutrition standard for schools sold in schools • Freshly made foods scored as either "sell (100% of choices)" or "don't sell (0% of choices)" • Prepackaged foods scored as either "sell most (at least 50% of choices)", "sell sometimes (up to 50% of choices)", "do not sell (should not be sold to students)" • Includes optional policies: restricting the marketing of unhealthy food and beverages, limiting the sale of sugar substitutes, and supporting healthy eating in the classroom
Alberta[32]	N			• Provides recommendations for childcare facilities, school facilities, recreational facilities and environments, and overall for any environment where children may be present • Provides guidelines for foods to choose most often, choose sometimes, and choose least often from each food group
Saskatchewan[33]	N			• Provides guidelines for foods to choose most often and choose sometimes for each food group and for mixed dishes

Manitoba[34]	N			• Provides guidelines/checklists for school food environment, breakfast/snack/lunch programs, foods sold in cafeteria, canteen/vending machines, sporting events, special lunch days • Provides nutrition criteria for processed/packaged products and convenience items • Provides information on fibre, sodium, sugar, sugar substitutes, trans fat, and whole grains and what to look for in ingredient lists (e.g., different names for sugar)
Ontario[35]	Y	2011	2011	• Requires that all food and beverages sold in schools comply with policy requirements and nutrition standards • Nutrition criteria divided into “sell most”, “sell less”, and “not permitted for sale” categories • Foods in sell most category must make up at least 80% of foods sold and sell less must be less than 20% • Foods in “not permitted for sale” category are not allowed at all • Guidelines for how to categorize foods is provided to schools • Schools are allowed up to 10 days a year where foods sold don’t need to meet nutrition standards for special events
Quebec[36]	Y	2008	2008	• Policy framework consists of two orientations for healthy eating: 1) offer a variety of foods and prioritize foods with

				high nutritional value; 2) eliminate foods of low nutrition value from schools • Provides nutritional guidelines for schools to implement for foods sold/provided in schools • Requires elimination of sugar-sweetened beverage, French fries, foods with sugar as the first ingredient, and frying of foods • Foods sold at school events, fundraisers, etc. need to meet nutritional guidelines
New Brunswick[37–39]	Y	2005	2005	• Groups foods into "higher nutritional value" and "lower nutritional value" and provides guidelines on how to determine which category a food falls into • Mandates that only foods in the "higher nutritional value" group may be sold • Provides nutritional guidelines for selling "a la carte" items • Lunch meals must include at least: vegetables, fruit, whole grain products, milk/alternatives and meat/alternatives • Foods sold at fundraisers must still fall into "higher nutritional value" category
Nova Scotia[40]	Y	2007	2007	• Categorizes foods as "maximum nutrition", "moderate nutrition", and "minimum nutrition" • Maximum, moderate, and minimum nutrition foods can be sold every day, no more than two times a week, and once or twice a month for special events, respectively • Provides guidelines on how to group foods, as well as information on the

				rationale behind why consumption certain nutrients are encouraged (e.g. fibre) or limited (e.g. trans fat) • Breakfast programs must meet the nutrition policy standards
Prince Edward Island[41,42]	Y	2005	2011	• Foods categorized into "foods to serve most often", "foods to serve sometimes", "foods to serve least often", and "healthier vending machine and canteen foods" • Foods available for breakfast and lunch should come from "foods to serve most often" or "foods to serve sometimes" • Foods from the "foods to serve least often" should rarely be sold • Foods sold in vending machines must meet nutritional standards, sugar-sweetened beverages and other low-nutritional beverages are not to be sold • Pricing should encourage students to purchase healthier foods • Schools should use a comprehensive approach to nutrition education
Newfoundland and Labrador[43]	N			• Encourages a focus on the four food groups • Groups foods as "serve most" and "serve moderately" and provides guidelines specific to each food group • At least 50% of items sold should come from the serve most category • Provides guidelines on foods to limit and serving sizes

Supplemental Table 2. Scoring criteria for 2015 Canadian HEI

Component	Maximum points	Criteria for max score	Criteria for min score
Adequacy sub-score	**60**		
Total fruits and vegetables	10	4-10 servings	No servings
Whole fruits	5	0.84-2.1 servings (21% of fruits and vegetables)	No servings
Greens and beans	5	0.42-1.05 servings (10.5% of fruits and vegetables)	No servings
Whole grains	10	1.5-4 servings (50% of grains)	No servings
Dairy	10	2-4 servings	No servings
Total protein foods	5	1-3 servings	No servings
Seafood and plant proteins	5	0.32-0.96 servings (32% of meats and alternatives)	No servings
Fatty acids	10	(PUFA+MUFA)/SFA $\geq$ 2.5	(PUFA+MUFA)/SFA $\leq$1.2
Moderation sub-score	**40**		
Refined grains	10	<50% of grains refined	$\geq$50% of grains refined
Sodium	10	AI to UL	2x UL
Added sugars	10	$\leq$6.5% of energy	$\geq$26% of energy
Saturated fats	10	$\leq$8% of energy	$\geq$16% of energy

* PUFA = Polyunsaturated Fatty Acids, MUFA = Monounsaturated Fatty Acids, SFA = Saturated Fatty Acids, AI = Adequate Intake, TUL = Tolerable Upper Limit

Supplemental Table 3. Scoring criteria for DQI-I[21]

Component	Score ranges	Points	Scoring criteria
Variety	**0-20**		
Overall food group variety	0-15	15	≥ 1 serving from each food group/d
		12	Any 1 food group missing/d
		9	Any 2 food groups missing/d
		6	Any 3 food groups missing/d
		3	≥ 4 food groups missing/d
		0	None from any food group
Within-group variety from protein source	0-5	5	≥ 3 different sources/d
		3	2 different sources/d
		1	From 1 source/d
		0	None
Adequacy	**0-40**		
Vegetable group	0-5	5	> 100% recommendations
		3	50-100% recommendations
		1	< 50% recommendations
		0	0% recommendations
Fruit group	0-5	5	> 100% recommendations
		3	50-100% recommendations
		1	< 50% recommendations
		0	0% recommendations
Grain group	0-5	5	> 100% recommendations
		3	50-100% recommendations
		1	< 50% recommendations
		0	0% recommendations
Fibre	0-5	5	> 100% recommendations
		3	50-100% recommendations
		1	< 50% recommendations
		0	0% recommendations
Protein	0-5	5	> 100% recommendations

		3	50-100% recommendations
		1	< 50% recommendations
		0	0% recommendations
Iron	0-5	5	> 100% recommendations
		3	50-100% recommendations
		1	< 50% recommendations
		0	0% recommendations
Calcium	0-5	5	> 100% recommendations
		3	50-100% recommendations
		1	< 50% recommendations
		0	0% recommendations
Vitamin C	0-5	5	> 100% recommendations
		3	50-100% recommendations
		1	< 50% recommendations
		0	0% recommendations
Moderation	**0-30**		
Total fat	0-6	6	≤ 20% of total energy/d
		3	> 20-30% of total energy/d
		0	> 30% of total energy/d
Saturated fat	0-6	6	≤ 7% of total energy/d
		3	> 7-10% of total energy/d
		0	> 10% of total energy/d
Cholesterol	0-6	6	≤ 300 mg/d
		3	> 300-400 mg/d
		0	> 400 mg/d
Sodium	0-6	6	≤ 2400 mg/d
		3	> 2400-3400 mg/d
		0	> 3400 mg/d
Empty calorie food	0-6	6	< 3% of total energy/d
		3	> 3-10% of total energy/d
		0	> 10% of total energy/d
Overall balance	**0-10**		

Macronutrient ratio (carbohydrate-protein-fat)	0-6	6	55-65:10-15:15-25
		4	52-68:9-16:13-27
		2	50-70:8-17:12-30
		0	Otherwise
Fatty acid ratio	0-4	4	P/S = 1-1.5; M/S = 1-1.5
		2	P/S = 0.8-1.7; M/S = 0.8-1.7
		0	Otherwise

* M/S = Ratio of MUFA to SFA intakes, P/S = Ratio of PUFA to SFA intakes

Supplemental Table 4. Respondents included in the final sample

	Included in sample		
Year	Yes (%)	No (%)	Total
2004	8186 (84.30)	1524 (15.70)	9710
2015	3956 (93.59)	271 (6.41)	4227
Total	12,142	1795	13,937

Supplemental Table 4 presents the number of respondents in the original dataset and the number that were included in the final sample. 8186 respondents from the 2004 CCHS and 3956 respondents from the 2015 CCHS were included in the final sample, giving an overall sample size of 12,142.

Supplemental Table 5. Number missing for included variables

	Original Sample Size: 13,937	
	2004: 9710	**2015: 4227**
Age	0	0
Sex	0	0
Province of residence	0	0
Rural/Urban	0	0
Some post-secondary education completed and Immigrant	139	16
Identify as white	8	262
Income	1004	0
Final sample size	**8186**	**3956**
Total sample size	**12,142**	

Supplemental Table 5 presents the number of responses missing for variables included in analyses.

Supplemental Table 6. Study population characteristics

Variable	2004		2015	
	Mean or %	SD	Mean or %	SD
Age	11.44	3.33	11.70	3.38
Age^2	141.91	77.30	148.33	79.54
Intervention (%)	80.73	—	79.25	—
Female (%)	48.70	—	49.65	—
High school (%)	35.96	—	40.17	—
Some post-secondary completed in household (%)	74.35	—	83.43	—
Rural (%)	18.95	—	18.97	—
Immigrant (%)	6.64	—	11.98	—
White (%)	82.65	—	71.04	—
Province of residence				
NL (%)	1.49	—	1.31	—
PEI (%)	0.46	—	0.44	—
NS (%)	2.91	—	2.55	—
NB (%)	2.27	—	2.09	—
QC (%)	21.99	—	23.25	—
ON (%)	40.71	—	39.00	—
MB (%)	3.81	—	3.52	—
SK (%)	2.95	—	3.03	—
AB (%)	11.02	—	12.89	—
BC (%)	12.39	—	11.91	—
Income quintile				
1 (%)	22.47	—	21.55	—
2 (%)	22.63	—	20.18	—
3 (%)	21.17	—	23.87	—
4 (%)	20.19	—	18.40	—
5 (%)	13.54	—	16.01	—
Food security status				
Food secure (%)	94.46	—	94.63	

Food insecure, moderate (%)	5.04	—	5.05
Food insecure, severe (%)	0.50	—	0.31

Supplemental Table 6 presents the characteristics of the study population in 2004 and 2015. The average age of this group was 11.44 years (SD: 3.33) in 2004 and 11.70 years (SD: 3.38) in 2015. In 2004, 48.70% of the study population were female, compared to 49.65% in 2015. In 2004, 74.35% of the study population had a household member who had been awarded a post-secondary degree (at least “trades certificate or diploma awarded”), compared to 83.43% in 2015. In 2004, 18.95% of the study population resided in a rural area, compared to 18.97% in 2015. In 2004, 6.64% of the study population were immigrants, compared to 11.98% in 2015. In 2004, 82.65% of the study population identified as white, compared to 71.04% in 2015. The percentage of the study population residing in each province remained similar between 2004 and 2015.

Supplemental Table 7. Changes in Whole-Day, School-Hour, and Non-School-Hour HEI Scores among Canadian Children and Youth Aged 6 to 18: Difference-in-Differences Estimates

Variable	Whole-day HEI						School-hour HEI						Non-school-hour HEI					
	Conventional			DID			Conventional			DID			Conventional			DID		
	β	p-value	95% CI	β	p-value	95% CI	β	p-value	95% CI	β	p-value	95% CI	β	p-value	95% CI	β	p-value	95% CI
Intercept	62.28	0.000	56.71, 67.85	61.71	0.000	58.19, 67.24	53.09	0.000	45.18, 61.00	51.81	0.000	44.11, 59.51	60.59	0.000	55.39, 65.80	60.35	0.000	55.17, 65.53
Intervention	1.78	0.013	0.38, 3.18	1.75	0.050	0.28, 3.23	-0.50	0.554	-2.13, 1.14	-1.32	0.269	-3.67, 1.02	2.14	0.002	0.79, 3.49	1.47	0.039	0.07, 2.86
Post				1.23	0.107	-0.27, 2.73				5.42	0.000	3.19, 7.64				1.63	0.028	0.18, 3.08
DID				0.08	0.933	-1.71, 1.87				2.21	0.095	-0.38, 4.81				-0.12	0.887	-1.85, 1.60

Supplemental Table 7 presents the estimated impact of nutrition policy on whole-day HEI, school-hour HEI, and non-school-hour HEI in the study population. Whole-day HEI scores did not change (β = 0.08, 95% CI: -1.714 to 1.869, p = 0.933). HEI scores during school-hours (β = 2.21, 95% CI: -0.38 to 4.81, p = 0.095) and outside of school-hours (β = -0.12, 95% CI: -1.85 to 1.62, p = 0.887) did not change.

Supplemental Table 8. Whole-Day, School-Hour and Non-School-Hour HEI Scores among Canadian Children and Youth Aged 6 to 18 by Sex: Difference-in-Differences Estimates

a) Males

Variable	Whole-day HEI			School-hour HEI			Non-school-hour HEI		
	β	p-value	95% CI	β	p-value	95% CI	β	p-value	95% CI
Intercept	64.52	0.000	56.76, 72.27	53.38	0.000	43.19, 63.57	65.73	0.000	58.68, 72.27
Intervention	0.89	0.386	-1.13, 2.92	-2.43	0.136	-5.62, 0.77	0.04	0.973	-2.01, 2.08
Post-Intervention	0.96	0.358	-1.09, 3.03	4.21	0.007	1.13, 7.29	1.69	0.099	-0.31. 3.69
DID	0.73	0.562	-1.75, 3.22	4.32	0.016	0.81, 7.83	-0.04	0.977	-2.44, 2.37

b) Females

Variable	Whole-day HEI			School-hour HEI			Non-school-hour HEI		
	β	p-value	95% CI	β	p-value	95% CI	β	p-value	95% CI
Intercept	59.27	0.000	51.40, 67.13	50.86	0.000	39.48, 62.23	55.43	0.000	47.90, 62.96
Intervention	2.75	0.011	0.63, 4.88	-0.18	0.917	-3.50, 3.12	2.93	0.002	1.09, 4.76
Post-Intervention	1.63	0.128	-0.47, 3.74	6.76	0.000	3.62, 9.89	1.76	0.086	-0.25, 3.78
DID	-0.79	0.537	-3.32, 1.73	-0.07	0.970	-3.78, 3.64	-0.52	0.668	-2.94, 1.89

Supplemental Table 8 presents the estimated impact of nutrition policy on whole-day HEI scores, during school-hours HEI, and outside of school-hours HEI by sex. Among males, whole-day HEI scores did not change (β = 0.73, 95% CI: -1.751 to 3.221, p = 0.562). HEI scores during school-hours increased by 4.32 points (95% CI: 0.81 to 7.83, p = 0.016), but HEI scores outside of school-hours did not change (β = -0.04, 95% CI: -2.44 to 2.37, p = 0.977). Among females, whole-day HEI scores did not change (β = -0.79, 95% CI: -3.321 to 1.730, p = 0.537). HEI scores during school-hours and non-school-hours decreased but statistically non-significant by 0.07 points (95% CI: -3.78 to 3.64, p = 0.970) and 0.52 points (95% CI: -2.94 to 1.89, p = 0.668), respectively.

Supplemental Table 9. Whole-Day, School-Hour and Non-School-Hour HEI Scores among Canadian Children and Youth Aged 6 to 18 by School Grade: Difference-in-Differences Estimates

a) Elementary school

Variable	Whole-day HEI			School-hour HEI			Non-school-hour HEI		
	β	p-value	95% CI	β	p-value	95% CI	β	p-value	95% CI
Intercept	66.52	0.000	55.96, 77.08	43.03	0.000	29.22, 56.83	69.12	0.000	59.15, 79.09
Intervention	1.50	0.128	-0.43, 3.44	-2.25	0.133	-5.18, 0.68	0.87	0.343	-0.93, 2.68
Post-Intervention	0.85	0.394	-1.10, 2.81	4.41	0.003	1.55, 7.27	1.19	0.211	-0.67, 3.05
DID	0.46	0.700	-1.87, 2.79	3.86	0.022	0.56, 7.15	0.09	0.940	-2.14, 2.30

b) High school

Variable	Whole-day HEI			School-hour HEI			Non-school-hour HEI		
	β	p-value	95% CI	β	p-value	95% CI	β	p-value	95% CI
Intercept	124.26	0.008	32.81, 215.71	142.31	0.034	10.50, 274.12	66.93	0.115	-16.27, 150.14
Intervention	2.23	0.047	0.03, 4.44	0.44	0.822	-3.35, 4.22	2.49	0.024	0.33, 4.65
Post-Intervention	2.03	0.080	-0.24, 4.31	7.11	0.000	3.61, 10.59	2.41	0.039	0.12, 4.67
DID	-0.75	0.592	-3.50, 1.99	-0.65	0.758	-4.80, 3.49	-0.51	0.714	-3.21, 2.22

Supplemental Table 9 presents the estimated change in HEI scores overall, during school-hours, and outside of school-hours by school grade. Among elementary school students, whole-day HEI scores did not change (β = 0.46, 95% CI: -1.874 to 2.793, p = 0.700) in the intervention group from 2004 to 2015. HEI scores during school-hours increased by 3.86 points (95% CI: 0.56 to 7.15, p = 0.022). HEI scores outside of school-hours did not change (β = 0.09, 95% CI: -2.14 to 2.30, p = 0.940). Among high school students, whole-day HEI scores did not change (β = -0.75, 95% CI: -3.501 to 1.999, p = 0.592) in the intervention group from 2004 to 2015. HEI scores during school-hours (β = -0.65, 95% CI: -4.80 to 3.49, p = 0.758) and outside of school-hours did not change (β = -0.51, 95% CI: -3.21 to 2.22, p = 0.714).

Supplemental Table 10. Whole-Day, School-Hour and Non-School-Hour HEI Scores among Canadian Children and Youth Aged 6 to 18 by Income Group: Difference-in-Differences Estimates

a) Low income household

Variable	Whole-day HEI			School-hour HEI			Non-school-hour HEI		
	β	p-value	95% CI	β	p-value	95% CI	β	p-value	95% CI
Intercept	57.49	0.000	49.44, 65.54	48.23	0.000	36.15, 60.31	59.41	0.000	51.87, 66.94
Intervention	2.63	0.013	0.56, 4.70	-3.79	0.066	-7.82, 0.25	0.99	0.365	-1.16, 3.16
Post-Intervention	0.18	0.878	-2.08, 2.44	5.53	0.003	1.84, 9.22	1.24	0.274	-0.98, 3.47
DID	0.30	0.831	-2.48, 3.09	1.68	0.433	-2.53, 5.90	-0.37	0.788	-3.06, 2.32

b) Middle-high income household

Variable	Whole-day HEI			School-hour HEI			Non-school-hour HEI		
	β	p-value	95% CI	β	p-value	95% CI	β	p-value	95% CI
Intercept	65.84	0.000	58.24, 73.44	56.24	0.000	46.36, 66.12	61.94	0.000	54.67, 69.22
Intervention	1.14	0.285	-0.95, 3.23	0.58	0.660	-2.01, 3.17	1.80	0.053	-0.02, 3.63
Post-Intervention	1.98	0.051	-0.01, 3.97	5.34	0.000	2.73, 7.94	1.80	0.065	-0.11, 3.72
DID	-0.22	0.854	-2.55, 2.11	2.55	0.109	-0.56, 5.67	0.06	0.962	-2.21, 2.31

Supplemental Table 10 presents the estimated change in HEI scores overall, during school-hours, and outside of school-hours by income group. Among the low income group, whole-day HEI scores did not change (β = 0.30, 95% CI: -2.48 to 3.09, p = 0.831). HEI scores during school-hours (β = 1.68, 95% CI: -2.53 to 5.90, p = 0.433) and outside of school-hours did not change (β = -0.37, 95% CI: -3.06 to 2.32, p = 0.788). Among the middle-high income group, whole-day HEI scores did not change (β = -0.22, 95% CI: -2.55 to 2.11, p = 0.854). HEI scores during school-hours (β = 2.55, 95% CI: -0.56 to 5.67, p = 0.109) and outside of school-hours did not change (β = 0.06, 95% CI: -2.21 to 2.31, p = 0.962).

Supplemental Table 11. Whole-Day HEI Scores, School-Hour and Non-School-Hour HEI Scores among Canadian Cren and Youth Aged 6 to 18 by Food Security Status: Difference-in-Differences Estimates

a) Food secure

Variable	Whole-day HEI			School-hour HEI			Non-school-hour HEI		
	β	p-value	95% CI	β	p-value	95% CI	β	p-value	95% CI
Intercept	62.70	0.000	56.93, 68.44	52.46	0.000	44.14, 60.78	59.92	0.000	54.50, 65.35
Intervention	1.07	0.156	-0.41, 2.55	-0.58	0.639	-3.03, 1.85	1.38	0.063	-0.07, 2.84
Post-Intervention	1.32	0.098	-0.24, 2.90	5.97	0.000	3.65, 8.29	1.51	0.050	-0.02, 3.03
DID	0.36	0.706	-1.50, 2.22	1.84	0.185	-0.88, 4.57	0.25	0.784	-1.54, 2.04

b) Food insecure, moderate

Variable	Whole-day HEI			School-hour HEI			Non-school-hour HEI		
	β	p-value	95% CI	β	p-value	95% CI	β	p-value	95% CI
Intercept	45.81	0.000	23.75, 67.84	40.29	0.007	10.84, 69.73	53.44	0.000	34.75, 72.13
Intervention	0.99	0.702	-4.12, 6.12	-7.18	0.096	-15.64, 1.27	3.75	0.135	-1.16, 8.67
Post-Intervention	1.95	0.439	-3.00, 6.92	4.90	0.141	-1.63, 11.45	3.97	0.107	-0.86, 8.81
DID	-6.07	0.072	-12.70, 0.54	-1.02	0.813	-9.53, 7.48	-7.15	0.030	-13.61, -0.69

c) Food insecure, severe

Variable	Whole-day HEI			School-hour HEI			Non-school-hour HEI		
	β	p-value	95% CI	β	p-value	95% CI	β	p-value	95% CI
Intercept	92.56	0.000	52.02, 133.09	8.68	0.844	-83.85, 101.22	83.39	0.000	51.20, 115.58
Intervention	-0.21	0.971	-11.52, 11.10	-0.606	0.976	-43.42, 42.21	2.59	0.667	-9.50, 14.68
Post-Intervention	5.13	0.349	-5.81, 16.08	-20.26	0.239	-55.44, 14.92	2.85	0.559	-6.93, 12.64
DID	4.20	0.514	-8.69, 17.10	23.74	0.235	-17.13, 64.63	3.55	0.566	-8.83, 15.99

Supplemental Table 11 presents the estimated change in HEI scores overall, during school-hours, and outside of school-hours by food security status. Among the food secure group, whole-day HEI scores did not change (β = 0.36, 95% CI: -1.50 to 2.22, p = 0.706) in the intervention group from 2004 to 2015. HEI scores during school-hours (β = 1.84, 95% CI: -0.88 to 4.57, p = 0.185) and outside of school-hours (β = 0.25, 95% CI: -1.54 to 2.04, p = 0.784) did not change. Among the moderately food insecure group, whole-day HEI scores did not change (β = -6.07, 95% CI: -12.70 to 0.54, p = 0.072). HEI scores during school-hours did not change (β = -1.02, 95% CI: -9.53 to 7.48, p = 0.813). HEI scores outside of school-hours decreased by 7.15 points (95% CI: -13.61 to -0.69, p = 0.030). Among the severely food insecure group, whole-day HEI scores did not change (β = 4.20, 95% CI: -8.69 to 17.10, p = 0.514). HEI scores during school-hours (β = 23.74, 95% CI: -17.13 to 64.43, p = 0.235) and outside of school-hours (β = 3.55 95% CI: -8.83 to 15.99, p = 0.566) did not change.