

# School Region Socio-economic Status and Geographic Locale is Associated with Food Behaviour of Ontario and Alberta Adolescents

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## ABSTRACT

**Background:** In an attempt to elucidate broader determinants of adolescent dietary intake and habits, food intakes and selected food behaviours of grades 9 and 10 students from Ontario and Alberta were examined according to school region socio-economic status and urban/rural locale.

**Methods:** Using a stratified random sample framework, 53 high schools from 28 school boards were recruited (45 public and 8 private; 33 urban and 20 rural). Median family income for Canada Post's forward sortation area of the school was used to define school region SES. Public and private schools were compared as a proxy measure of SES. A web-based survey of food intake and behaviours, including a 24-hour diet recall and food frequency questionnaire, was completed by 2,621 students in grades 9 and 10. Comparison of intakes and behaviours by school designation as urban/rural, public/private or regional SES (generalized linear model procedure) controlled for student gender and grade distribution and number of participants within schools.

**Results:** School region SES ranged from \$40,959 to \$85,922/year. Vegetable and fruit consumption ( $p < 0.001$ ), fibre intake ( $p < 0.001$ ) and frequency of breakfast consumption ( $p < 0.01$ ) increased with increasing income, while added sugar intake decreased ( $p < 0.01$ ). Private versus public school students had lower intakes of sweetened drinks ( $p < 0.01$ ) and higher intakes of fibre ( $p = 0.02$ ). Rural students reported higher mean intakes of calcium (1106 vs. 995 mg/day, respectively,  $p = 0.03$ ) and milk products (2.7 vs. 2.3 servings/day,  $p < 0.01$ ) than urban students.

**Conclusion:** Selected food behaviours of youth from Ontario and Alberta improve with increasing school SES and vary with rural/urban school locale. Identifying regional demographics may be useful in tailoring healthy eating programs to the specific school.

**MeSH terms:** Nutrition; population health; adolescent; cross-sectional studies

*La traduction du résumé se trouve à la fin de l'article.*

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The obesity epidemic in Canadian youth continues to intensify.<sup>1-3</sup> Since excessive weight in youth has negative consequences for both immediate<sup>2,4</sup> and long-term<sup>5</sup> health, research is increasingly focussed on factors that contribute to adolescent obesity.

Both socio-economic environment and geographic locale may influence diet and consequent long-term energy balance<sup>1</sup>. For example, breakfast skipping and high soft drink consumption have been associated with low SES and suboptimal nutrition.<sup>6</sup> Moreover, low intakes of calcium,<sup>7</sup> iron,<sup>8</sup> folate,<sup>9</sup> vitamin D<sup>10</sup> and fibre,<sup>6,11</sup> and high intakes of fat<sup>10,11</sup> and sugar<sup>11,12</sup> are more prevalent among people with low income. Dietary quality has also been found to vary by degree of urbanization. Although unstudied in Canada, rural children in the United States had higher caloric and fat intakes than urban children.<sup>13</sup>

Schools provide access to student populations that are generally representative of the community in which the school is situated. In addition, schools can significantly influence adolescents' food choices and food quality.<sup>14</sup>

This study examined the associations between both school region SES and geographic locale and grade nine and ten students' self reported food intake and behaviour. The study received approval from the Office of Research Ethics at University of Waterloo.

## METHODS

Schools in Ontario and Alberta, Canada were randomly selected using a stratified two-stage sampling scheme. Within regionally-defined strata, both Catholic and Public school boards were selected, using a probability proportional to the number of schools in the board. Within identified boards, four schools were randomly selected. Twenty private schools were randomly selected from the same regions based on sample sizes proportional to the relative number of private/non-private schools.

Of 161 schools from 28 school boards approached, 57 (35.4%) agreed to participate. Either passive or active parental consent was obtained based on school preference. Data collection took place from November 2002 to June 2003.

**Food behaviour questionnaire**

The web-based survey encompassed a 24-hour (24-hr) diet recall and questions on the frequency of specific food consumption or behaviours.<sup>15</sup> Validity of the survey compared with dietitian interviews for the same 24-hr period was good<sup>16</sup> (intraclass correlation coefficients for calories, fat, carbohydrates, calcium vitamin D of >0.65, n=2, grade 6-8). Test-retest reliability of the food frequency questionnaire was high, e.g., % agreement for cola, n=159 grade 9-10 students surveyed 6.5±5.1 days apart was 79.2%; kappa = 0.681, 95% CI = 0.57-0.79 across three categories: ≥once a day, 2-6 times/week, and ≤4 times/month.

**Food Group Consumption**

For the diet recall, students identified foods they consumed from approximately 500 foods on the survey. The nutritional quality of foods reported was assessed according to Canada’s Food Guide to Healthy Eating (CFGHE)<sup>17</sup> servings for the Food Groups: “vegetables and fruit”, “grain products”, “milk products”, “meat and alternatives” and “others.” Foods in the “other” group were further categorized as: mostly fat, mostly sugar, high salt/fat snacks and high calorie beverages according to Canadian Nutrient File descriptions.<sup>18</sup>

**Selected Nutrient Intake**

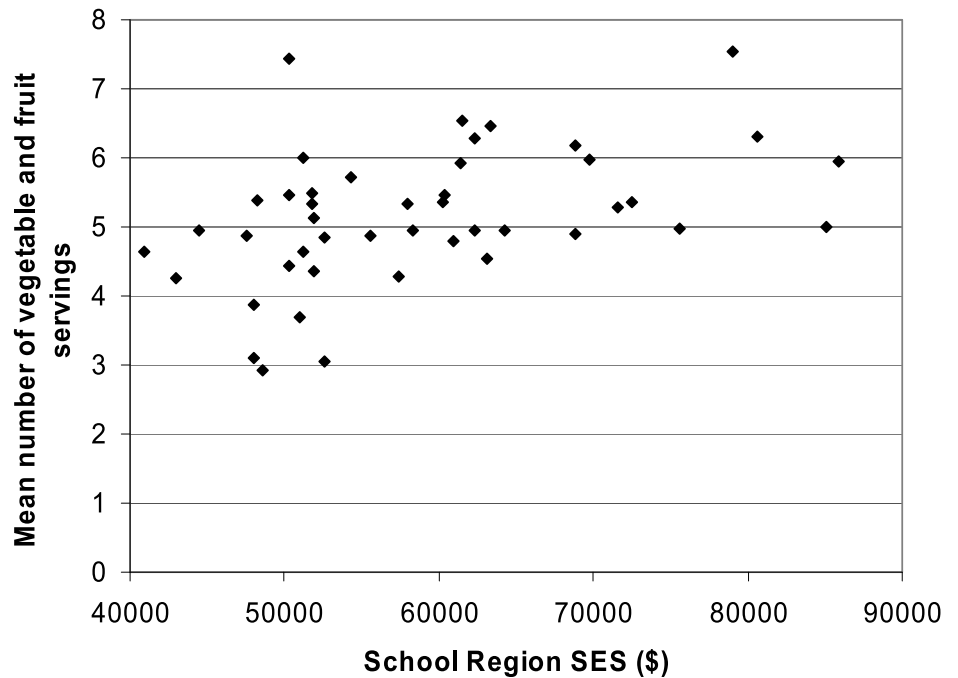
Intake of selected nutrients, specifically calcium, iron, folate, vitamin D and fibre, were estimated from diet recalls using ESHA, Food Processor® version 7.8 (Salem, Oregon) and Canadian Nutrient File 2001 data.<sup>18</sup> The added sugar content of survey foods was calculated by investigators and did not include naturally occurring sugars.

**Breakfast Skipping**

Breakfast skipping was assessed by the question, “How often do you usually eat breakfast?” and response options: “Every day,” “More than half of the week (≥4 days/week),” “Less than half of the week (≤3 days/week),” “Weekends only,” “Never” and “Not answered.”

**Cola Consumption**

The frequency of consumption of cola beverages was measured as an indicator of habitual sweetened beverage intake.



**Figure 1.** Mean vegetable and fruit intake (◆) varies by median family income of the school region

Participants selected from options: “At least twice a day,” “Once a day,” “5-6 times a week,” “2-4 times a week,” “2-4 times a month,” “Rarely/never” and “Not answered”.

**Socio-economic and geographic locale designation**

Since schools were the unit of random assignment, an aggregate measure of household income for the school region was used to denote SES. This was identified using the location’s forward sortation area (FSA), denoted by the first three digits of its Canadian postal code and the associated median family income from Statistics Canada 2001 data.

A second proxy measure of SES was the private/public distinction of schools, assuming that, on average, family income would be higher for those attending private versus public schools. Urban and rural designations were based on Canada Post descriptions of the schools’ FSA.

**Data analysis**

Data were analyzed using SAS statistical software package Version 8 (SAS Institute, Inc. Cary, NC). Food behaviour comparisons between urban/rural and public/private schools were conducted via the generalized linear model (GLM) procedure.

Residual plots were examined to ensure that data did not violate assumptions of the GLM procedure. Associations between school region SES and food behaviours were analyzed by linear regression. Private school data were excluded from analyses examining effects of school region SES. Grade and gender were controlled for in analyses. Data were also weighted by the number of participants per school. To control for false reporting, 129 diet records were excluded based on total caloric intakes of <200 or >6000 kcals or unfeasible food group intakes.

**RESULTS**

**Recruitment and participants**

Of the 57 schools recruited, 4 (7%) were excluded due to insufficient sample size for school-level analyses. Participating students thus represented 53 schools from 28 school boards across Ontario and Alberta. Forty-five public schools and eight private schools participated, of which 20 were rural and 33 urban, and 47% were from Ontario and 53% from Alberta. Of 2,615 students whose data were analyzed, 58% were girls and 52% were in grade 9. Median family incomes for the school regions ranged from \$40,959 to \$85,922 per year.

**TABLE I**  
**Food Groups and Nutrients: Differences by Public/Private Designation**

Variable	Mean $\pm$ Standard Error of the Mean		p
	Public schools n=45	Private schools n=8	
Food Group Servings			
Vegetables and fruit	5.2 $\pm$ 0.1	5.4 $\pm$ 0.3	0.589
Milk products	2.4 $\pm$ 0.1	2.5 $\pm$ 0.2	0.751
Grain products	5.3 $\pm$ 0.1	5.2 $\pm$ 0.3	0.861
Meat and alternatives	2.6 $\pm$ 0.1	2.6 $\pm$ 0.2	0.759
Other servings: mostly fat	0.8 $\pm$ 0.0	0.7 $\pm$ 0.1	0.427
Other servings: mostly sugar	0.5 $\pm$ 0.0	0.5 $\pm$ 0.1	0.791
Other servings: high salt/fat snack	0.8 $\pm$ 0.0	0.6 $\pm$ 0.1	0.086
Other servings: high calorie beverages	1.0 $\pm$ 0.0	0.7 $\pm$ 0.1	0.007
Other servings: high sugar/fat	0.4 $\pm$ 0.0	0.5 $\pm$ 0.1	0.175
Nutrient Intakes			
Iron intake (mg)	12.5 $\pm$ 0.2	12.9 $\pm$ 0.6	0.566
Folate intake (mcg)	302 $\pm$ 5	308 $\pm$ 16	0.740
Calcium intake (mg)	1021 $\pm$ 20	1071 $\pm$ 64	0.464
Vitamin D intake (mcg)	230 $\pm$ 5	235 $\pm$ 17	0.803
Fibre intake (g)	14 $\pm$ 0	16 $\pm$ 1	0.016
Added sugar intake (g)	84 $\pm$ 1	75 $\pm$ 5	0.081

**TABLE II**  
**Food Groups and Nutrients: Differences by Urban/Rural Designation\***

Variable	Mean $\pm$ Standard Error of the Mean		p
	Urban schools n=33	Rural schools n=20	
Food Group Servings			
Vegetables and fruit	5.3 $\pm$ 0.1	4.9 $\pm$ 0.2	0.089
Milk products	2.3 $\pm$ 0.1	2.7 $\pm$ 0.1	0.008
Grain products	5.2 $\pm$ 0.1	5.3 $\pm$ 0.2	0.954
Meat and alternatives	2.7 $\pm$ 0.1	2.5 $\pm$ 0.1	0.388
Other servings: mostly fat	0.7 $\pm$ 0.0	0.7 $\pm$ 0.1	0.969
Other servings: mostly sugar	0.5 $\pm$ 0.0	0.5 $\pm$ 0.1	0.744
Other servings: high salt/fat snack	0.8 $\pm$ 0.0	0.7 $\pm$ 0.1	0.166
Other servings: high calorie beverages	1.0 $\pm$ 0.0	0.9 $\pm$ 0.1	0.141
Other servings: high sugar/fat	0.4 $\pm$ 0.0	0.5 $\pm$ 0.0	0.063
Nutrient Intakes			
Iron intake (mg)	12.5 $\pm$ 0.2	12.5 $\pm$ 0.4	0.893
Folate intake (mcg)	305 $\pm$ 6	290 $\pm$ 10	0.210
Calcium intake (mg)	995 $\pm$ 24	1105 $\pm$ 43	0.028
Vitamin D intake (mcg)	223 $\pm$ 6	254 $\pm$ 11	0.015
Fibre intake (g)	14 $\pm$ 0	13 $\pm$ 0	0.129
Added sugar intake (g)	84 $\pm$ 2	83 $\pm$ 3	0.715

\* When only public and not private schools were included, urban (n=27) school populations had significantly lower intakes than rural (n=18) school populations for milk product servings (p=0.01) and calcium intake (p=0.03).

### Impact of school region SES

Mean vegetable and fruit intake within public schools ranged from 2.9 to 7.5 servings/day and was positively correlated with school region SES (p<0.001), with an increase of 0.33 servings for every \$10,000 increase in school region SES (Figure 1). For all other food groups, no significant relationship with school region SES was observed.

The mean daily fibre intake of the student population was positively correlated with school region SES (p<0.001) with an increase of 0.8 g of fibre for every \$10,000 increase in school region SES. Added sugar intake was negatively correlated with school region SES (p=0.009) with a decrease of 3.3 g added sugar for every \$10,000 increase in school region SES. No other nutrients were significantly influenced by school region SES.

Frequency of breakfast consumption was significantly correlated with school region SES, with students from regions of lower SES skipping breakfast more often than students from regions of higher SES (p=0.008). Frequency of cola beverage consumption was not significantly related to school region SES.

### Impact of private/public school designation

Most food group and nutrient intakes were similar by private and public school designation (Table I). Only the high calorie beverage group was consumed more frequently in public than private schools (1.0 $\pm$ 0.03 vs. 0.7 $\pm$ 0.11 servings/day, respectively, X $\pm$ SEM, p=0.007). Of the nutrients analyzed, only fibre differed significantly by school designation, being higher for private schools. Although both

breakfast skipping and cola beverage consumption tended to be more frequent in public vs. private schools, differences were not significant.

### Impact of urbanization

Food group and nutrient intakes are compared by rural and urban school designation in Table II. On average, students from rural schools drank significantly more milk than those from urban schools and had higher calcium and vitamin D intakes.

Students from rural versus urban schools tended to consume more servings of "high fat/sugar" foods, though the difference was not significant.

## DISCUSSION

The overwhelming cost of obesity to both the individual and society has prompted research on factors associated with adolescent obesity. This paper identified a relationship of both school region SES and school urban/rural locale with selected food behaviours and intake of Ontario and Alberta adolescents.

Only 49% of participating school populations satisfied the recommended 5-10 vegetable and fruit servings per day. Moreover, school region SES was positively correlated with students' average number of servings of vegetables and fruit, with an increase of approximately one-third serving per additional \$10,000. The protective associations of vegetable and fruit consumption with overweight,<sup>1</sup> coronary artery disease,<sup>19</sup> and several type of cancer<sup>20</sup> are widely documented. It is therefore imperative that students be given opportunities to increase vegetable and fruit intakes.

A recent systematic review of school-based programs<sup>21</sup> found that interventions including both environmental and educational components were more effective than single-component interventions, increasing daily intake of fruit by 0.2 to 0.6 servings and vegetables by 0 to 0.3 servings. Such multi-component interventions may be especially important for schools in lower SES areas.

In this study, mean fibre intake (range 8.7 g to 19.6 g) was much lower than the daily adequate intake of 26 g fibre for girls and 38 g for boys aged 14-18 years.<sup>22</sup> Mean fibre intake was also positively corre-

lated with school region SES, increasing about one gram per \$10,000 increase in school region SES. Consistent with these findings was the lower fibre intake of public vs. private school students. Low mean fibre intakes have also been observed in other Canadian<sup>23</sup> and American studies,<sup>24</sup> and may be inadequate for optimal health.

The high prevalence of breakfast skipping (49.3% in public school students for some days of the week) is similar to other findings in Canadian youth. Breakfast cereal is an important source of fibre,<sup>25</sup> hence skipping this meal may have contributed to the lower fibre intakes. Breakfast skipping may be an index of other unhealthy behaviours, such as smoking and physical inactivity.<sup>26</sup> Moreover, in the long term, breakfast skipping has been negatively associated with nutritional status, school attendance and dropout rates.<sup>27</sup> Since the prevalence of breakfast skipping increased with decreasing school region SES in this study, school breakfast programs may especially benefit students in regions of lower SES. Only 3% of students reported eating breakfast at school on the day surveyed, however the availability of specific programs was not assessed.

Public school students were more likely than private school students to report high-calorie beverage consumption and lower fibre intakes. In keeping with these findings, cola beverage consumption was somewhat more frequent among public than private school populations. Private versus public school students reported less frequent consumption of food from convenience stores ( $p=0.017$ ) and vending machines ( $p=0.006$ ), which is one possible explanation for this difference.

Neither urban nor rural students' mean calcium intake met the 1300 mg/day adequate intake suggested for adolescents.<sup>22</sup> Nevertheless, students from rural schools had a higher mean intake of milk products, calcium and vitamin D than students from urban schools. Given the overall low calcium intakes, it may be prudent to promote low-fat milk products within schools during this critical period for bone mineralization.<sup>28,29</sup>

Study results should be interpreted cautiously. There could potentially be a volunteer bias resulting from the poor response rate (35.4%) of randomly selected schools. For example the % of rural schools partici-

pating in the current study was 37.7%, but in the non-participating schools was 25.6%. Nevertheless, the school region SES was similar between participating schools (mean \$58,806, median \$57,339, range \$40,959-85,922) and non-participating schools (mean \$58,329, median \$54,716, range \$40,959-85,922), as was the distribution of incomes. Furthermore, the observed nutrient intakes and concerns are similar to those in other Canadian<sup>23,30</sup> and American<sup>24</sup> studies. It is recognized that SES and rural/urban status varies among individuals within a school. Moreover, the study did not address parental education level which may interact with income to affect children's food intake.<sup>1,7</sup> Finally, self-reported diet recalls frequently underestimate intake, do not reflect day-to-day variability of intake of individuals and may be influenced by social desirability.<sup>16</sup> Nevertheless, observed links between sub-optimal food intakes and school region SES or urban/rural status, in spite of these limitations, support a need for promotion of healthy diets, especially for students in lower SES locales.

### Implications

Many high school students are exposed to a plethora of high-fat and high-sugar foods within schools, in the forms of à la carte programs, vending machines, and fundraisers. Adolescents report that greater availability of convenient, tasty, low-priced healthy foods would help them improve their food choices.<sup>31-33</sup> School programs can have an important impact on student health indicators.<sup>34</sup> The findings of the current study support the need for healthy eating programs tailored to school demographics.

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## RÉSUMÉ

**Contexte :** Pour élucider les grands déterminants des habitudes et apports alimentaires des adolescents, nous avons analysé les rations et certains comportements alimentaires d'élèves de 9<sup>e</sup> et de 10<sup>e</sup> année de l'Ontario et de l'Alberta selon le statut socioéconomique (SSE) du territoire de l'école et son emplacement en milieu urbain ou rural.

**Méthode :** À partir d'un échantillon aléatoire stratifié, nous avons recruté 53 écoles secondaires dans 28 conseils scolaires (45 écoles publiques et 8 écoles privées; 33 en milieu urbain et 20 en milieu rural). Le revenu familial médian pour la région de tri d'acheminement de Postes Canada dans laquelle se trouvait l'école a servi à définir le SSE régional. Comme variable de substitution au SSE, nous avons aussi comparé les écoles publiques et privées. Deux mille six cent vingt et un élèves de 9<sup>e</sup> et de 10<sup>e</sup> année ont répondu à un sondage en ligne sur les rations et les comportements alimentaires, qui comprenait une feuille de rappel des aliments ingérés pendant les 24 dernières heures et un questionnaire sur la fréquence de consommation des produits alimentaires. Notre comparaison des apports et des comportements selon le profil de l'école (urbaine, rurale, publique, privée) ou le SSE régional (par modèle linéaire généralisé) a tenu compte des effets du sexe des élèves et de leur niveau, ainsi que du nombre de répondants dans chaque école.

**Résultats :** Le SSE régional des écoles variait entre 40 959 \$ et 85 922 \$ par année. La consommation de fruits et de légumes ( $p < 0,001$ ), l'apport en fibres ( $p < 0,001$ ) et la fréquence de consommation du petit déjeuner ( $p < 0,01$ ) augmentaient avec le revenu, tandis que l'apport en sucre ajouté diminuait ( $p < 0,01$ ). Par rapport aux élèves des écoles publiques, les élèves des écoles privées affichaient une consommation inférieure de boissons sucrées ( $p < 0,01$ ) et des apports supérieurs en fibres ( $p = 0,02$ ). Par rapport aux élèves en milieu urbain, les élèves en milieu rural ont déclaré des apports moyens de calcium plus élevés (1 106 c. 995 mg/jour respectivement,  $p = 0,03$ ) et une consommation supérieure de produits laitiers (2,7 c. 2,3 portions/jour,  $p < 0,01$ ).

**Conclusion :** Certains comportements alimentaires des jeunes de l'Ontario et de l'Alberta s'améliorent avec l'accroissement du SSE régional et changent selon que l'école se trouve en milieu rural ou urbain. Il peut donc être utile de définir le profil démographique régional pour adapter les programmes de saine alimentation à une école en particulier.

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