Where Should We Eat? Lunch Source and Dietary Measures Among Youth During the School Week

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ABSTRACT

Purpose: To examine lunch sources during the school week among students and the associations with fruits and vegetable (F&V) and sugar-sweetened beverage (SSB) consumption.
Methods: Students (n = 23 680) from 43 Ontario, Canada, secondary schools completed a health behaviour survey in the Year 1 COMPASS study. Analysis used generalized linear mixed effects models.
Results: The most frequently reported lunch source was home (2.9 days per school week), then the school cafeteria (1.1) and fast-food places or restaurants (FFRs) (0.9). Eating a home lunch was associated with having less spending money, white ethnicity, and females; whereas cafeteria lunch was associated with more spending money, lower school grade, and females. A FFR lunch was associated with males, more spending money, and higher physical activity. Greater frequency of a home lunch was associated with greater F&V consumption. Greater frequency of a FFR lunch was associated with more frequent SSB consumption. Cafeteria lunches were associated with increases in both SSB and F&V.
Conclusions: Eating a lunch obtained from outside of the home is a regular behaviour among students. Sources of school-week lunches may have an important influence on dietary intake among youth. These findings reinforce the need for strategies to promote healthier lunch sources and healthier food options.

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RÉSUMÉ

Objectif. Examiner les sources des dîners des élèves durant la semaine d'école et leur association avec la consommation de fruits et légumes (FL) et de boissons avec sucre ajouté (BSA).
Méthodes. Des élèves (n = 23 680) de 43 écoles secondaires de l'Ontario, au Canada, ont répondu à un sondage sur les comportements relatifs à la santé durant l'année 1 de l'étude COMPASS. L'analyse a été effectuée à l'aide de modèles linéaires généralisés à effets mixtes.
Résultats. La source la plus fréquente des dîners était la maison (2,9 jours par semaine d'école), puis la cafétéria de l'école (1,1) et finalement les restaurants-minute ou les restaurants (RM) (0,9). Un dîner de la maison était associé au fait d'avoir moins d'argent de poche, à la race blanche et au sexe féminin; alors que le dîner de cafétéria était associé au fait d'avoir plus d'argent de poche, à des résultats scolaires plus faibles et au sexe féminin. Le dîner de RM était associé au sexe masculin, au fait d'avoir plus d'argent de poche et à une activité physique plus importante. La fréquence accrue de dîners provenant de la maison était associée à une consommation plus importante de FL. La fréquence accrue de dîners de RM était associée à une consommation plus importante de BSA. Les dîners de cafétéria étaient associés à une augmentation de la consommation de BSA et de FL.
Conclusions. Il est fréquent que le dîner des élèves ne provienne pas de la maison. Les sources des dîners de semaine d'école peuvent avoir une influence importante sur l'apport alimentaire chez les jeunes. Ces conclusions renforcent le besoin d'élaborer des stratégies pour promouvoir des sources de dîners et des options d'aliments plus saines.

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INTRODUCTION

Declining diet quality among youth is a public health concern. In Canada, the proportion of overweight or obese adolescents has doubled to 32% over the past 3 decades [1] and is projected to result in 70% adult obesity prevalence by the year 2040 [2]. Excess weight among adolescents is associated with chronic disease risk factors and shorter life expectancy [3]. Obesity costs Canadians an estimated $19 billion yearly [4].

Literature on Canadian adolescents' food sources, especially lunch patterns, is limited. Many Canadian youth frequently eat meals prepared outside the home [5]. According to national food recall data, 55% of youth ate "outside meals" the previous day; approximately 34% consumed food from a fast-food outlet [6].

Food source influences the selection of foods consumed by adolescents and overall diet quality [7]. Eating food outside the home is associated with lower fruit and vegetable (F&V) intake [8] and higher sugar-sweetened beverage (SSB) intake [9]. Canada's Food Guide recommends adolescents consume 7/8 (females/males) F&V servings daily. No upper limit for SSBs or sugar consumption is provided but limited intake is advised [10]. Most Canadian youth do not meet these F&V recommendations [11] despite the health risks associated with low F&V consumption [12, 13]. Drinking SSBs promotes weight gain [14] and chronic disease risk [15–17]. Regular soft drinks are Canadian adolescents' greatest sugar source [18]; 53% of males and 35% of females consume these beverages daily [19].

There is a dearth of information on youth lunchtime eating behaviours and how lunch source (i.e., where students obtained their lunch on school days) relates to diet quality. The purpose of the current study was to analyze data from a

large cohort study conducted in Ontario schools to examine where secondary students obtain their lunches during the school week, how frequently they ate lunch for a given source, and what influences their lunch source selection. The study also examined the association between lunch source and frequency of SSB consumption, as well as number of F&V servings consumed.

METHODS

COMPASS is a prospective cohort study of secondary school students (grades 9–12) with longitudinal annual data collection over 4 years. The study examines youth health behaviours, outcomes, and school characteristics including programs, policies, and built environments. For a full description of the study's methods see Leatherdale et al. [20] and www.compass.uwaterloo.ca

The current analysis examines Year 1 student survey data from 43 Ontario secondary schools, collected during the 2012–2013 school year.

Participants

To obtain the study's convenience sample of students, 40 Ontario school boards were purposefully selected and contacted for recruitment via email or mail based on the following inclusion criteria: the school board provided English-language instruction, it permitted the use of active information – passive consent protocols, and it administered it in schools using a standard classroom setting with at least 100 students per grade. Eleven boards approved and their schools were contacted for recruitment. Forty-three schools (of 111) across the province agreed to participate (27 large or medium urban setting; 16 small urban or rural setting). Parents and guardians were informed of the study via mailed information letters and given opportunities to ask questions and, if desired, to withdraw their child. Students whose parents did not decline participation were considered eligible and could decline their participation any time. The University of Waterloo Office of Research Ethics and appropriate school board review panels approved all procedures.

From the sample of 30 147 enrolled students, 80.2% completed the in-class COMPASS student survey on youth health behaviours and outcomes. Nonresponse resulted from absenteeism (18.8%), student refusal (0.1%), and parental refusal (0.9%). An additional 493 students were deleted because data were missing data for grade (n = 96), sex (n = 211), or all three lunch source variables (n = 277). The final sample was 23 680 respondents with a median age of 16 years.

Measures

The COMPASS student-level questionnaire was designed based on national adolescent health research standards or current national public health guidelines [20]. The core survey questions, including measures of weight status, dietary intake, and physical activity, have demonstrated reliability and validity [21, 22].

Outcomes

Two sets of outcomes, all treated as "count" variables, were examined. First, 3 "lunch source" outcomes examined frequency of where students obtained their lunch on school days. Participants were asked, "In a usual school week (Monday to Friday), on how many days do you do the following? …" for each of the following statements, "Eat lunch at school – lunch packed and brought from home", "Eat lunch at school – lunch purchased in the cafeteria" and "Each lunch purchased at a fast food place or restaurant". Response options were "None" (coded as 0), 1, 2, 3, 4 or 5 days.

The second set of outcome variables assessed SSB consumption and F&V consumption. Participants were asked: "In a usual school week (Monday to Friday), on how many days do you do the following? … Drink SSB (soda pop, Kool-Aid, Gatorade, etc.) Do not include diet/sugar-free drinks". Response options were "None" (coded 0), 1, 2, 3, 4 or 5 days. For F&V, participants were asked, "Yesterday, from the time you woke up until the time you went to bed, how many servings of vegetables and fruits did you have?" and were given serving size descriptions and examples. Response options were "None" (coded 0), 1, 2, 3, 4, 5, 6, 7, 8, or "9 or more servings" (coded 9).

Socio-demographic covariates

Individual-level socio-demographic variables included grade [9–12] and sex ("Are you female or male?"). Age was excluded from analysis because of the high correlation with grade. (Age response options were "13 years or younger" (coded as 13), 14, 15, 16, 17, or "18 years or older" (coded as 18). Ethnicity was assessed with, "How would you describe yourself? (Mark all that apply: White, Black, Asian, Aboriginal (First Nations, Métis, Inuit), Latin American/Hispanic, Other)" and recoded as 0 = White only, Non-FNIM (First Nations, Métis, Inuit), 1 = Off-reserve FNIM, 2 = Other, Non-FNIM/Not-stated/Mixed. Spending money was measured as, "About how much money do you usually get each week to spend on yourself or to save?" Responses offered were $0, $1–$5, $6–$10, $11–$20, $21–$40, $41–$100, >$100, and Don't know"; responses were recoded as 0 = $0, 1 = $1–$20, 2 = $21–$100, 3 = >$100, and 4 = Not stated (Missing/Don't know). Body Mass Index (BMI) was calculated from previously validated self-reported height and weight measures [21] and grouped according to World Health Organization categories using age- and sex-specific cut-offs [23].

Behavioural covariates

Weight-related efforts were assessed by, "Which of the following are you trying to do about your weight?", with the responses 1 = "Lose weight", 2 = "Gain weight", 3 = "Stay the same weight" and 4 = "I am not trying to do anything about my weight". Physical activity was assessed using, "Mark how many minutes of HARD physical activity you did on each of the last 7 days. This includes physical activity during physical education class, lunch, after school, evenings,

and spare time" and, "Mark how many minutes of MODERATE physical activity you did on each of the last 7 days. This includes physical activity during physical education class, lunch, after school, evenings, and spare time. Do not include time spent doing hard physical activities" with descriptions and examples provided. Responses were combined and recoded as "yes" or "no" depending on whether the respondent had met the Canada's guideline for youth of at least 60min of moderate to vigorous intensity physical activity per day [24, 25].

Statistical analysis

Statistical analyses were conducted using SAS software (version 9.4; SAS Institute Inc., Cary, NC, USA; 2014). Five generalized linear mixed effects models were fit, 1 for each lunch source and dietary outcome measure. PROC GLIMMIX estimated models for each of the 5 outcomes, with Adaptive Gaussian Quadrature for approximating parameter estimation. To accommodate the outcomes' non-normal distributions (i.e., counts), a Poisson distribution and log link function were specified. School level was treated as a random effect to control for respondent clustering by school.

In each model, the socio-demographic and behavioural covariates were examined as fixed effects. For each statistically significant covariate, pairwise comparisons between all category levels were examined using *t* tests. To adjust for multiple comparisons, Bonferroni correction was applied to nonbinary categorical covariates. Adjusted values are presented where applicable.

In the dietary outcome models, lunch source variables were examined as covariates in addition to the base set of covariates. Students with missing data for the outcome or any covariate were excluded using listwise deletion from that outcome's regression analysis. To examine if there was an association between number of F&V servings consumed and what day students' "yesterday" period for F&V consumption fell on, an independent sample *t* test compared students who completed the survey on Monday (or Tuesday following a statutory holiday) versus those who completed the survey any other weekday. The threshold for statistical significance was set at $\alpha = 0.01$, based on the large sample size.

RESULTS

Sample characteristics

Overall, the sample's distribution across school grades was relatively even, with an equal proportion of males and females (Table 1). The majority self-identified as "white, non-FNIM" and approximately one-fifth were categorized as overweight or obese.

Lunch sources characteristics

Students reported eating a lunch brought from home an average of 2.9 days per school week (Table 2). Almost one quarter (23.7%) of students never had a lunch from home, whereas 35% ate a home lunch daily. Students reported a lunch purchased in school cafeteria 1.1 days per school week. Approximately half (52.4%) of students never ate a cafeteria lunch, whereas 7% purchased 1 daily. Students reported eating a lunch purchased at a fast-food restaurant (FFR) 0.9 days per school week. More than half (56.4%) never consumed a FFR lunch during the school week, whereas 4% ate 1 every day.

Table 1. Sample characteristics (n = 23 680).

Characteristic	No. (%)
Grade	
Grade 9	6 124 (26.2)
Grade 10	6 092 (25.7)
Grade 11	5 796 (24.5)
Grade 12	55 578 (23.6)
Sex	
Female	11 787 (49.8)
Male	11 893 (50.2)
Ethnicity	
White, non-FNIM	16 886 (71.3)
Off-reserve FNIM	1 262 (5.3)
Other, non-FNIM/mixed/not stated	5 532 (23.4)
Spending money (weekly)	
$0	3 709 (15.7)
$1–20	7 220 (30.5)
$21–100	6 384 (27.0)
›$100	3 326 (14.0)
Not stated (missing/don't know)	3 041 (12.8)
Body Mass Index category	
Underweight	338 (1.4)
Healthy weight	13 518 (57.1)
Overweight	3 283 (13.9)
Obese	1 476 (6.2)
Not stated	5 065 (21.4)
Weight-related efforts	
Lose weight	9 875 (41.7)
Gain weight	4 363 (18.4)
Stay the same weight	4 314 (18.2)
Not trying to do anything	4 916 (20.8)
Missing	212 (0.9)
At least 60 min of physical activity per day	
Yes	11 210 (47.3)
No	11 923 (50.4)
Missing	547 (2.3)

Note: FNIM, First Nations, Métis, Inuit.

Correlates of lunch sources

A generalized linear mixed effects model was fitted to examine correlates of lunch sources. All variables were significantly associated with each outcome (Table 3).

Table 2. Lunch sources by socio-demographic and behavioural factors.

Characteristic	Lunch brought from home,[a] mean days per school week (SD)	Lunch purchased in school cafeteria,[a] mean days per school week (SD)	Lunch purchased at fast food place or restaurant,[a] mean days per school week (SD)
Total	2.9 (2.0)	1.1 (1.5)	0.9 (1.3)
Grade			
Grade 9	3.0 (2.0)	1.1 (1.5)	0.8 (1.2)
Grade 10	2.9 (2.0)	1.1 (1.5)	0.8 (1.3)
Grade 11	3.0 (2.0)	1.0 (1.5)	0.9 (1.3)
Grade 12	2.8 (2.0)	0.9 (1.4)	1.0 (1.4)
Gender			
Female	3.0 (2.0)	1.1 (1.4)	0.7 (1.1)
Male	2.9 (2.1)	1.1 (1.5)	1.1 (1.5)
Ethnicity			
White, non-FNIM	3.0 (2.0)	1.0 (1.4)	0.8 (1.3)
Off-reserve FNIM	2.3 (2.1)	1.1 (1.5)	1.2 (1.6)
Other, on-FNIM/mixed/not stated	2.8 (2.1)	1.3 (1.7)	1.0 (1.5)
Spending money (weekly)			
$0	3.3 (2.0)	0.8 (1.4)	0.5 (1.0)
$1–20	3.0 (1.9)	1.0 (1.4)	0.8 (1.3)
$21–100	2.7 (2.0)	1.2 (1.6)	1.1 (1.4)
›$100	2.7 (2.0)	1.1 (1.5)	1.3 (1.5)
Not stated (missing/don't know)	3.1 (2.0)	1.1 (1.5)	0.7 (1.2)
Body Mass Index category			
Underweight	2.9 (2.1)	1.1 (1.5)	0.9 (1.4)
Healthy weight	3.0 (2.0)	1.0 (1.5)	0.9 (1.3)
Overweight	2.9 (2.0)	1.0 (1.5)	0.8 (1.3)
Obese	2.9 (2.0)	1.0 (1.5)	0.9 (1.4)
Not stated	2.8 (2.1)	1.1 (1.5)	0.9 (1.4)
Weight-related efforts			
Lose weight	2.8 (2.0)	1.0 (1.4)	0.8 (1.2)
Gain weight	3.0 (2.0)	1.2 (1.6)	1.2 (1.5)
Stay the same weight	3.1 (2.0)	1.0 (1.5)	0.9 (1.3)
Not trying to do anything	3.0 (2.0)	1.0 (1.5)	0.8 (1.3)
At least 60 min of physical activity per day			
Yes	2.9 (2.0)	1.1 (1.5)	1.0 (1.4)
No	3.0 (2.0)	1.0 (1.5)	0.8 (1.2)

[a]Scales range from 0–5.
Note: FNIM; First Nations, Métis, Inuit.

Lunch brought from home

Frequency of a lunch brought from home was higher among students not in Grade 12, female students, and "white, non-FNIM" students. Students who reported no spending money, smaller amounts of money, or did not specify an amount consumed a home lunch more often. Compared with students in the obese BMI category, students with a healthy or underweight BMI more frequently ate a home lunch. Students not trying to lose weight had a home lunch more often, as did those not meeting the physical activity guideline.

Lunch purchased in school cafeteria

A lunch purchased in the school cafeteria was more frequent among younger grades, females, nonwhite students, students with more spending money, and overweight (vs underweight students) and obese students (vs healthy weight and

Table 3. Exponentiated estimates for all pair-wise comparisons from the models[a] for lunch brought from home, lunch purchased in the school cafeteria and lunch purchased at a fast food place or restaurant.

	Lunch brought from home (days per school week)			Lunch purchased in school cafeteria (days per school week)			Lunch purchased at fast food place or restaurant (days per school week)		
Variable	**Exp (estimate)[b]**	**99% CI[b]**	**Adjusted *P* value[c]**	**Exp (estimate)[b]**	**99% CI[b]**	**Adjusted *P* value[c]**	**Exp (estimate)[b]**	**99% CI[b]**	**Adjusted *P* value[c]**
Grade	$F_{(3,22473)}$ = 9. 7, (P < 0.001)			$F_{(3,22649)}$ = 96.9 (P < 0.001)			$F_{(3,22706)}$ = 36.2 (P < 0.001)		
10 vs 9	0.99	(0.96–1.03)	1.00	**0.90**	**(0.85–0.95)**	**<0.001**	1.03	(0.96–1.10)	1.00
11 vs 9	1.01	(0.98–1.05)	1.00	**0.82**	**(0.78–0.87)**	**<0.001**	1.05	(0.98–1.12)	0.13
12 vs 9	**0.95**	**(0.92–0.99)**	**<0.001**	**0.72**	**(0.68–0.77)**	**<0.001**	**1.22**	**(1.14–1.30)**	**<0.001**
10 vs 12	**1.04**	**(1.00–1.08)**	**0.006**	**1.24**	**(1.17–1.32)**	**<0.001**	**0.84**	**(0.79–0.90)**	**<0.001**
11 vs 12	**1.06**	**(1.02–1.10)**	**<0.001**	**1.15**	**(1.08–1.22)**	**<0.001**	**0.86**	**(0.81–0.92)**	**<0.001**
10 vs 11	0.98	(0.95–1.01)	0.31	**1.09**	**(1.03–1.15)**	**<0.001**	0.98	(0.92–1.04)	1.00
Gender	$F_{(1,22473)}$ = 37.7 (P < 0.001)			$F_{(1,22649)}$ = 30.1 (P < 0.001)			$F_{(1,22706)}$ = 579. 8 (P < 0.001)		
Male v. female	**0.95**	**(0.92–0.97)**	**<0.001**	**0.92**	**(0.89–0.96)**	**<0.001**	**1.50**	**(1.44–1.57)**	**<0.001**
Ethnicity	$F_{(2,22473)}$ = 52.7 (P < 0.001)			$F_{(2,22649)}$ = 75.3, (P < 0.001)			$F_{(2,22706)}$ = 80.6 (P < 0.001)		
Off-reserve FNIM vs white	**0.82**	**(0.78–0.87)**	**<0.001**	**1.21**	**(1.11–1.33)**	**<0.001**	**1.24**	**(1.14–1.35)**	**<0.001**
Other vs white	**0.95**	**(0.92–0.98)**	**<0.001**	**1.20**	**(1.14–1.26)**	**<0.001**	**1.22**	**(1.16–1.29)**	**<0.001**
Off-reserve FNIM vs other	**0.86**	**(0.81–0.92)**	**<0.001**	1.01	(0.92–1.11)	1.00	1.01	(0.92–1.11)	1.00
Spending money	$F_{(4,22473)}$ = 69.8 (P < 0.0001)			$F_{(4,22649)}$ = 112.0 (P <0.001)			$F_{(4,22706)}$ = 244.8 (P < 0.001)		
$1–20 vs $0	**0.93**	**(0.89–0.96)**	**<0.001**	**1.42**	**(1.31–1.53)**	**<0.001**	**1.70**	**(1.55–1.87)**	**<0.001**
$21–100 vs $0	**0.84**	**(0.81–0.88)**	**<0.001**	**1.58**	**(1.47–1.71)**	**<0.001**	**2.14**	**(1.95–2.35)**	**<0.001**
›$100 vs $0	**0.82**	**(0.78–0.86)**	**<0.001**	**1.62**	**(1.49–1.77)**	**<0.001**	**2.37**	**(2.14–2.62)**	**<0.001**
Not stated vs $0	0.96	(0.91–1.00)	0.02	**1.37**	**(1.26–1.50)**	**<0.001**	**1.57**	**(1.40–1.75)**	**<0.001**
$21–100 vs $1–20	**0.91**	**(0.88–0.94)**	**<0.001**	**1.12**	**(1.06–1.18)**	**<0.001**	**1.26**	**(1.18–1.34)**	**<0.001**
›$100 vs $1–20	**0.89**	**(0.85–0.93)**	**<0.001**	**1.15**	**(1.07–1.23)**	**<0.001**	**1.39**	**(1.29–1.50)**	**<0.001**
$1–20 vs not stated	0.97	(0.93–1.01)	0.16	1.03	(0.96–1.11)	1.00	1.08	(1.00–1.18)	0.02
›$100 vs $21–100	0.97	(0.93–1.02)	0.60	1.03	(0.96–1.10)	1.00	**1.11**	**(1.03–1.18)**	**<0.001**
$21–100 vs not stated	**0.88**	**(0.85–0.93)**	**<0.001**	**1.15**	**(1.08–1.24)**	**<0.001**	**1.36**	**(1.25–1.48)**	**<0.001**
›$100 vs not stated	**0.86**	**(0.82–0.91)**	**<0.001**	**1.18**	**(1.09–1.29)**	**<0.001**	**1.51**	**(1.38–1.65)**	**<0.001**
BMI category	$F_{(4,22473)}$ = 11.0 (P < 0.001)			$F_{(4,22649)}$ = 15.2 (P < 0.0001)			$F_{(4,22706)}$ = 10.1 (P < 0.001)		
Underweight vs healthy	1.01	(0.97–1.05)	1.00	0.96	(0.90–1.03)	0.40	1.04	(0.97–1.12)	0.74
Overweight vs healthy	0.99	(0.93–1.06)	1.00	1.09	(0.98–1.21)	0.05	1.06	(0.95–1.18)	1.00
Obese vs healthy	**0.95**	**(0.90–0.99)**	**<0.001**	**1.08**	**(1.00–1.17)**	**0.007**	**1.15**	**(1.06–1.25)**	**<0.001**
Not stated vs healthy	0.94	(0.84–1.06)	0.98	0.96	(0.80–1.16)	1.00	1.16	(0.95–1.43)	0.16
Underweight vs overweight	1.02	(0.96–1.08)	1.00	**0.88**	**(0.80–0.97)**	**<0.001**	0.99	(0.89–1.09)	1.00
Obese vs overweight	0.95	(0.90–1.01)	0.11	0.99	(0.89–1.09)	1.00	1.09	(0.98–1.21)	0.11
Not stated vs overweight	0.95	(0.84–1.08)	1.00	0.88	(0.72–1.08)	0.38	1.10	(0.89–1.37)	1.00

Table 3. (cont'd).

Variable	Lunch brought from home (days per school week)			Lunch purchased in school cafeteria (days per school week)			Lunch purchased at fast food place or restaurant (days per school week)		
	Exp (estimate)[b]	99% CI[b]	Adjusted *P* value[c]	Exp (estimate)[b]	99% CI[b]	Adjusted *P* value[c]	Exp (estimate)[b]	99% CI[b]	Adjusted *P* value[c]
Not stated vs obese	1.00	(0.89–1.12)	1.00	0.89	(0.74–1.07)	0.39	1.01	(0.83–1.24)	1.00
Underweight vs not stated	1.07	(0.96–1.20)	0.40	0.99	(0.83–1.19)	1.00	0.90	(0.74–1.09)	0.64
Underweight vs obese	**1.07**	**(1.03–1.11)**	**<0.001**	**0.87**	**(0.84–0.94)**	**<0.001**	**0.91**	**(0.85–0.96)**	**<0.001**
Weight-related efforts	$F_{(3,22473)} = 25.4$ ($P < 0.001$)			$F_{(3,22649)} = 15.0$ ($P < 0.001$)			$F_{(3,22706)} = 28.6$ ($P < 0.001$)		
Trying to lose vs nothing	**0.95**	**(0.92–0.98)**	**<0.001**	0.98	(0.92–1.04)	1.00	0.98	(0.91–1.04)	1.00
Trying to gain vs nothing	1.02	(0.98–1.06)	0.81	**1.12**	**(1.05–1.19)**	**<0.001**	**1.18**	**(1.10–1.26)**	**<0.001**
Trying to maintain vs nothing	**1.05**	**(1.01–1.09)**	**0.002**	1.01	(0.94–1.07)	1.00	1.04	(0.97–1.12)	0.57
Trying to gain vs trying to maintain	0.98	(0.94–1.02)	0.35	**1.11**	**(1.04–1.19)**	**<0.001**	**1.13**	**(1.06–1.22)**	**<0.001**
Trying to gain vs trying to lose	**1.07**	**(1.03–1.12)**	**<0.001**	**1.14**	**(1.07–1.22)**	**<0.001**	**1.21**	**(1.13–1.29)**	**<0.001**
Trying to lose vs trying to maintain	**0.91**	**(0.88–0.94)**	**<0.001**	0.97	(0.92–1.03)	0.95	0.94	(0.88–1.00)	0.02
At least 60 min of physical activity per day	$F_{(1,22473)} = 16.0$ ($P < 0.001$)			$F_{(1,22649)} = 32.4$ ($P < 0.001$)			$F_{(1,22706)} = 94.3$ ($P < 0.001$)		
Yes vs no	**0.97**	**(0.95–0.99)**	**<0.001**	**1.08**	**(1.04–1.12)**	**<0.001**	**1.15**	**(1.11–1.20)**	**<0.001**

[a]Separate generalized linear mixed effects models for each outcome, with covariates grade, gender, ethnicity, spending money, BMI, weight-related efforts, and physical activity; school included as a random intercept.
[b](exp)estimate (exponentiated estimate) represents the difference between the 2 groups in the expected count of the number of days per school week of that source for lunch, controlling for all other variables in model (e.g., an exp(estimate) of 1.07 for group A vs group B would correspond to an expected 7% greater number of days per school week for group A over group B, controlling for all other variables in the model).
[c]*P* value adjusted for multiple comparisons (Bonferroni), $\alpha = 0.01$.
Note: Values in bold font represent findings significant at the $P < 0.01$ level. FNIM, First Nations, Métis, Inuit.

underweight students). Students trying to gain weight and those who achieved the physical activity guideline had a cafeteria lunch more often.

Lunch purchased at a fast-food restaurant

Frequency of lunch purchased at a FFR was higher among Grade 12 students, males, non-white students, students with more spending money, obese students (vs healthy weight and underweight students), students who were trying to gain weight, and students who met the physical activity guideline.

SSB consumption

Students reported drinking one or more SSBs an average of 1.8 days per school week (Figure 1). One-third (33.2%) of the students reported never consuming SSBs during a usual school week, whereas 14% consumed 1 or more SSB daily.

A generalized linear mixed effects model (n = 21 943) including all covariates was fitted to examine frequency of SSB consumption. SSB intake was significantly associated with cafeteria lunch intake ($e^{\beta} = 1.06, P < 0.001$) and FFR lunch intake ($e^{\beta} = 1.16, P < 0.001$), as well as grade, gender, ethnicity, BMI, and weight-related efforts. The exponentiated estimates (e^{β}) were interpreted as a 1-day increase in eating a cafeteria lunch; this was associated with a 6% increase in the number of days per school week that SSBs were consumed, whereas a 1-day increase in eating a FFR lunch was associated with a 16% increase in the number of days SSBs were consumed, controlling for all other variables.

F&V consumption

Students consumed a mean of 3.2 F&V servings the previous day (SD = 2.1) (Figure 1). Almost onequarter (24.1%) ate 5 or more servings, whereas 7% had no servings. There was no significant difference in mean number of F&V servings consumed between students whose “yesterday” period was not a weekday (i.e., a Sunday or statutory holiday Monday) (mean = 3.15, SD = 2.0) and those reporting for weekday period (mean = 3.18, SD = 2.1); $t(23\,237) = -.622$, $P = .385$.

The model (n = 21 827) for F&V included all covariates. Two food source correlates were significant: home lunch intake ($e^{\beta} = 1.01$, $P < 0.001$) and cafeteria lunch intake ($e^{\beta} = 1.07$, $P < 0.001$), as well as spending money, BMI, weight-related efforts, and physical activity. Controlling for all other variables, a 1-day increase in eating a home lunch was associated with

a 1% greater number of F&V servings consumed, whereas a 1-day increase in eating a cafeteria lunch was associated with a 7% greater number of F&V servings.

DISCUSSION

To our knowledge, this study is among the first in Canada to explore school day lunchtime food source patterns and their links to dietary outcomes in a large sample of adolescents. Among the Ontario secondary school students in this study, the most frequent school day lunch source was home (2.9 days per school week). However, other sources were not insignificant. On average, 2 days per week students obtained lunch from a school cafeteria (1.1 days) and FFR (0.9 days). Fast-food consumption frequency was lower than reported elsewhere [5, 6]. The current study may have underestimated this rate due to the questionnaire's limited lunchtime behaviour measures or if sampling occurred in locations where fast food was inaccessible.

Several novel patterns to Canadian research emerged that influenced students' selection of lunch source. Quantity of spending money was associated with lunch source. Students with more money more frequently ate food from outside of home, a relationship not previously examined in Canada but identified in other countries [26–28]. Males were associated with more frequent FFR food consumption, consistent with some [7], but not all, similar studies [5]. Grade and lunch source are related, an association not examined elsewhere. There was a novel and concerning ethnicity trend whereby, compared with white students, FNIM and nonwhite students reported eating a home lunch less frequently and a cafeteria or FFR lunch more frequently. The relationship between high BMI and more frequent consumption of foods from outside the home may relate to the impact of out-of-home eating on increased weight gain [29]. Finally, students with higher physical activity levels had more frequent fast-food consumption, supporting others' findings [30].

Almost one-third of students regularly consumed SSBs (3 or more days per school week). Only 14% of students reported daily consumption, a rate substantially lower than Canada's 2004 national nutrition data [19]. This apparent decrease may have resulted from an underestimation of youth SSB consumption owing to survey design (i.e., the survey did not prompt respondents for specific drinks and volumes). Conversely, the difference could be attributed to a true decline as a result of prevention measures.

Students' consumption of F&V was low; students ate an average of 3.2 servings per day. Only 7% of students met Canada's Food Guide recommendation of 7 or more servings, similar to a recent comparable national study [11].

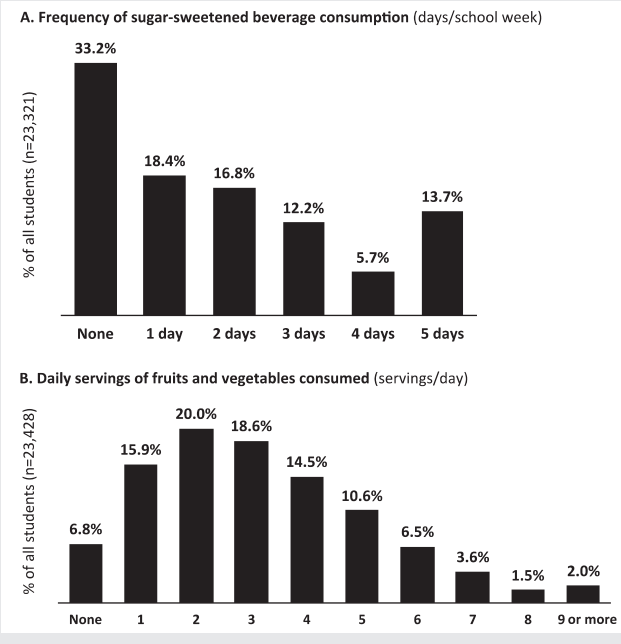
The findings from this sample of Ontario secondary school students support the role of certain food sources in promoting healthy and unhealthy food consumption. Consistent with Woodruff et al. [31], more frequent consumption of a home lunch was associated with higher F&V consumption, whereas more frequent consumption of a FFR lunch was associated with more frequent SSB consumption. The present study did not find an association between fast-food consumption and F&V consumption. Eating a cafeteria lunch was associated with increasing both healthy (F&V consumption) and unhealthy (SSB consumption) dietary behaviours. Owing to the survey's design, precisely where and how students obtained SSBs remains a critical question as a provincial policy prohibits the sale of SSBs on Ontario school property (32).

The present study did not examine the available COMPASS data on schools' cafeterias, vending machines, and surrounding built environments – likely important contributors to food patterns among youth [33, 34].

Limitations and strengths

This study has several limitations common to survey research. Self-report bias may have contributed to overestimation of healthy behaviours and underestimation of unhealthy behaviours, including high BMI, as the study's prevalence of overweight and obesity is lower than the Canadian adolescent population [1]. This may have been exacerbated by recall bias, as participants were asked to describe a usual rather than the most recent week. These biases may have attenuated associations with diet intake measures. Each outcome was measured through a single question. For F&V consumption, some participants reported "yesterday" period was not a school day. More complex outcome measures would have permitted better specificity and strengthened statements on the

Figure 1. Dietary outcomes: frequency of sugar-sweetened beverage consumption (n = 23 321) and daily servings of fruits and vegetables consumed (n = 23 428).



examined associations [35]. However, some survey elements were validated against more comprehensive self-report measures [21]. Inherent to cross-sectional survey design, this study does not establish causality, but longitudinal studies have reported similar associations [30]. Although the study's sample is not probability-based, given the sample's large size and diversity, and students' high response rate, the results may be generalizable to the population of Ontario secondary students.

RELEVANCE TO PRACTICE

This study provides novel findings on where Ontario secondary school students obtained their school lunches and important associations between lunch source and socio-demographic and health-related factors. The type of lunch source is related to F&V consumption and SSB consumption. These findings reinforce the need to implement effective strategies that encourage greater use of health-promoting lunch sources and that support the consumption of healthier foods within these venues.

In the provision of nutrition guidance to adolescents and their families, dietitians and other practitioners should consider where the young person is obtaining lunch during school hours and how often they frequent a lunch source, as well as specific relevant socio-demographic factors and health behaviours. Improvement in healthy eating may be achieved through shifting from lunch sources associated with poor diet (e.g., fast-food places) to those linked to better eating practices (e.g., a lunch brought from home). In the policy realm, dietitians are a critical advocacy voice for strategies that effectively improve food environments in and around schools.

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