Dietary Intake and Risk Factors for Poor Diet Quality Among Children in Nova Scotia

Paul J. Veugelers, PhD¹

Angela L. Fitzgerald, MSc, PDr²

Elizabeth Johnston, PhD, PDr, FDC³

ABSTRACT

Objective: Public health policies promote healthy nutrition but evaluations of children's adherence to dietary recommendations and studies of risk factors of poor nutrition are scarce, despite the importance of diet for the temporal increase in the prevalence of childhood obesity. Here we examine dietary intake and risk factors for poor diet quality among children in Nova Scotia to provide direction for health policies and prevention initiatives.

Methods: In 2003, we surveyed 5,200 grade five students from 282 public schools in Nova Scotia, as well as their parents. We assessed students' dietary intake (Harvard's Youth Adolescent Food Frequency Questionnaire) and compared this with Canadian food group and nutrient recommendations. We summarized diet quality using the Diet Quality Index International, and used multilevel regression methods to evaluate potential child, parental and school risk factors for poor diet quality.

Results: In Nova Scotia, 42.3% of children did not meet recommendations for milk products nor did they meet recommendations for the food groups 'Vegetables and fruit' (49.9%), 'Grain products' (54.4%) and 'Meat and alternatives' (73.7%). Children adequately met nutrient requirements with the exception of calcium and fibre, of which intakes were low, and dietary fat and sodium, of which intakes were high. Skipping meals and purchasing meals at school or fast-food restaurants were statistically significant determinants of poor diet. Parents' assessment of their own eating habits was positively associated with the quality of their children's diets.

Interpretation: Dietary intake among children in Nova Scotia is relatively poor. Explicit public health policies and prevention initiatives targeting children, their parents and schools may improve diet quality and prevent obesity.

MeSH terms: Nutrition; obesity; child; lifestyle; prevention & control; public health

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

1. Department of Community Health & Epidemiology, Dalhousie University, Halifax, NS and Department of Public Health Sciences, University of Alberta, Edmonton, AB
2. Department of Community Health & Epidemiology, Dalhousie University
3. School of Nutrition & Dietetics, Acadia University, Wolfville, NS

Correspondence and reprint requests: Dr. Paul J. Veugelers, Department of Public Health Sciences, Faculty of Medicine & Dentistry, University of Alberta, Room 13-106D Clinical Sciences Building, Edmonton, AB T6G 2G3

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Over the past three decades, public health nutrition policies have gradually broadened from the promotion of adequacy and variety to prevent nutrient deficiencies and optimize growth and development, to also emphasizing moderation of calorie-dense foods to prevent excess body weight and related comorbidities.¹ In Canada, dietary adequacy, variety and moderation are addressed through dietary recommendations in the form of Canada's Food Guide to Healthy Eating and Dietary Reference Intakes (DRIs).^{2,3} However, there is no systematic monitoring of adherence to these recommendations.

Poor nutrition and insufficient physical activity are the primary mechanisms underlying the temporal increase in the prevalence of excess body weight among children.⁴⁻⁶ In Canada, it is estimated that approximately 30% of children are overweight or obese.^{7,8} Through a spectrum of comorbidities, excess body weight decreases quality of life and life expectancy and has become one of Canada's major public health concerns.⁹⁻¹⁴ Research into the risk factors of poor diet is scarce, however such research may provide evidence and direction for educators, practitioners and policy-makers for the promotion of healthy eating and addressing the growing problem of childhood obesity.

In 2003, we conducted a comprehensive nutrition survey among children. In the current study, we evaluate how well their diets adhere to Canadian dietary recommendations and examine factors that influence poor diet quality. This research targets Nova Scotia, a province in which health and lifestyles are poor in comparison to other parts of Canada and thus, a province in which considerable health gains can be made through improved lifestyle.¹⁵⁻¹⁷

METHODS

Survey

The 2003 Children's Lifestyle And School-performance Study (CLASS) is a large study of the inter-relations of health, nutrition, lifestyle and socio-economic factors of grade five students. Of the 291 public schools in Nova Scotia with grade five classes, 282 (96.9%) participated by distributing a consent form and short survey to parents. Parental consent was received

for 5,517 students, giving an average response rate of 51.1% per school. CLASS representatives visited these schools to administer a modified version of Harvard's Youth Adolescent Food Frequency Questionnaire (YAQ),¹⁸ and a short survey on children's activities. The YAQ is a validated instrument that is suitable for grade five students who are primarily 10 or 11 years of age.¹⁸

Assessment of dietary intake

We compared students' YAQ responses with the recommended number of servings for each of the four food groups of Canada's Food Guide to Healthy Eating.² Students' nutrient intakes were assessed using Canadian Nutrient Files¹⁹ and compared with the Dietary Reference Intakes (DRIs).^{3,20-25} Intake of carbohydrate, protein, and fat were compared with the Acceptable Macronutrient Distribution Range (AMDR).²⁰ Vitamins A, B-Complex, and C as well as iron and zinc were compared with the Estimated Average Requirement (EAR), the value that is estimated to meet the requirements of 50% of healthy individuals.²¹⁻²³ Vitamin D, calcium and fibre were compared with the Adequate Intake (AI), as an EAR is unavailable for these nutrients.^{20,24} In the absence of definitive data on which to base an EAR, an AI represents a value that is observed to be adequate in healthy populations.³ Conclusions regarding the extent of inadequacy with values below an AI cannot be drawn because lower values may be adequate.³ Therefore, we did not estimate the prevalence of inadequacy for nutrients with an AI as we did for nutrients with an AMDR and an EAR. Sodium intakes were compared with the Upper Limit (UL), a value above which potential adverse effects may occur (i.e., high blood pressure).²⁵ For sodium, only the UL was used because health concerns primarily pertain to the excess consumption of this nutrient and sodium deficiencies are extremely rare in Canada. All of the above requirements are detailed in Table II.

Diet quality

Overall, diet quality is better described through a composite measure rather than a single food or nutrient.^{26,27} The use of a single composite measure is also preferred because multiple analyses of foods and nutrients would provide a multitude of risk

TABLE I

Recommended and Observed Number of Servings from Canada's Food Guide to Healthy Eating² Among Grade Five Students in Nova Scotia

Food Group	Recommended # Servings/Day	Mean # Servings/Day	Less Than the Minimum Recommended Servings/Day (%)
Grain Products	5-12	5.3	54.4
Vegetables & Fruit	5-10	5.8	49.9
Milk Products	3-4	3.7	42.3
Meat & Alternatives	2-3	1.6	73.7

The findings originate from 4,966 participants of the 2003 Children's Lifestyle And School-performance Study and are adjusted for non-response.

TABLE II

Dietary Reference Intakes (DRI)²⁰⁻²⁵ and Observed Nutrient Intakes Among Grade Five Students in Nova Scotia

Nutrient	DRI Category*	Reference Value	Mean†	Prevalence of Inadequacy (%)‡
Carbohydrate (%)	AMDR	45-65	56.7	9.4
Protein (%)	AMDR	10-30	15.1	2.7
Fat (%)	AMDR	25-35	30.3	26.2
Vitamin C (mg)	EAR	39	165.4	4.7
Folate (DFE)	EAR	250	523.6	8.8
Vitamin A (RAE)	EAR			
Males		445	1015.8	11.9
Females		420	984.2	10.8
Iron (mg)	EAR			
Males		5.9	13.5	6.1
Females		5.7	12.3	7.8
Zinc (mg)	EAR	7.0	9.7	27.6
Calcium (mg)	AI	1300	1157	
Vitamin D (IU)	AI	200	242.0	
Fibre (g)	AI			
Males		31	14.8	
Females		26	14.4	
Sodium (mg)	UL	2200	2626	

* AMDR = Acceptable Macronutrient Distribution Range, EAR = Estimated Average Requirement, AI = Adequate Intake, UL = Upper Limit

† Intakes are without supplements

‡ Comparisons of participants' dietary intake with recommendations should be interpreted carefully because food frequency questionnaires are thought to be more effective at ranking nutrient intakes than providing accurate estimates of absolute intakes, potentially resulting in biased estimates of the prevalence of inadequacy.^{3,32}

The findings originate from 4,966 participants of the 2003 Children's Lifestyle And School-performance Study and are adjusted for non-response.

factor estimates that would be difficult to summarize.²⁸⁻³⁰ A limited number of composite measures of overall diet quality exists but none has been established for risk-factor studies. For our analyses, we chose the Diet Quality Index International (DQI-I) as this encompasses dietary variety, adequacy, moderation, and balance.³¹

Statistical methods

Of the 5,517 children who received parental consent, 5,200 completed the YAQ. Following established criteria for outlying observations, we excluded 234 (4.5%) students reporting average energy intakes less than 500 kcal or greater than 5000 kcal per day.³²

We used multilevel linear regression to examine the associations of socio-demographic and lifestyle risk factors with overall diet quality while acknowledging

the clustering of students' observations within schools. To facilitate the interpretation of these analyses, we exponentiated the resulting β -coefficients to represent relative risks (and 95% confidence limits) associated with a 10% reduction in diet quality.

To minimize non-response bias, we calculated response weights on the basis of postal code-level estimates of household income that are available through the Canada Census for both participating and non-participating grade five students. As we considered these response weights in the analyses, our results represent provincial population estimates for grade five students.

RESULTS

Among grade five students in Nova Scotia, 42.3% did not meet the minimum recommendations of Canada's Food Guide to

TABLE III
Risk Factors for Poor Diet Quality Among Grade Five Students in Nova Scotia

Risk Factor	Percentage	Relative Risk (95% CI)	Multivariate Relative Risk (95% CI)
Gender			
Girls	51.5%	1	1
Boys	48.5%	1.11 (1.09-1.14)	1.07 (1.05-1.09)
Place of birth			
Nova Scotia	88.3%	1	
Other	11.7%	0.92 (0.88-0.96)	
Breakfast			
Usually eats	96.4%	1	1
Skips	3.6%	1.39 (1.27-1.47)	1.18 (1.10-1.26)
Lunch			
Bring from home	61.5%	1	1
At home	18.2%	1.03 (0.99-1.07)	1.00 (0.97-1.04)
Buy at school	18.9%	1.21 (1.17-1.25)	1.10 (1.07-1.14)
Skips	1.4%	1.61 (1.45-1.79)	1.34 (1.20-1.49)
Family supper			
< once/week	12.0%	1	1
1-2 times/week	16.0%	0.94 (0.90-0.99)	0.98 (0.93-1.03)
3-4 times/week	14.8%	0.83 (0.79-0.87)	0.88 (0.83-0.92)
≥5 times/week	57.3%	0.73 (0.70-0.76)	0.86 (0.83-0.90)
Supper in front of TV			
< once/week	43.9%	1	1
1-2 times/week	33.0%	1.14 (1.12-1.17)	1.04 (1.02-1.06)
3-4 times/week	11.3%	1.36 (1.31-1.41)	1.10 (1.05-1.14)
≥5 times/week	11.7%	1.50 (1.44-1.56)	1.13 (1.08-1.18)
Eating at fast-food restaurant			
< once/week	50.3%	1	1
1-2 times/week	46.3%	1.21 (1.18-1.24)	1.14 (1.11-1.17)
≥3 times/week	3.4%	1.87 (1.75-1.99)	1.56 (1.47-1.66)
Participation in physical activities			
≤ once/week	4.9%	1	1
2-4 times/week	31.3%	0.74 (0.69-0.78)	0.79 (0.75-0.84)
5-7 times/week	53.9%	0.63 (0.59-0.67)	0.69 (0.66-0.73)
≥8 times/week	9.8%	0.57 (0.53-0.61)	0.65 (0.61-0.70)
Sedentary activities (TV, computer, video games)			
≤1 hour/day	9.7%	1	1
>1 and ≤4 hours/day	51.3%	1.24 (1.19-1.29)	1.17 (1.12-1.21)
>4 and ≤7 hours/day	27.8%	1.54 (1.47-1.61)	1.36 (1.30-1.42)
>7 hours/day	11.2%	1.98 (1.87-2.10)	1.60 (1.51-1.70)
Parental eating habits			
Very healthy	10.0%	1	1
Healthy	46.5%	1.12 (1.08-1.17)	1.07 (1.03-1.12)
Somewhat healthy	41.1%	1.31 (1.25-1.36)	1.14 (1.10-1.19)
Not healthy	2.4%	1.22 (1.11-1.34)	1.03 (0.93-1.13)
Parental activity level			
Very high	6.0%	1	
High	20.5%	1.06 (1.00-1.12)	
Moderate	56.1%	1.15 (1.10-1.21)	
Low	17.4%	1.17 (1.11-1.24)	
Parental place of birth			
Canada	95.3%	1	
Other	4.7%	0.99 (0.94-1.04)	
Marital status			
Married or common-law	82.2%	1	
Separated or divorced	12.2%	1.10 (1.06-1.14)	
Single or widowed	5.6%	1.14 (1.06-1.22)	
Parental education			
Secondary or less	30.0%	1	1
Community college	37.8%	0.91 (0.88-0.94)	0.94 (0.91-0.97)
University	23.0%	0.81 (0.78-0.83)	0.88 (0.85-0.91)
Graduate university	9.2%	0.77 (0.73-0.81)	0.88 (0.83-0.92)
Annual household income			
<\$20,000	11.7%	1	
\$20,000-\$39,999	22.5%	1.04 (0.99-1.09)	
\$40,000-\$60,000	26.4%	0.92 (0.88-0.97)	
>\$60,000	39.4%	0.80 (0.76-0.84)	

CI: Confidence interval; Diet quality is quantified using the Diet Quality Index International.³¹ All relative risk estimates are adjusted for energy intake following established recommendations.³² The findings originate from 4,966 students and their parents participating in the 2003 Children's Lifestyle And School-performance Study. The findings are adjusted for non-response. Information on breakfast, lunch, family supper, supper in front of TV, eating at fast-food restaurant was taken from the Harvard's Youth Adolescent Food Frequency Questionnaire; information on gender, participation in physical activities and sedentary activities was taken from the children's survey on activities; information on children's place of birth, parental eating habits, parental activity level, parental place of birth, marital status, parental education and annual household income was taken from a survey completed by parents.

Healthy Eating for *milk products*, nor did they meet recommendations for the food groups *vegetables and fruit* (49.9%), *grain products* (54.4%) and *meat and alternatives* (73.7%) (Table I).

The mean daily energy intake was 2077 and 2256 kilocalories for girls and boys, respectively. Intakes of nutrients that are considered to be indicative of or critical for proper nutrition among children are presented in Table II. On average, carbohydrate contributed 56.7% of total energy intake, of which 11% (32 grams/day) was sucrose. With respect to fat, 26.2% of students were not within the recommended range (25-35% of total calories) with 13.9% and 12.3% exceeding or beneath this range, respectively.

The average intakes of vitamin A, folate, vitamin C, iron and zinc exceeded reference values, and 4.7%-27.6% of students had inadequate intakes (Table II). Similarly, average intakes of B vitamins (thiamin, riboflavin, B6 and B12) exceeded the reference values with less than 10% of respondents having inadequate levels (data not shown). The average intake of Vitamin D was higher than the AI, whereas that of calcium and fibre was lower. The average intake of sodium exceeded the upper limit with 59.5% of students above this level.

The observed overall diet quality score averaged 62.4 and ranged from 15.5 to 88.0 on a scale of 0 to 100. Diet quality was better among girls than boys: relative to girls, boys had a 1.11 (or 11%) higher risk for lower diet quality (Table III). After adjusting for differences in lifestyle and socio-economic factors, gender differences decreased to a 7% higher risk among boys. Skipping breakfast was reported by 3.6% and was independently associated with an 18% higher risk for lower diet quality. Similarly, purchasing lunch at school and skipping lunch were associated with a 10% and 34% increase in risk for lower diet quality, respectively. Eating at a fast-food restaurant 3 or more times per week was associated with a 56% increased risk for lower diet quality. Children reporting frequent consumption of meals in front of the TV, less participation in physical activity, and frequent participation in sedentary activities were also observed to have poorer diet quality. Children of parents with healthy eating habits and advantaged

socio-economic backgrounds had better diet quality.

DISCUSSION

Grade five students in Nova Scotia adequately meet the recommendations for most nutrients. However, nutrients of concern include calcium and fibre, of which intakes are low, and dietary fat and sodium, of which intakes are high. The dietary reference intake (DRI) for calcium is based on optimal calcium retention for bone development and prevention of osteoporosis.²⁴ The DRI for fibre is set to lower the risk for certain cancers, obesity, diabetes, and coronary heart disease.²⁰ As intakes of calcium and fibre are low, the prevention of these conditions may therefore not be optimal. The observed calcium intake, however, exceeded the 1990 recommendations (900 mg/day for boys and 1100 mg/day for girls) and paralleled observations among youth in other Canadian jurisdictions.³³⁻³⁵

High intakes of fat and sodium have long been linked to chronic diseases. Since the early 1970s, Canadian adults have gradually decreased their fat intake from 40-41% of calories to 30-31% by the late 1990s.³⁶ A similar decline was observed among American children, from 39% in the late 1970s to 33% by the late 1990s.³⁷ In contrast, the consumption of refined sugars increased to approximately 60 grams of sucrose per day, originating primarily from soft drinks.³⁷ Given that higher sucrose consumption in the United States (US) parallels a higher prevalence of childhood obesity, Canadian policies to abandon soft drink (pop) sales in elementary schools may be an appropriate step in the prevention of childhood obesity, as it may contribute to a decrease in the consumption of refined sugars in this country.⁶

Adherence to the Canada's Food Guide to Healthy Eating, which is currently under review, was observed to be poor. Better compliance with the recommendations for *grain products* and *vegetables & fruit* should increase fibre intakes and reduce intakes of fat and sodium. Similarly, better compliance with the recommendations for *milk products* is likely to increase the consumption of calcium. We observed a mean intake from *meat & alternatives* that was lower than the recommen-

dation. A low intake of foods from this group is reflected in the 27.6% of students with zinc intakes lower than the DRI. In comparison to 178 Quebec adolescents surveyed in 1997/1998,³⁸ children in Nova Scotia consume more servings from *vegetables & fruits* and *milk products* and fewer from *grain products* and *meat & alternatives*. Relative to children in the US who consume 3.7 servings of fruits and vegetables per day,³⁷ children in Nova Scotia consume notably more of this food group (5.8 servings per day).

Consistent with the established association between socio-economic factors and health,^{39,40} we observed a gradient whereby socio-economically advantaged groups had healthier diets. Similar to studies in the US, we found that frequent family meals resulted in healthier diets.^{41,42} Also similar to studies in the US, we observed that eating in front of the television is common and results in lower diet quality, probably because these meals are more likely to consist of unhealthy snacks, ready-made meals and soft drinks.⁴¹ Skipping breakfast or lunch was observed among relatively few students but was found to have a negative effect on diet quality, possibly because these meals are replaced by unhealthy snack foods. Frequent consumption of fast food was also observed to be detrimental to children's diets.

Despite the pandemic increases in childhood obesity, very few studies have evaluated risk factors for poor diet.^{43,44} Such research is critical to providing direction to educators and as a basis for evidence-based health policy. The present study quantified the independent importance of various child, parental and school factors, all of which could serve as targets for health promotion. For example, a focus could be on encouraging children not to skip meals and to limit consumption of fast food and soft drinks. Parents could play a key role in discouraging their children's sedentary activities and in emphasizing healthy family meals. In addition to providing health education, schools can contribute by serving and promoting healthier lunches. In this respect, integrated school programs have been demonstrated to be effective in improving diet quality and preventing obesity.⁴⁵

We administered validated questions and questionnaires, however, responses

remain subjective and subject to error. Strengths of the present study further include the population-based design, the large sample size, the relative high response rates, the adjustment for non-response bias and the consideration of various potential confounders.

In summary, grade five students in Nova Scotia adequately met the requirements for most nutrients. Intakes of calcium, fibre, fat and sodium, however, are of concern and could be addressed by better adherence to Canada's Food Guide to Healthy Eating. Dietary quality is influenced by various child, parental and school factors, all of which could serve as targets for promotion of healthy diet and prevention of childhood obesity.

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RÉSUMÉ

Objectif : Les politiques de santé publique font la promotion d'une saine alimentation, mais rares sont les évaluations de l'observation par les enfants des recommandations alimentaires et les études des facteurs de risque de la malnutrition, malgré le rôle important que joue le régime alimentaire dans l'augmentation temporelle de la prévalence de l'obésité de l'enfance. Nous examinons ici les apports alimentaires et les facteurs de risque d'une mauvaise alimentation chez les enfants de la Nouvelle-Écosse afin de mieux orienter les politiques sanitaires et les initiatives de prévention.

Méthode : En 2003, nous avons sondé 5 200 élèves de 5^e année dans 282 écoles publiques de la Nouvelle-Écosse, ainsi que leurs parents. Nous avons évalué les apports alimentaires des élèves (à l'aide du questionnaire « Youth Adolescent Food Frequency » de l'Université Harvard) et nous les avons comparés aux recommandations canadiennes sur les groupes d'aliments et les apports en nutriments. Nous avons résumé la qualité du régime à l'aide de l'instrument « Diet Quality Index-International » (DQI-I) et utilisé des méthodes de régression multiniveau pour évaluer les éventuels facteurs de risque d'une mauvaise alimentation pour les enfants, les parents et les écoles.

Résultats : En Nouvelle-Écosse, 42,3 % des enfants ne respectaient pas les recommandations de consommation de produits laitiers, ni des groupes d'aliments « légumes et fruits » (49,9 %), « produits de céréales » (54,4 %) et « viande et substituts » (73,7 %). Les besoins des enfants en nutriments étaient respectés, à l'exception du calcium et des fibres, pour lesquels les apports étaient faibles, et des matières grasses et du sodium alimentaire, pour lesquels les apports étaient élevés. Le fait de sauter des repas et d'en acheter à l'école ou dans les restaurants rapides étaient d'importants déterminants d'une mauvaise alimentation. L'évaluation par les parents de leurs propres habitudes alimentaires était associée positivement à la qualité du régime de leurs enfants.

Interprétation : L'alimentation des enfants de la Nouvelle-Écosse est relativement mauvaise. Des politiques de santé publique explicites et des initiatives de prévention ciblant les enfants, les parents et les écoles pourraient améliorer la qualité de l'alimentation et prévenir l'obésité.