ORIGINAL RESEARCH ARTICLE

Traditional food consumption behaviour and concern with environmental contaminants among Cree schoolchildren of the Mushkegowuk territory

Tina Hlimi[1]*, Kelly Skinner[2], Rhona M Hanning[2], Ian D. Martin[1] and Leonard J.S. Tsuji[1,2]

[1]Department of Environment and Resource Studies, University of Waterloo, Waterloo, ON, Canada;
[2]Department of Health Studies and Gerontology, University of Waterloo, Waterloo, ON, Canada

Objectives: To investigate factors influencing consumption of traditional foods (e.g. wild game, fish) and concerns about environmental contaminants among schoolchildren of the Mushkegowuk Territory First Nations (Moose Factory, Fort Albany, Kashechewan, Attawapiskat, and Peawanuck).
Study design: Cross-sectional data collection from a Web-based Eating Behaviour Questionnaire (WEB-Q).
Methods: Schoolchildren in grades 6–12 ($n = 262$) responded to 4 of the WEB-Q questions: (a) Do you eat game? (b) How often do you eat game? (c) How concerned are you about the environmental contaminants in the wild game and fish that you eat? (d) I would eat more game if. . . [6 response options]. Data were collected in 2004 (Fort Albany), 2005 (Peawanuck), 2006 (Attawapiskat), 2007 (Moose Factory) and 2009 (Kashechewan). Hierarchical log-linear modelling (LLM) was used for analyses of multi-way frequency data.
Results: Of the schoolchildren answering the specific questions: 174 consumed game; 95 reported concerns about contaminants in game; and 84 would increase their game consumption if it were more available in their homes. LLM revealed significant differences between communities; schoolchildren in Moose Factory consumed game ‘‘rarely or never’’ at greater than expected frequency, and fewer than expected consumed game ‘‘at least once a day’’. Schoolchildren in Kashechewan had greater frequency of daily game consumption and few were concerned about contaminants in game. Using LLM, we found that sex was an insignificant variable and did not affect game consumption frequency or environmental contaminant concern.
Conclusion: The consumption of traditional foods differed between communities and appears to be related to contamination concerns. In addition, latitudinal variation appears to influence the frequency of traditional food consumption in children; children in the most southerly location consumed traditional food less frequently.

Keywords: *First Nations*; *adolescents*; *environmental contaminants*; *food insecurity*; *hierarchical log-linear modelling.*

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In recent years, it has become apparent that Aboriginal Peoples (First Nations, Inuit, and Métis) have significant health disparities in contrast to the non-Aboriginal Canadian population (1–3). Among First Nations, this is especially true of remote, northern communities (4,5). Poor nutritional status and food insecurity are prevalent due to the westernization of dietary habits, and socio-economic, environmental and behavioural factors (6). For example, several studies indicate relatively high consumption of nutrient-poor market foods, which often are loaded with saturated fats and refined sugars (7,8). Poor dietary habits are especially common among First Nations adolescents (5,9), and in addition to genetic susceptibility, (10,11),

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contribute to their high prevalence of overweight, paediatric diabetes, anemia (12,13) and risk of adult chronic disease (17).

The westernization of dietary habits in First Nations communities is of concern, as traditional foods have higher nutrient densities (i.e. more nutrients per volume of food or relatively more nutrients compared to calories) than market foods (14). Traditional food acquisition also promotes physical activity, and minimizes food costs and cultural erosion (15). First Nations adolescents, in particular, have increased susceptibility to chronic lifestyle diseases; unhealthy dietary behaviours may be the most frequently occurring risk behaviour in adolescents 12–17 years of age (16) and often persist into adulthood (17). In the Mushkegowuk Territory (the area of study), it has been documented that abandoned Mid-Canada Radar line sites are known sources of environmental contamination (e.g. polychlorinated biphenyls) and there has been great concern over contamination of traditional foods (18). Further, there has been concern of food chain contamination from mining projects, such as, the Victor Diamond mine. Thus, it is well known in the Mushkegowuk Territory that there are real (Mid-Canada Radar line sites) and potential (Victor Diamond Mine) point sources of contamination that may be impacting traditional foods. Thus, perceptions and opinions about potential environmental contaminants in game (e.g. wild game, fish) may contribute to decreased traditional food consumption (15,19). Consequently, the availability of low-nutrient market foods combined with potential concerns regarding game contamination may serve as barriers to traditional food consumption among First Nations adolescents. Such barriers may produce household food insecurity which can be defined as the lack of domestic access to nutritionally wholesome foods, which are safe (e.g. free of contaminants), culturally acceptable (e.g. wild game and fish) and accessible to individuals at all times (20). The literature on First Nations adolescents' dietary patterns and traditional food consumption behaviour is limited (21,22). The present study addresses this gap in knowledge, by examining patterns of game consumption and contaminant perception among First Nations adolescents using a selection of food frequency and perceptions questions from a Web-based Eating Behaviour Questionnaire (WEB-Q). The WEB-Q was administered in 5 Cree schools in the Mushkegowuk Territory which encompasses south-western Hudson Bay and the western James Bay region of northern Ontario, Canada.

Material and methods

Study population

The coastal First Nations Cree of the Mushkegowuk Territory number approximately 10,000 people living in 5 communities. A cross-sectional study was conducted among Cree schoolchildren living in these 5 remote, sub-arctic communities of the Mushkegowuk Territory: Moose Factory (sample n = 82; community population of ~3,000), Fort Albany (n = 63; population of ~850), Kashechewan (n = 44, population of ~1,400), Attawapiskat (n = 62, population of ~1,600) and Peawanuck (n = 11; population of ~250) (Fig. 1). In total, 131 (50%) boys and 131 (50%) girls participated. The mean age of the 262 participants was 13.4 years of age (SD = 1.7) with a range of 10–17 years of age. One-hundred-and-eighty-eight (72%) of the adolescents in this study were in grades 6–8 of elementary school; while, the remaining 74 (28%) were in grades 9–12 of secondary school.

Dietary study method

First Nations adolescents participated in the WEB-Q, which was developed and validated at the University of Waterloo (23). This study was approved by the Office of Research Ethics at the University of Waterloo and at each participating school; passive parental consent was assumed if there was no response to letters sent to each home. Student assent was obtained at the start of the online survey. The WEB-Q was employed as an inexpensive and effective way of collecting nutritional behaviour data from adolescents in remote communities (24). First Nations community advisory groups (composed of Band Council members and/or personnel from health and educational services) examined the WEB-Q for cultural appropriateness and appropriate modifications were made to the WEB-Q. Modifications included the creation of 4 additional questions related to game consumption and concern toward potential environmental contamination of wild game and fish. Sampling was based on a convenience sample of children present at school on the day of data collection. As a convenience sample was employed in the present study, one limitation is that this sampling method is based on school attendance. Thus, to optimize the number of students participating in the study, WEB-Q administration was scheduled during times of the year not conflicting with cultural pursuits and/or school trips. A trained research assistant was present during data collection.

Data collection

Data were collected in the winter or spring of 2004 (Fort Albany), 2005 (Peawanuck), 2006 (Attawapiskat), 2007 (Moose Factory) and 2009 (Kashechewan). In total, the WEB-Q consisted of 43 questions, of which the following 4 were examined: (a) Do you eat game? (possible answers: "no" or "yes") (b) How often do you eat game? (Initially this question had 6 categories: "rarely or never", "2–4 times a month", "2–4 times a week", "5–6 times a week", "once a day" and "at least twice a day". These response options were collapsed into 3 categories for ease of computation to form: "rarely or never", "at least once

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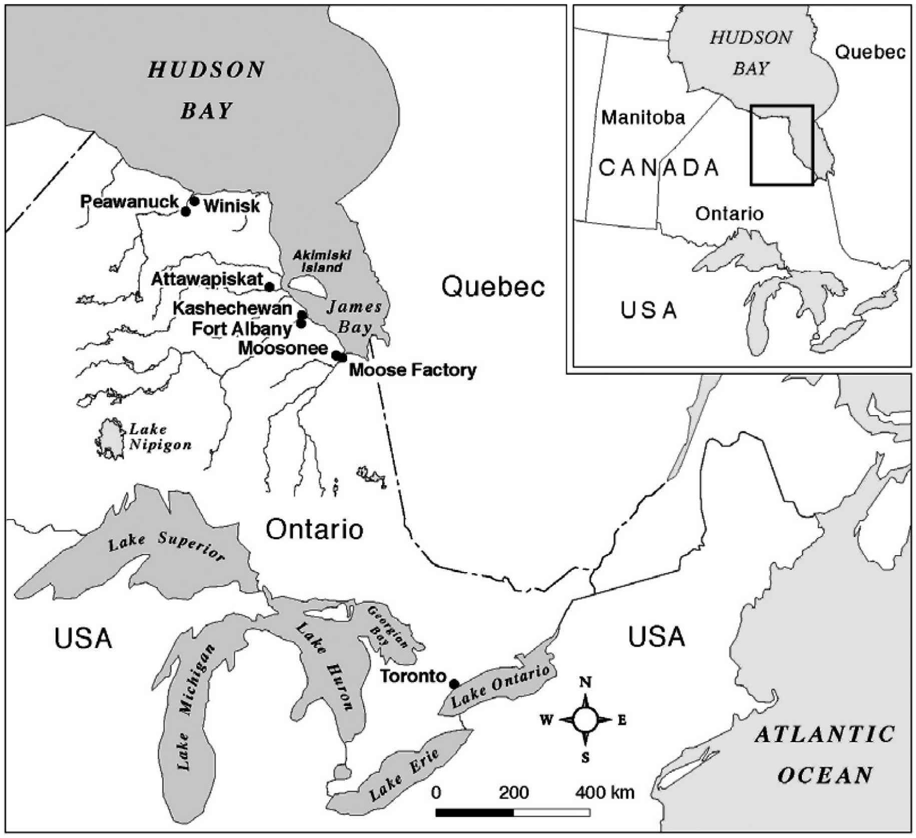

Fig. 1. Map of surveyed communities.

a week'' and ''at least once a day''.) (c) How concerned are you about the environmental contaminants in the game, fish or other meats that you eat? (Initially this question had 3 categories: ''not concerned'', ''somewhat concerned'' and ''very concerned''. The response options of ''somewhat concerned'' and ''very concerned'' were collapsed to form ''concerned''.) (d) I would eat more game if... (with 6 possible response options: (a) My friends ate more game, (b) My parents ate more game, (c) My family knew how to properly prepare it, (d) It was more available in my home, (e) It was more available at school and (f) None of the above. Students could choose as many responses as applied.

Statistical analyses

Questionnaire data were compiled in Access files and/or Excel spreadsheets (Version 2007; Microsoft Corp., Bellevue, WA, USA) and analyses of frequency data were carried out using hierarchical log-linear contingency modeling (PASW, formerly SPSS, Version 18; SPSS, Chicago, IL, USA); hereafter referred to as log-linear modelling (LLM). The latter allowed for multi-way frequency data comparisons of specific combinations of variables. Analysis commences with a ''fully saturated'' model which tests all possible main and interaction effects and provides a perfect fit to the data. Thus, the Chi-square value and the coinciding p value are both zero. The deletion of any interaction or variable from the model will create an unsaturated or reduced model and a positive Chi-square value, but these more parsimonious models may still provide an adequate fit to the data. The hierarchical nature of this model necessitates that the highest order term is tested first by deletion of the 3-way interaction, followed by each of the various 2-way interactions. Interactions are selectively eliminated to test the influence of each variable of interest, and significance of influence is judged by resultant ''badness of fit'' as quantified by increased value of the Chi-square and decrease in associated p-value. Examination of the adjusted standardized residual (ASR) in each cell of the table shows the departure from expected value for each cell. Any ASR with an absolute value greater than 1.96 is considered significant because it confirms a dependent relationship between the excluded variables (see Tsuji et al. (25) for a detailed discussion). LLM could not be conducted on question 4 owing to its multiple-response format.

We analyzed responder bias by examining potential SEX and AGE (in years) differences between those participants who did or did not answer each question. The frequency of non-respondents by SEX was examined using 2×2 Chi-square cross tablulation, and mean age of responding and non-responding subjects was compared by 1-way ANOVA.

Results

Frequency data are reported individually or entirely by community, sex and question. The elimination of the 3-way interaction (COMMUNITY × SEX × RESPONSE) LLM had inconsequential effects on model fit; therefore, testing continued to examine the 2-way interactions testing the effects of subject SEX (boy, girl) or geographic COMMUNITY (Moose Factory, Fort Albany, Kashechewan, Attawapiskat, Peawanuck) on CONSUMPTION, FREQUENCY and CONCERN. Since some of the 262 participants chose not to respond to specific questions, the number of respondents per question varies as indicated.

There was no significant difference in frequency of males and females among respondent and non-respondent participants for any of the 4 questions (Chi-square; $p > 0.05$). Mean age of responding and non-responding subjects was not significantly different for questions 1, 2, and 3 (ANOVA; $p > 0.05$); however, mean age of non-respondents to question 4 (I would eat more game if...) was significantly greater (15.2 years) than the age of respondents (13.3 years) to this question (ANOVA; $p < 0.0001$).

Question 1: Do you eat game?

Of 194 respondents, 174 (90%) answered "yes" indicating that most schoolchildren consumed game (Table I). In total, 93 (53%) boys reported consuming game compared to 81 (47%) of the girls. The fitted LLM for game consumption was not significant for the test of the 2-way interaction of SEX with CONSUMPTION (Chi-square = 10.086, $p = 0.756$), or for COMMUNITY with CONSUMPTION (Chi-square = 10.086, $p = 0.756$).

Question 2: How often do you eat game?

Two-way LLM ($n = 224$) testing the interaction of SEX with FREQUENCY was not significant (Chi-square = 17.864, $p = 0.270$), showing that boys and girls consumed game at similar frequency. However, the interaction of COMMUNITY with FREQUENCY was significant (Chi-square = 51.078, $p < 0.05$) and revealed that significantly more schoolchildren in Moose Factory than expected "rarely or never" (ASR = 2.428) consume game and that significantly fewer than expected consume game frequently ("at least once a day") (ASR = −2.420). In Kashechewan, significantly more subjects than expected reported game consumption "at least once a day" (ASR = 2.427) and in Peawanuck, more children than expected consume game "at least once a week" (ASR = 3.242) (Table II; Fig. 2).

Question 3: How concerned are you about the environmental contaminants in the game, fish or other meats that you eat?

Overall, 95 of 173 (55%) respondents to this question were concerned about potential environmental contaminants in game (Table I). The LLM 2-way interaction testing SEX on CONCERN was not significant (Chi-square = 5.642, $p = 0.844$). However, the 2-way interaction testing COMMUNITY on CONCERN proved significant (Chi-square = 18.012, $p = 0.021$) as fewer children than expected in Kashechewan were "not concerned" (ASR = −2.031) about potential contaminants in game (Table II).

Table I. Percentage and number of schoolchildren who responded "yes" or "no" to eating game (and "concerned" and "not concerned" with potential environmental contaminants in game) for each community and for each sex. No significant differences ($p < 0.05$) were found for gender or community using log-linear contingency modelling

		Eating game				Game contamination			
		Yes		No		Concerned		Not concerned	
Community	Sex	n	%	n	%	n	%	N	%
Moose Factory	Boy	33	92	3	8	19	53	17	47
	Girl	25	89	3	11	9	36	16	64
Fort Albany	Boy	19	100	0	0	11	58	8	42
	Girl	21	84	4	16	12	63	7	37
Kashechewan	Boy	23	88	3	12	15	75	5	25
	Girl	15	88	2	12	14	88	2	12
Attawapiskat	Boy	16	94	1	6	7	44	9	56
	Girl	16	84	3	16	6	35	11	65
Peawanuck	Boy	2	100	0	0	1	50	1	50
	Girl	4	80	1	20	1	33	2	67

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Table II. Adjusted standardized residuals (ASR) from log-linear model testing effect of community on frequency of consumption of game (and on concern of potential environmental contaminants in game) among First Nations schoolchildren

Community	Sex	Frequency of consumption	ASR[a]	Concern	ASR[a]
Moose Factory	Boy	Rarely or never	1.006	Not concerned	0.385
		At least once a week	0.041	Concerned	−0.335
		At least once a day	−1.435		
	Girl	Rarely or never	***2.428***	Not concerned	1.197
		At least once a week	−1.341	Concerned	−1.139
		At least once a day	***−2.420***		
Fort Albany	Boy	Rarely or never	−0.779	Not concerned	−0.060
		At least once a week	1.476	Concerned	0.052
		At least once a day	−0.188		
	Girl	Rarely or never	−0.154	Not concerned	−0.674
		At least once a week	0.775	Concerned	0.641
		At least once a day	−0.537		
Kashechewan	Boy	Rarely or never	0.232	Not concerned	−1.228
		At least once a week	−0.910	Concerned	1.067
		At least once a day	0.461		
	Girl	Rarely or never	−0.899	Not concerned	***−2.031***
		At least once a week	−1.034	Concerned	1.932
		At least once a day	***2.427***		
Attawapiskat	Boy	Rarely or never	−0.918	Not concerned	0.807
		At least once a week	−0.601	Concerned	−0.701
		At least once a day	1.795		
	Girl	Rarely or never	−1.194	Not concerned	1.029
		At least once a week	0.360	Concerned	−0.979
		At least once a day	1.490		
Peawanuck	Boy	Rarely or never	−0.073	Not concerned	0.151
		At least once a week	0.215	Concerned	−0.131
		At least once a day	−0.084		
	Girl	Rarely or never	−1.477	Not concerned	0.482
		At least once a week	***3.242***	Concerned	−0.458
		At least once a day	−0.953		
Pearson chi-square		51.078		18.012	
DF		16		8	
p		<0.05		0.021	

[a]Significant ($p < 0.05$; ASR with an absolute value greater than 1.96) results are italicised and in bold.

Question 4: I would eat more game if . . .

Two-hundred-and-forty-six students answered this question and the number of responses totalled 1,476. Thirty-four percent ($n = 84$) of the schoolchildren who answered this question would increase their game consumption if it were more available in their homes; while, 33% ($n = 82$) would increase game consumption if their parents ate it more often. Many students would also choose to consume more game if their family knew to properly prepare it (23%; $n = 56$). Few schoolchildren would eat more game if their friends ate it more often (16%; $n = 39$). LLM could not be conducted on this question owing to its multiple-response format.

Discussion

Game and fish consumption and frequency of consumption

The majority of Mushkegowuk Territory schoolchildren responded "yes" to game consumption, similar to results reported by Tsuji and colleagues (26). Although it has been reported that geographical differences and distinctive community characteristics, such as, transport access, animal migration routes, population size, demographics, and variation in dual economies can generate varying access to traditional food (7,27,28); in the present study, we did not find significant differences between communities in the percent and number of children who said they ate game (Table I).

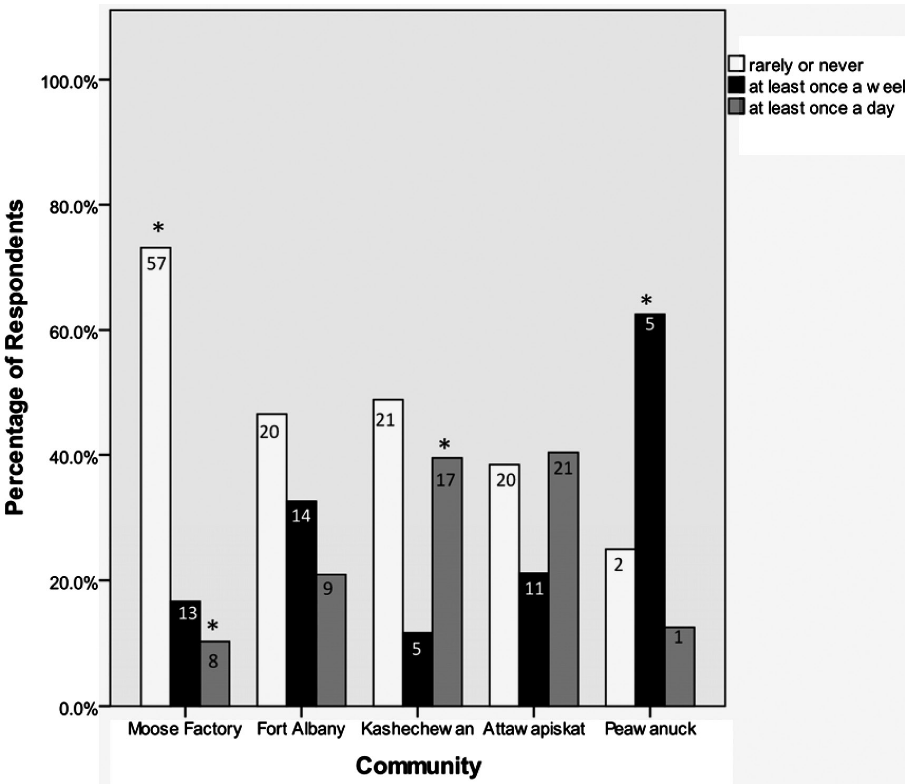

Fig. 2. Frequency of game consumption among schoolchildren by community. The number inside the bar indicates the sample number "n" of a total of 224 and an asterisk indicates a significant ($p < 0.05$) adjusted standardized residual, or an absolute value greater than 1.96, between consumption categories.

By contrast, frequency of game consumption did differ significantly across communities. As Moose Factory is the most southerly of the coastal First Nations of the Mushkegowuk Territory, it was not surprising that Moose Factory schoolchildren were found to have reported consuming game and fish less frequently than the other communities. A more southern location has often been associated with a less traditional lifestyle (29,30). Decreasing frequency of game consumption in communities like Moose Factory may prove problematic for schoolchildren, as decreasing frequency of consumption may produce or exacerbate the risk of chronic illnesses, such as, anemia, a prevalent condition among adolescents of First Nations ancestry (13). Low game consumption has also been reported to be linked to obesity; Cree children who consume an adequate portion of traditional foods "at least once a week" have been found to have a lower body mass index compared to those who do not (31). Low game intake among adolescents combined with economic factors may also instigate adverse social and developmental outcomes, if not supplemented with healthy market foods (e.g. dairy products, fruits, vegetables), such as, anxiety, short attention span, increased school absences and unpunctuality (32,33).

The results of the present study for frequency of game consumption in Kashechewan – where schoolchildren reported frequency of game consumption "at least once a day" significantly different (higher) than the other communities – supports a 1994 harvest study (34) in the Mushkegowuk Territory which reported that Kashechewan had the highest game and fish consumption frequency in the region. In addition, schoolchildren in Kashechewan may have a greater daily game consumption frequency comparative to other Mushkegowuk Territory First Nations due to a greater game sharing network and the stronger preservation of their traditional lifestyle (34–36). Fig. 2, however, depicts Attawapiskat to have a higher daily game consumption, in comparison to Kashechewan, but it is not statistically greater than expected.

Community location and northern latitude is often analogous with increased daily game consumption frequency (7). Of the schoolchildren in Peawanuck who consumed wild game and/or fish, consumption frequency of "at least once a week" was found to be significantly different (higher) compared to the other First Nations – supporting this argument. However, Kashechewan is located at a lower latitude, but has a higher frequency of game consumption than Peawanuck, suggesting that other factors, such as socio-economic issues may also be of importance.

Contaminant concern

Concern of potential environmental contaminants in game and fish is a predicament facing northern Aboriginal communities, as game food consumption is beneficial from nutritional and cultural aspects, but these benefits are not realized if Aboriginal people lose trust in their traditional foods (37). It is interesting to note that in Kashechewan – we found a daily game consumption frequency significantly different (higher) than the other communities – plus, a significantly higher frequency of schoolchildren who were "not concerned" about potential contaminants in game. These findings suggest that when children are not concerned about contaminants in game and fish, their game and fish consumption increases.

Further, it appears as if the increased availability and affordability of low-nutrient market foods available in the more southerly Mushkegowuk Territory First Nations combined with concerns over potential environmental contamination has resulted in some barriers to game and fish consumption among First Nations schoolchildren. In some instances, contaminant concern may stem from disadvantageous risk management and communication strategies in northern First Nations communities regarding environmental contaminants and their bioaccumulation in traditional foods (19,38). Moreover, new research is consistently modifying contaminant intervention strategies, hence heightening confusion (38). A study by Chan and colleagues (39) found that Kahnawake fishermen were decreasing their fish intake due to the misperception that the fish may contain unsafe levels of contaminants. Their perception was proven erroneous by laboratory tests which revealed minimal contaminant risks. Although Kahnawake is a southern First Nations community located on the south shore of the Saint Lawrence River by Montreal, Quebec, Canada, it is nevertheless a relevant case study as it presents the common concern of First Nations toward possible environmental contaminants in game. Therefore, effective contaminant reduction measures should be communicated to First Nations to decrease anxiety and increase game consumption (19,39). Contaminant reduction measures may include game preparation techniques, such as, trimming fat and/or boiling meat (15) for organohalogens – avoiding eating the liver and kidney of large game (40,41) with respect to toxic metals – and smoking game which has proven to reduce Polychlorinated biphenyl (PCB) contaminants in fish by 40–50% (42). Enhanced game preservation and storage facilities (e.g. community freezers) may also prove useful in increasing consumption (43). Furthermore, it is essential to provide educational material to First Nations adolescents and adults about the nutritional benefits of traditional foods, so that they can make informed decisions.

Increasing consumption

The adolescents in this study reported they would increase game intake if it were eaten more regularly by their parents or it was more available at home. This multiple response question highlights the importance of traditional food availability. Barriers to household availability of wild game and fish may be related to economic factors (44–46). Intervention strategies to increase traditional food consumption include greater game sharing initiatives, for instance food co-operatives within communities (47), the encouragement of local food consumption (48), a school curriculum component focused on healthy eating (49), environmental education about the risks and benefits of game consumption for parents and schoolchildren and food preparation workshops in community centres and schools (48).

Limitations

Non-response to a question is one of the limitations seen in the present study; however, gender was not related to this inaction (for any of the questions) and age was only significantly related to question 4 (note: LLM was not applied to this question). The only factor that we know of that may have contributed to non-responses on the WEB-Q is that sometimes a question and/or section of the WEB-Q would "freeze-up" due to technical problems and/or loss of Internet connection; thus, some students may not have been able to complete all questions. Another limitation relates to seasonality, though not specified in the questions, may have influenced schoolchildren's responses with respect to game consumption frequency, and harvests vary year-to-year.

Conclusion

The frequency of game/fish consumption was found to differ among communities examined in the present study and this finding may be attributable, in part, to concern with respect to contamination of game/fish and the westernization of dietary habits. Other factors affecting the availability of game/fish include economic variables and climate change. Overall, the results highlight the requirement for enhanced dissemination of risk management and communication strategies regarding potential environmental contaminants in traditional foods and the nutritional benefits of game/fish – that is, a balanced approach should be employed.

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Conflict of interest and funding

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***Tina Hlimi**
Department of Environment and Resource Studies
University of Waterloo
200 University Avenue West
Waterloo ON N2L 3G1
Canada
Email: thlimi@uwaterloo.ca