

Factors associated with the intake of traditional foods in the *Eeyou Istchee* (Cree) of northern Quebec include age, speaking the Cree language and food sovereignty indicators

Willows Noreen ^a, Louise Johnson-Down ^b, Moubarac Jean-Claude ^b, Michel Lucas ^{c,d}, Elizabeth Robinson^e and Malek Batal ^b

^aDepartment of Agricultural, Food and Nutritional Science, University of Alberta, Edmonton, AB, Canada; ^bDépartement de nutrition, Faculté de Médecine, Université de Montréal, Montréal, QC, Canada; ^cAxe Santé publique et pratiques optimales en santé, Centre de recherche du Centre Hospitalier Universitaire (CHU) de Québec, Québec, QC, Canada; ^dDepartment of Social and Preventive Medicine, Université Laval, Québec, QC, Canada; ^eCree Board of health and Social Services of James Bay, Montreal, QC, Canada

ABSTRACT

The *Eeyouch* are a First Nations (Cree) population that live above 49.6°N latitude in *Eeyou Istchee* in northern Quebec. *Eeyouch* rely on traditional foods (TF) hunted, fished or gathered from the land. The overarching aim of this study was to achieve an understanding of the factors associated with TF intake among *Eeyouch*. Data were from 465 women and 330 men who participated in the *Nituuchischaayihititaa Aschii* Multi-Community Environment-and-Health (E&H) study. The relationship between TF consumption and dietary, health, sociodemographic and food sovereignty (i.e. being a hunter or receiving Income Security to hunt, trap or fish) variables was examined using linear and logistic regression. Analyses were stratified by sex because of the male/female discrepancy in being a hunter. Among respondents, almost all (99.7%) consumed TF, 51% were hunters and 10% received Income Security. Higher intake of TF was associated with lower consumption of less nutritious ultra-processed products (UPP). In women, TF intake increased with age, hunting and receiving Income Security, but decreased with high school education. In men, TF intake increased with age and speaking only Cree at home. The findings suggest that increased food sovereignty would result in improved diet quality among *Eeyouch* through increased TF intake and decreased UPP intake.

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Introduction

There are 3 groups of Indigenous peoples recognised in the Canadian constitution: First Nations, Inuit and Metis [1]. The *Eeyouch* are a First Nations population that live in 9 rural or remote communities located above 49.6°N latitude in *Eeyou Istchee*, the boreal and taiga forest region of their traditional hunting lands in northern Quebec. Traditional foods (TF) hunted, fished, trapped or gathered from the land have always been an important part of the diet and culture of the *Eeyouch* [2]. More common examples of their TF include moose, goose, ptarmigan, caribou and whitefish [3]. Not only do TF contribute nutritious, minimally processed food to the diet, but the harvesting and gathering activities involved in their procurement are also important to the health and well-being of *Eeyouch*, as they require physical activity and connect people to their traditional lands [4,5].

Similar to other Indigenous peoples of Canada, the *Eeyouch* have had to contend with colonial policies that

have led to a loss of control of their lands and resources, and a decline in their traditional way of life as hunters and gatherers [3,6]. As a result, the intake of TF along with the activities associated with their procurement has decreased over time in the *Eeyouch* population, similar to other Indigenous populations in Canada [7,8]. Diminished TF consumption has been accompanied by an increased consumption of store-bought market foods (MF) and increased sedentariness [3]. Although nutritious MF could be an important complement to TF in the diet, a large portion of First Nations' diets consists of MF that are ultra-processed food and drinks (that is, ultra-processed products (UPP)) of poor nutritional quality [9]. The prevalence of these highly processed foods and drinks in the diet is likely the result of their ubiquity in rural and remote stores, which is attributable to their long shelf life and light weight making them ideal products for shipping over long distances. Another attribute of these foods which

CONTACT Willows Noreen  noreen.willows@ualberta.ca  Department of Agricultural, Food and Nutritional Science, University of Alberta, Mailbox #54 11405 87 Avenue, Edmonton, AB T6G 2P5, Canada

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makes them ubiquitous is the use of flavour enhancers, oils, sugar and sodium, creating cheap and highly palatable products [10].

The dietary shift from TF to MF has resulted in a contemporary *Eeyouch* diet that is high in saturated fat, free sugar, refined foods and low in fibre; this combination is often termed the “Western diet” [3,11,12]. Evidence that a compromised diet and increased sedentariness have accompanied this nutrition transition is the rise in nutrition-related chronic disease (NRCD) among *Eeyouch* such as insulin resistance, type 2 diabetes and cardiovascular disease [13,14]. For example, the prevalence of diabetes for *Eeyouch* aged 20 years and older is almost 3 times higher than the average in Canada and diabetes affects 1 quarter of adults [15,16]. Previous research in the *Eeyouch* showed a positive association between the percentage of total energy intake from ultra-processed MF and cardiometabolic risk [14].

Given the high prevalence of NRCD, an increased dietary share of TF could improve the health of *Eeyouch* people. There are many factors at multiple ecological levels that both promote and impede the consumption of TF. Factors that are associated with TF intake among other Indigenous groups are community remoteness, having a hunter in the family, being physically active, participating in traditional activities, food sharing practices and the high cost of MF [17–22]. Previous studies in *Eeyouch* found higher intakes of TF to be associated with older age, walking more than 30 min a day, and having fewer years of schooling [19]. Likely obstacles to *Eeyouch* procuring TF based on data from other Indigenous groups include lack of transmission of traditional knowledge of hunting and preserving TF; the time, cost and energy required for harvesting activities; the yearly and seasonal availability of game and fish; climate change; and wage labour opportunities [21,23–25].

The concept of food sovereignty has been used to represent the difficulties encountered by Indigenous peoples in Canada in harvesting TF [26,27]. Food sovereignty is

the right of peoples to define their own policies and strategies for sustainable production, distribution, and consumption of food, with respect to their own cultures and their own systems of managing natural resources and rural areas, and is considered to be a precondition for Food Security. [28]

Advocates in this area identify the ability of First Nations to fish, hunt and gather as key elements in achieving food sovereignty [26,27,29] and the *Eeyouch* are partnering in projects to articulate their vision of

this [30]. As Indigenous peoples strive to become sovereign over their own environments including their TF systems, they face many challenges that are outside of their control but have a great impact on their TF systems and way of life [4,26,27]. For example, some TF have been identified as containing environmental contaminants (e.g. mercury, lead and organochlorines), and thus individuals and communities need to balance the health risks and benefits of consuming these foods [13,19,20,31].

It is important to advance our understanding of the many factors that influence TF intake among *Eeyouch* and the impact of TF on their health. Using data from the *Nituuchischaayihitaau Aschii* Multi-Community (E&H) study, we explored the relationship between food sovereignty proxy variables and socio-economic, dietary, lifestyle and health factors that are associated with TF consumption in the *Eeyouch*. Diet was assessed using the NOVA method to classify foods as UPP considering the success that we had with this method in examining the diet of the *Eeyouch* and other First Nations in 4 Canadian regions [9,14]. In this study, having a hunter in the home and receiving Income Security for hunters and trappers (a programme whereby *Eeyouch* are paid an annual income to spend time on the land hunting, trapping and fishing) were considered proxy indicators of food sovereignty as they signify individuals were engaged in cultural food procurement activities from the local food system.

Methods

Study population

The *Nituuchischaayihitaau Aschii* Multi-Community (E&H) study was cross-sectional, funded and coordinated by the Cree Board of Health and Social Services of James Bay (CBHSSJB) of Quebec. It was a joint project of the CBHSSJB and McMaster, Laval and McGill universities. Seven *Eeyouch* communities were approached to participate in the study. All *Eeyouch* adults except pregnant women were eligible to participate. A random age-stratified sample was targeted, as described elsewhere [32]. Bilingual interviewers (Cree, English) were recruited and trained in each community in interviewing and diet-assessment methods. In total, data were pooled from 1,101 adults 18 years and over interviewed during the spring and (or) summer of 2005, 2007, 2008 and 2009. Written consent was obtained in either English or Cree First Nation language from all participants [32–34]. Ethical approval was obtained from the

research committee of the CBHSSJB, and from McGill, Laval and McMaster universities.

Dietary assessment

We derived frequency of TF intake from a qualitative food frequency questionnaire (FFQ). The FFQ that included all TF species consumed by the *Eeyouch* (that is, wild game, fish, fowl and berries) was administered to originally estimate the frequency of yearly consumption of TF by season. Participants were asked the following questions: "In the past 12 months, did you eat any of the following animals, fish, birds and ducks, wild berries? If yes, how often did you eat these for each of the following seasons?" and participants estimated their intake by season. A total of 35 possible TF items were investigated. The average daily frequency of each TF consumed per season was estimated from the FFQ. Thereafter, the daily frequency estimates per season for each item were summed, and this figure was then multiplied by 7 to obtain the weekly frequency of all TF consumed. Quintiles of weekly frequency of TF were also established.

Information about UPP intake was derived from 24-h dietary recalls. Although a second 24-h recall was collected in 26% of adults, only the first recall was used for these analyses. The 24-h dietary recalls used a 5-step multiple pass approach [35,36] and were collected from May to September. Food models helped to estimate portion size. To ensure quality control, a research assistant reviewed the recalls daily and provided feedback as necessary. Foods from the 24-h dietary recalls that were soft drinks and juices, commercial breads, sweet and salty snacks and ready-to-eat meals were categorised as UPP using the NOVA classification [10] similar to other studies examining the diet of First Nations in 4 Canadian regions and elsewhere in the same *Eeyouch* population [9,14]. Per cent of energy intake from UPP was determined from the ratio of UPP energy divided by total dietary energy from all foods.

Sociodemographic characteristics

Sociodemographic data were obtained from interviewer-administered questionnaires. Hunting and receiving Income Security to hunt, fish or trap were considered proxy variables for food sovereignty. Age was divided by 10 to provide the impact of a 10-year change in age on the outcome variable. Other variables were Cree (First Nation) language only spoken at home; at least some high school education; large household size (>4 persons); children under 18 years of age in the home; wage employment (full-time or part-time employment) vs. employment

insurance or not working (due to health reasons, parental leave, hunter and trapper Income Security Program, social welfare, student, homemaker, pension and other); perceived good health (excellent, very good and good); and smoking >5 cigarettes/day.

Cardiometabolic risk

Trained research nurses measured height and waist circumference (WC) upon exhalation with the measuring tape between the last floating rib and the iliac crest. Weight and body mass index (BMI) ($\text{kg}\cdot\text{m}^{-2}$) were assessed using a bioelectrical impedance scale (Tanita Corp., Arlington Heights, IL, USA). Lifestyle characteristics such as average daily walking over the past 7 days were obtained from the International Physical Activity Questionnaire [37]. Blood pressure (BP) was taken at 3 intervals as recommended by the Canadian Hypertension Education Program using a manual mercury sphygmomanometer, 15-in stethoscopes, and cuffs sized to the subjects' arms [38]; the last 2 measures were then averaged. Blood samples were taken to measure several metabolites from participants who had fasted overnight with methods described elsewhere [13]. For the current study, data on triglycerides [39], high-density lipoprotein cholesterol (HDL-C) and fasting plasma glucose (FPG) were used as measures of cardiovascular health.

Cardiometabolic risk was determined using metabolic syndrome (MetS) as assessed using recommendations of the International Diabetes Federation (IDF) [40]. IDF thresholds for TG (>1.7 mmol/L), HDL-C (<1.03 mmol/L for men and <1.29 mmol/L in women) and FPG (>5.6 mmol/L) were applied. Central adiposity was considered WC ≥ 90 cm for men and ≥ 80 cm for women. High blood pressure (HBP) was deemed a systolic BP ≥ 130 mmHg or a diastolic BP ≥ 85 mmHg [41]. Participants were categorised as having MetS if they presented with central obesity and 2 of the following: HBP, elevated TG, elevated FPG or low HDL-C [40,41].

Statistical analysis

Descriptive statistics with non-normal distributions were log-normally transformed and reported as geometric means with a 95% confidence interval (CI). Means of continuous variables were compared using unpaired *t*-tests. Chi-square was used to compare categorical variables. TF intake was modelled as quintiles of frequency (per week) of TF intake and descriptive statistics were compared across quintiles with *p* trend assessed using univariate logistic regression. Following this, separate unadjusted logistic regression and

adjusted backward multiple logistic regression models were conducted for each independent variable, to report the unadjusted and adjusted odds ratio (OR) of being in the 5th quintile of TF intake compared to being in the other 4 quintiles (combined) of intake. Multiple linear regression analyses were performed with continuous weekly frequency of TF intake, taking care to eliminate issues of collinearity and backward selection of variables was done with $p < 0.1$. Having a hunter in the home and receiving Income Security for hunters and trappers were forced in all analyses as proxy variables of food sovereignty. The presence of interactions was investigated in all multivariate analyses. Data were stratified by gender in all analyses because of the difference in hunting practice between females and males. MetS was removed from all analysis considering the strong association with BMI. Statistical analyses were conducted with SAS software (version 9.4, SAS Institute, Cary, NC, USA). Two-sided $p < 0.05$ values were statistically significant.

Results

The sample consisted of 465 (58.5%) women and 330 (41.5%) men. Table 1 provides data on socio-demographic, lifestyle and health characteristic stratified by gender. Two-thirds of the participants lived in communities on the coast of James Bay or Hudson Bay and the remainder in inland communities located in the boreal forest of *Eeyou Istchee*. The mean age of participants was 38.8 ± 14.9 years. Most of the participants (82%) had attended some high school, 58% received income from working outside the home. Median household size was 5 persons; women were more likely to report having children in their households ($p < 0.01$). A high connection with Cree culture was evident among participants. A majority (65%) spoke only Cree in their homes. With 1 exception, all respondents (99.7%) reported TF consumption. Despite pervasive TF consumption, 39% of energy in the diet came from UPP. Altogether, 51% of the participants self-identified as hunters and 10% received Income Security for being a hunter, fisher or trapper. Compared to women, men had more frequent TF intake and were more likely to be hunters and receive Income Security ($p < 0.001$) (Table 1).

The mean BMI of participants was $33.8 \pm 6.92 \text{ kg} \cdot \text{m}^{-2}$, with women having a significantly higher BMI than men. A large proportion (70.6%) of the sample was obese with the clear majority (98%) of all participants

demonstrating central adiposity. MetS was present in 49% of participants.

In unadjusted analyses in both sexes, higher quintiles of frequency of consumption of TF were associated with participation in the Income Security Program and increasing age, whereas lower quintiles of frequency of consumption of TF were associated with a greater likelihood of having attended high school and increasing intake of UPP. In women, BMI and the likelihood of being a hunter increased as the frequency of consumption of TF did, whereas frequency of consumption of TF was lower if children under 18 years of age were present in the home. In men, higher quintiles of TF intake were associated with speaking only Cree in the home and having MetS, whereas lower TF intake was associated with smoking, income from employment and having attended high school (Table 2).

The odds of being in the highest quintile of TF intake compared to other quintiles combined were determined using logistic multivariate regression analysis. Women had greater odds for high TF intake if they were a hunter (OR 2.77, 95% CI: 1.59, 4.85), received Income Security (OR 2.72, 95% CI: 1.14, 6.46), were older (OR 1.34, 95% CI: 1.09, 1.64) or had a higher BMI (OR 1.04, 95% CI: 1.00, 1.08). Lower odds of high TF consumption occurred for having some high school education (OR 0.38, 95% CI: 0.19, 0.75) (Table 3). Men had greater odds of high TF intake if they were older (OR 1.41, 95% CI: 1.16, 1.70) or only spoke Cree at home (OR 2.79, 95% CI: 1.31, 3.84) (Table 3).

Adjusted multivariate regression in women ($R^2 = 0.256$) found increasing age, receiving Income Security and being a hunter as positively associated with frequency of TF intake, whereas having some high school was negatively associated with frequency of TF intake (Table 4). In men, R^2 was only 0.088 and the frequency of TF intake increased with age (Table 4).

Discussion

The *Eeyouch* First Nations living in the northern part of the province of Quebec are still reliant on foods hunted, fished, trapped and gathered from the land, for sustenance and to provide a sense of cultural connectedness, spirituality, social cohesion, cultural identity and physical activity through procurement activities [4,19]. The traditional diet of the *Eeyouch* offers them some protection from insulin resistance, a precursor to diabetes [13]. Given its many positive benefits, our study examined factors measured in the *Nituuchischaayihitaaui Aschii* Multi-Community (E&H) study which were associated with TF consumption.

Table 1. Characteristics of 795 adults 18 years and older from 7 *Eeyoulstchee* communities in northern Quebec (Canada), by gender, 2005–2009.

Characteristics	Women (n = 465)	Men (n = 330)	P ^a
Diet quality			
TF intake ^b (times per week)	2.04 [1.83, 2.27]	3.34 [2.98, 3.74]	<0.001
Per cent energy as UPP ^{b, c}	38.9 [32.7, 46.1]	39.7 [32.8, 48.1]	0.871
Food sovereignty			
Hunter (n (%))	99 (21.3)	307 (93.0)	<0.001
Hunter Income Security ^d (n (%))	35 (7.53)	48 (14.6)	0.001
Sociodemographic			
Age ^b (years)	35.7 [34.5, 37.0]	36.7 [35.1, 38.2]	0.357
Coastal community ^e (n (%))	318 (68.4)	225 (68.2)	0.951
Household size >4 (n (%))	288 (61.9)	207 (62.7)	0.820
Children <18 years in household (n (%))	340 (73.1)	211 (63.9)	0.006
Some high school education ^f (n (%))	378 (81.3)	274 (83.0)	0.529
Income from wage employment ^g (n (%))	274 (58.9)	188 (57.0)	0.582
Speak Cree at home ^h (n (%))	295 (63.4)	223 (67.6)	0.228
Health			
Walk ≥60 min/day ⁱ (n (%))	229 (49.2)	178 (53.9)	0.192
Smoking ^j (n (%))	136 (29.2)	110 (33.3)	0.219
Perceived good health ^k (n (%))	342 (73.5)	246 (74.5)	0.752
Body mass index (kg·m ⁻²) ^b	34.5 [33.9, 35.2]	31.3 [30.7, 31.9]	<0.001
Normal weight ^l (n (%))	29 (6.24)	39 (11.8)	0.006
Overweight ^l (n (%))	80 (17.2)	86 (26.1)	0.002
Obese ^l (n (%))	356 (76.6)	205 (62.1)	<0.001
Waist circumference ^b (cm)	111 [110, 113]	109 [107, 111]	0.066
Central adiposity ^m (n (%))	454 (97.6)	303 (98.7)	0.295
Systolic blood pressure ^b	118 [117, 119]	124 [123, 126]	<0.001
Diastolic blood pressure ^b	71.2 [70.2, 72.2]	76.1 [75.0, 77.2]	<0.001
Hypertension ⁿ (n (%))	110 (23.7)	124 (37.6)	<0.001
Triglycerides [39] ^b (mmol/L)	1.38 [1.32, 1.44]	1.44 [1.36, 1.53]	0.260
Elevated TG ^o (n (%))	143 (30.8)	114 (34.5)	0.260
HDL-C ^b (mmol/L)	1.23 [1.20, 1.26]	1.16 [1.13, 1.19]	<0.001
Low HDL-C ^p (n (%))	260 (55.9)	96 (29.1)	<0.001
Fasting blood glucose (FBG) ^b (mmol/L)	6.02 [5.86, 6.19]	5.95 [5.78, 6.11]	0.539
Elevated FBG ^q (n (%))	215 (46.2)	161 (48.8)	0.478
Metabolic syndrome ^r (n (%))	235 (50.5)	158 (47.9)	0.460

TF: traditional food; UPP: ultra-processed products; HDL-C: high-density lipoprotein cholesterol.

^aContinuous variables compared with *t*-test and proportions with Chi-square. ^bAll such variables, geometric mean [95% confidence interval]. ^cPer cent energy as UPP was obtained from 24-h recalls. ^dA programme whereby members of the community are paid an annual income to spend time on the land hunting, trapping and fishing. ^eTwo of the communities were inland and the remainder on the coast of James Bay. ^fAttended some high school, not necessarily complete. ^gAnyone reporting working full- or part-time. ^hIndividuals that usually speak only Cree at home. ⁱSelf-report of average time walked per day for the past 7 days. ^jSmoked ≥5 cigarettes per day. ^kReported good, very good or excellent health. ^lBody mass index <25 = normal weight, 25–30 = overweight and BMI ≥30 = obese. ^mCentral adiposity defined as WC ≥90 cm for men and ≥80 cm for women. ⁿHigh blood pressure defined as systolic blood pressure ≥130 or diastolic blood pressure as ≥85. ^oTriglycerides are elevated when >1.7 mmol/L. ^pHDL-C is low when <1.03 mmol/L in men and <1.29 mmol/L in women. ^qFasting blood glucose is elevated when >5.6 mmol/L. ^rMetabolic syndrome defined as the presence of central adiposity plus any 2 of: HBP, elevated TG or FBG, low HDL-C.

We found that almost every participant of the *Nituuchischaayihititaa Aschii* Multi-Community (E&H) study included TF in their diet, typically 4.8 times per week. Despite the pervasiveness of TF in the diet of *Eeyouch* participants, 39% of energy in the diet was derived from the consumption of ultra-processed foods and beverages (UPP). The percentage of energy in the diet derived from UPP was lower than the share (48%) in the general Canadian populace [42,43]. TF intake is an indicator of positive diet quality, while UPP intake is an indicator of poor diet quality [42,44–46]. A previous study found that in *Eeyouch*, increasing intake of UPP was associated with presence of the MetS [14]. Obesity (BMI >30 kg·m⁻²) was highly prevalent in our participants (70.6%). Almost every participant in our study had central adiposity and half of respondents had MetS using culturally appropriate criteria for this population [40,41]. In our analyses, BMI only appears as a factor in the adjusted logistic regression

in women comparing the highest quintile of TF intake to all others. Since all quintiles of TF intake had BMI with geometric means greater than 30, the results may not be clinically relevant. In the present study, UPP intake decreased with increasing TF consumption, like another study in Canadian First Nations [9]. These findings suggest that those who eat TF most often have a healthier diet not only because TF has inherent health attributes but because it also replaces UPP in the diet

Age was positively associated with TF intake among *Eeyouch* participants in all analyses, as seen in other Indigenous and First Nations studies [3,47,48]. Laberge et al. state that determinants of TF consumption are intrinsically related to cultural factors in *Eeyouch* and other First Nations populations [19,20]. Our findings confirmed this supposition. We chose speaking Cree in the home as a proxy for a more traditional First Nations lifestyle. The numbers of Cree speakers in the present study showed a

Table 2. Characteristics of 795 adults 18 years and older according quintiles of weekly frequency of traditional food intake for 7 *Eeyou Istchee* communities in northern Quebec (Canada), by gender, 2005–2009.

Characteristics	Quintiles of frequency (per week) of traditional food intake					P for trend ^b
	Q1	Q2	Q3	Q4	Q5 ^a	
Women						
n	91	94	94	93	93	
Per cent energy as UPP ^{c, d}	44.2 [29.6, 66.0]	54.8 [50.5, 59.76]	31.3 [18.3, 53.3]	36.2 [24.5, 53.4]	32.3 [21.9, 47.6]	<0.001
Hunter (n (%))	9 (9.89)	7 (7.45)	22 (23.4)	23 (24.7)	38 (40.9)	<0.001
Hunter Income Security ^e (n (%))	3 (3.30)	4 (4.25)	4 (4.25)	3 (3.23)	21 (22.6)	<0.001
Age ^c (years)	28.8 [27.1, 30.7]	31.7 [29.7, 33.9]	36.3 [33.7, 39.0]	39.0 [36.4, 41.7]	45.0 [41.5, 48.7]	<0.001
Coastal community ^f (n (%))	56 (61.5)	70 (74.5)	72 (76.6)	66 (71.0)	54 (58.1)	0.450
Household size >4 (n (%))	52 (57.1)	59 (62.8)	66 (70.2)	56 (60.2)	55 (59.1)	0.938
Children <18 years in household	76 (83.5)	76 (80.9)	71 (75.5)	63 (67.7)	54 (58.1)	<0.001
Some high school education ^g (n (%))	81 (89.0)	86 (91.5)	84 (89.3)	77 (82.8)	50 (53.8)	<0.001
Income from employment ^h (n (%))	54 (59.3)	51 (54.3)	61 (64.9)	66 (71.0)	42 (45.2)	0.465
Speak only Cree at home ⁱ (n (%))	49 (53.8)	65 (69.1)	54 (57.4)	63 (67.7)	64 (68.8)	0.074
Walk ≥60 min/day ^j (n (%))	46 (50.5)	50 (53.2)	43 (45.7)	47 (50.5)	43 (46.2)	0.490
Smoking ^k (n (%))	34 (37.4)	27 (28.7)	22 (23.4)	36 (38.7)	17 (18.3)	0.063
Perceived good health ^l (n (%))	68 (74.7)	65 (69.1)	70 (74.5)	69 (74.2)	70 (75.3)	0.667
Body mass index ^c (kg·m ⁻²)	32.9 [31.5, 34.4]	34.6 [33.2, 36.2]	34.8 [33.3, 36.3]	34.4 [33.0, 35.9]	35.8 [34.4, 37.2]	0.030
Metabolic syndrome ^m (n (%))	37 (40.7)	53 (56.4)	44 (46.8)	43 (46.2)	58 (62.4)	0.046
Men						
n	65	67	66	66	66	
Per cent energy as UPP ^{c, d}	56.6 [50.5, 63.3]	35.7 [20.7, 61.6]	41.5 [23.9, 71.8]	31.6 [18.2, 54.6]	37.6 [31.6, 44.7]	<0.001
Hunter (n (%))	56 (86.1)	62 (92.5)	65 (98.5)	62 (93.9)	62 (93.9)	0.050
Hunter Income Security ^e (n (%))	2 (3.08)	6 (8.95)	12 (18.2)	10 (15.1)	18 (27.3)	<0.001
Age ^c (y)	29.1 [26.8, 31.6]	35.8 [32.8, 39.0]	35.3 [32.3, 38.5]	40.7 [37.1, 44.8]	44.0 [39.7, 48.7]	<0.001
Coastal community ^f (n (%))	44 (67.7)	42 (62.7)	46 (69.7)	51 (77.3)	42 (63.6)	0.712
Household size >4 (n (%))	40 (61.5)	39 (58.2)	43 (65.1)	50 (75.8)	35 (53.0)	0.974
Children <18 years in household	39 (60.0)	39 (58.2)	52 (78.8)	41 (62.1)	40 (60.6)	0.778
Some high school ^g (n (%))	61 (93.8)	61 (91.0)	60 (90.9)	50 (75.8)	42 (63.6)	<0.001
Income from employment ^h (n (%))	44 (67.7)	44 (65.7)	33 (50.0)	39 (59.1)	28 (42.4)	0.003
Speak only Cree at home ⁱ (n (%))	29 (44.6)	43 (64.2)	47 (71.2)	49 (74.2)	55 (83.3)	<0.001
Walk ≥60 min/day ^j (n (%))	33 (50.8)	39 (58.2)	39 (59.1)	31 (47.0)	36 (54.5)	0.842
Smoking ^k (n (%))	31 (47.7)	20 (29.9)	24 (36.4)	21 (31.8)	14 (21.2)	0.006
Perceived good health ^l (n (%))	46 (70.8)	51 (76.1)	51 (77.3)	48 (72.7)	50 (75.8)	0.699
Body mass index ^c (kg·m ⁻²)	30.9 [29.2, 32.7]	31.0 [29.9, 32.2]	30.7 [29.6, 31.8]	31.5 [30.1, 32.9]	32.4 [31.0, 33.9]	0.106
Metabolic syndrome ^m (n (%))	25 (38.5)	33 (49.2)	25 (37.9)	34 (51.5)	41 (62.1)	0.011

UPP: ultra-processed products.

^aQ5 represents the highest quintile of intake. ^bLogistic regression used to test for trend. ^cAll such variables, geometric mean [95% confidence interval]. ^dPer cent energy as UPP was obtained from 24-h recalls. ^eA programme whereby members of the community are paid an annual income to spend time on the land hunting, trapping and fishing. ^fTwo of the communities were inland and the remainder on the coast of James Bay. ^gAttended some high school, not necessarily complete. ^hAnyone reporting working full- or part-time plus those who reported obtaining income from hunting. ⁱIndividuals that usually speak only Cree at home. ^jSelf-report of average time walked per day for the past 7 days. ^kSmoked ≥5 cigarettes per day. ^lReported good, very good or excellent health. ^mMetabolic syndrome defined as the presence of central adiposity (defined as WC ≥90 cm for men and ≥80 cm for women) plus any 2 of: HBP (defined as systolic blood pressure ≥130 or diastolic blood pressure as ≥85), elevated TG (>1.7 mmol/L) or FBG (>5.6 mmol/L), low HDL-C (<1.03 mmol/L in men and <1.29 mmol/L in women).

remarkable connection of participants to the *Eeyou* culture. In men, speaking only Cree in the home was a positive predictor in our analyses of TF intake. To support TF procurement, the Cree Hunters and Trappers Income Security Program provides an annual income, benefits and other incentives to *Eeyouch* who choose hunting, trapping and fishing activities as a way of life [49]. We found that as the frequency of TF intake increased, so did reliance on the Hunting Income Security Program, a proxy indicator of food sovereignty. In women, both hunting and Income Security were common factors for TF intake in both the linear and logistic regressions indicating the importance of food sovereignty in helping women secure food from the land. Future studies could examine the cost of hunting and food sharing practices to better characterise the relationship between hunting and TF intake.

Understanding the facilitators and barriers to TF intake can help to better promote food sovereignty and this very important practice in Indigenous peoples like the *Eeyouch*. We found that age and factors indicating a strong connection to Cree culture (speaking only Cree at home) and food sovereignty (being a hunter and receiving income support to hunt, fish and trap) were associated with TF intake, similar to preliminary analysis of data from the *Nituuchischaayihitaa Aschii* Multi-Community E&H study by Laberge et al. [20]. Our findings indicate the importance of the Income Security Program in promoting the intake of TF. The promotion of hunting, especially in women, may help to encourage TF intake as well as encouraging individuals to apply for the Income Security Program. In our analysis, more highly educated women had lower TF intake. This association is perhaps due to women with higher

Table 3. Odds ratio of being in the highest quintiles (Q5) of the weekly traditional food intake according to food sovereignty proxy and sociodemographic, lifestyle and health characteristics for adults 18 years and older from 7 *Eeyou Istchee* communities in northern Quebec (Canada), by gender, 2005–2009.

Gender	Women (n=465)				Men (n=330)			
	Unadjusted		Adjusted ^a		Unadjusted		Adjusted ^a	
	Odds ratio [95% confidence limits]	p	Odds ratio [95% confidence limits]	p	Odds ratio [95% confidence limits]	p	Odds ratio [95% confidence limits]	p
Diet quality								
Per cent energy as UPP ^b	0.979 [0.969, 0.990]	<0.001			0.982 [0.970, 0.994]	0.003		
Food sovereignty								
Hunter	3.523 [2.145, 5.786]	<0.001	2.773 [1.586, 4.851]	<0.001	1.202 [0.398, 3.661]	0.746	1.145 [0.337, 3.886]	0.828
Hunter Income Security ^c	7.458 [3.623, 15.355]	<0.001	2.719 [1.144, 6.461]	0.023	2.925 [1.509, 5.669]	0.001	1.420 [0.653, 3.086]	0.377
Sociodemographic, lifestyle and health								
Age ^d	1.757 [1.492, 2.069]	<0.001	1.338 [1.089, 1.645]	0.006	1.499 [1.258, 1.784]	<0.001	1.407 [1.161, 1.705]	<0.001
Coastal community ^e	0.566 [0.354, 0.905]	0.018			0.775 [0.440, 1.634]	0.376	0.576 [0.307, 1.082]	0.086
Household size >4	0.863 [0.543, 1.373]	0.535	1.731 [0.939, 3.190]	0.079	0.604 [0.350, 1.042]	0.070		
Children <18 years in household	0.416 [0.258, 0.671]	<0.001	0.589 [0.314, 1.105]	0.099	0.837 [0.481, 1.457]	0.529		
Some high school education ^f	0.156 [0.093, 0.261]	<0.001	0.378 [0.191, 0.746]	0.005	0.241 [0.129, 0.450]	<0.001		
Income from employment ^g	0.497 [0.314, 0.787]	0.003			0.479 [0.277, 0.828]	0.008		
Speak Cree at home ^h	1.347 [0.828, 2.190]	0.230			2.857 [1.427, 5.720]	0.003	2.790 [1.307, 3.886]	0.008
Walk ≥60 min ⁱ	0.860 [0.545, 1.356]	0.516			1.031 [0.600, 1.772]	0.912		
Smoking ^j	0.476 [0.269, 0.840]	0.010			0.471 [0.248, 0.895]	0.021		
Perceived good health ^k	1.119 [0.663, 1.889]	0.674			1.084 [0.579, 2.029]	0.800		
Body mass index	1.028 [0.997, 1.060]	0.075	1.038 [1.003, 1.075]	0.032	1.044 [0.998, 1.092]	0.063		

UPP: ultra-processed products.

^aBackward multiple logistic regression with odds ratio for model containing only variables with $p < 0.1$. ^bPer cent energy as UPP was obtained from 24-h recalls. ^cA programme whereby members of the community are paid an annual income to spend time on the land hunting, trapping and fishing. ^dAge was divided in 10-year increments. ^eTwo of the communities were inland and the remainder on the coast of James Bay. ^fAttended some high school, not necessarily complete. ^gAnyone reporting working full- or part-time plus those who reported obtaining income from hunting. ^hIndividuals that usually speak only Cree at home. ⁱSelf-report of average time walked per day for the past 7 days. ^jSmoked ≥5 cigarettes per day. ^kReported good, very good or excellent health.

Table 4. Linear regression of the average weekly traditional food intake over 1 year according to sociodemographic, lifestyle and health characteristics for 795 adults 18 years and older from 7 *Eeyou Istchee* communities in northern Quebec (Canada), by gender, 2005–2009.

Gender	Women						Men					
	Unadjusted			Adjusted ^a			Unadjusted			Adjusted ^a		
	Beta coefficient	SE	p	Beta coefficient	SE	p	Beta coefficient	SE	p	Beta coefficient	SE	p
Diet quality												
Per cent energy as UPP ^b	-0.060	0.013	<0.001				-0.054	0.026	0.043			
Food sovereignty												
Hunter	4.574	0.711	<0.001	3.149	0.657	<0.001	2.395	2.416	0.322	1.904	2.341	0.417
Hunter Income Security ^c	8.149	1.087	<0.001	4.448	1.076	<0.001	5.942	1.717	<0.001	3.193	1.838	0.083
Sociodemographic, lifestyle and health												
Age ^d	0.174	0.019	<0.001	0.951	0.220	<0.001	0.171	0.039	<0.001	1.445	0.042	<0.001
Coastal community ^e	-1.71	0.648	0.009				0.495	1.323	0.709			
Household size >4	-1.125	0.623	0.072				0.115	1.274	0.928			
Children <18 years in household	-0.648	0.145	<0.001				-0.090	1.283	0.944			
Some high school ^f	-6.170	0.724	<0.001	-2.727	0.830	0.001	-6.057	1.607	<0.001			
Income from employment ^g	-2.051	0.610	<0.001				-2.314	1.240	0.062			
Speak only Cree at home ^h	1.442	0.627	0.022				3.470	1.302	0.008	2.335	1.304	0.074
Walk ≥60 min/day ⁱ	-0.638	0.607	0.293				1.263	1.234	0.307	2.103	1.199	0.080
Smoking ^j	-1.729	0.663	0.009				-2.638	1.299	0.043			
Perceived good health ^k	-0.162	0.688	0.813				0.646	1.414	0.648			
Body mass index	0.040	0.042	0.333				0.113	0.106	0.283			

UPP: ultra-processed products.

^aBackward multiple regression beta coefficients for model containing only variables with $p < 0.1$. ^bPer cent energy as UPP was obtained from 24-h recalls. ^cA programme whereby members of the community are paid an annual income to spend time on the land hunting, trapping and fishing. ^dAge was divided in 10-year increments. ^eTwo of the communities were inland and the remainder on the coast of James Bay. ^fAttended some high school, not necessarily complete. ^gAnyone reporting working full- or part-time plus those who reported obtaining income from hunting. ^hIndividuals that usually speak only Cree at home. ⁱSelf-report of average time walked per day for the past 7 days. ^jSmoked ≥5 cigarettes per day. ^kReported good, very good or excellent health.

education having wage employment, and therefore less time to dedicate to traditional activities. Understanding the relationship between health and TF can help us to better target interventions to improve the quality of life of First Nations individuals. However, promotion of TF in Indigenous peoples also needs to take into account the link between TF and environmental contaminants, a concern that has arisen from many years of environmental degradation as a result of human activity [50–53]. Changing climate conditions are also affecting the harvesting of TF [54]. Future research needs to elucidate the complex systems that influence TF intake, food sovereignty and its relationship to the culture of First Nations peoples.

There are limitations to our study. Self-reporting of diet may have resulted in the underestimation of unhealthy foods and the overestimation of healthy foods such as TF that are promoted in these communities [55]. One 24-h recall is a good measure of group intake but cannot be used to characterise usual intake in individuals [55]. The FFQ measured yearly TF consumption from which weekly TF consumption was derived. Better precision in weekly estimates might have been obtained if the FFQ had used a shorter duration of time. Our analysis was cross-sectional thereby not allowing us to infer any causal relationships between TF and factors that may influence it. Having a hunter in the home and receiving income security for hunting and trapping were used as proxies for food sovereignty in this study population; however, these variables may be poor proxies for self-determination over food practices in many Indigenous communities in Canada because they are influenced by economic, food and harvest policies. The analyses were also unweighted, so they may not be completely representative of this population. Our results may also not be representative of other Canadian First Nations with rates of obesity that are considerably lower than among the participants in the present study [9,56].

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ORCID

Willows Noreen  <http://orcid.org/0000-0002-8550-5213>
 Louise Johnson-Down  <http://orcid.org/0000-0002-4426-7108>
 Moubarac Jean-Claude  <http://orcid.org/0000-0001-8409-7855>
 Michel Lucas  <http://orcid.org/0000-0001-6629-5612>
 Malek Batal  <http://orcid.org/0000-0001-5672-0371>

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