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Local food procurement behavior and overall diet quality among adults in Québec: results from the NutriQuébec project



Marianne Rochette^{1,2}, Gabrielle Rochefort^{1,2}, Catherine Laramée¹, Annie Lapointe¹, Simone Lemieux^{1,2}, Ariane Bélanger-Gravel^{1,3}, Sophie Desroches^{1,2}, Véronique Provencher^{1,2} and Benoît Lamarche^{1,2*}

Abstract

Background Consumption of locally produced foods is generally perceived as being part of a healthy dietary pattern. Accordingly, in 2020, the provincial government of Québec (Canada) promoted the purchase of local foods for economic and health benefits. The present cross-sectional study aimed to document the association between the behavior of local food procurement and overall diet quality in a sample of adults from the province of Québec.

Methods Data were collected in a sample of 834 adults (86.6% females) from the NutriQuébec project, a webbased longitudinal population study that aims to document the lifestyle and eating habits of adults in Québec, Canada. Dietary intakes were measured using a validated web-based 24-h recall tool and diet quality was assessed using the Healthy Eating Food Index (HEFI-2019), which measures adherence to the 2019-Canada's Food Guide recommendations on healthy food choices. Local food procurement behavior was measured using the Locavore-I-SF score, which assesses the frequency of short food supply chain use as well as the geographical origin of three locally produced foods.

Results The Locavore-I-SF score was weakly correlated with the HEFI-2019 score (r = 0.08, p < 0.02). Positive correlations were observed for the Vegetables and fruits (r = 0.09, p = 0.005), Beverages (r = 0.08, p = 0.04) and Free sugars (r = 0.14, p < 0.001) components of the HEFI-2019. Associations between the Locavore-I-SF and the HEFI-2019 scores were found in specific subgroups of participants: males (r = 0.33, p < 0.001), participants aged between 50 and 70 years (r = 0.16, p = 0.003), participants with a greater education level (r = 0.13, p = 0.003) and higher income (r = 0.12, p = 0.02), non-vegetarian participants (r = 0.10, p = 0.008) and participants living in Census Metropolitan Areas (r = 0.11, p = 0.004).

Conclusion These results suggest that the behavior of local food procurement is only weakly associated with better overall diet quality among a sample of adults from Québec, raising doubts on the relevance of promoting local food procurement as an effective public health measure for improving diet quality in Québec.

Study registration number NCT04140071.

Keywords Local food procurement, Diet quality, Healthy Eating Food Index-2019

*Correspondence: Benoît Lamarche benoit.lamarche@fsaa.ulaval.ca

Full list of author information is available at the end of the article



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Background

The COVID-19 pandemic has uncovered the fragility of the global food system with disruptions in food supply chains such as export stoppages and food shortage [1-3]. As Canada's food sector relies primarily on larger food supply chains due to its large territory and on importation outside of the growing season [4], governments and policy-makers are trying to find solutions towards more resilient alternatives to the current global food system [5]. Hence, at the beginning of the COVID-19 pandemic, the Government of the province of Québec promoted the production and purchase of local foods through financial incentives and investments [6, 7] along with the publication in 2020 of a national strategy for the purchase of food grown in Québec for public institutions [8]. This strategy aimed to support the economy of the province but was also part of orientations to promote healthy eating among the population.

Consumption of locally produced foods has been perceived to be part of a healthy dietary pattern [9, 10], and for many consumers, this is a major motivation for purchasing locally produced foods [11, 12]. However, the numerous studies that have examined the link between the purchase and the consumption of local food and diet quality have generated contradicting findings. Studies have shown that various forms of local food procurement such as community-supported agriculture box scheme, self-production and shopping at farmers' market [13-18] were associated with higher fruit and vegetable consumption. Results from observational studies suggest that the intention to purchase or consume local foods may be associated with a better overall diet quality [19] as well as with favorable health outcomes [20, 21], while data from intervention studies have shown no clear impact of purchasing or consuming local foods on diet quality [22–25]. In sum, although the reliance on local food systems has the potential to improve nutritional status and health [26], there is yet very limited scientific evidence supporting this hypothesis. It is therefore essential to examine how the procurement of local foods is associated with diet quality in order to better inform future public health policies.

This study aimed to document for the first time the behavior of local food procurement in a sample of adults from the province of Québec and to examine the extent to which local food procurement behavior and its different dimensions are associated with diet quality. We tested the hypothesis that the behavior of local food procurement is positively associated with overall diet quality in this population.

Methods

Study design and population

Data are from the NutriQuébec project, a web-based longitudinal population study [27]. This project aims to document the lifestyle and eating habits of adults in Québec, Canada, and to provide longitudinal data for the evaluation of the first Québec Government Health Prevention Policy, Politique gouvernementale de prévention en santé, launched in 2016 [28]. Briefly, recruitment of participants began in June 2019 and the recruitment is still ongoing with over 6000 participants enrolled thus far. To be eligible, participants must be 18 years and older, have a residential address in the province of Québec, be able to read and understand French or English, have access to the internet and have an active email address. At the launch of the study, the recruitment was supported by a multimedia campaign throughout the province of Québec, with various media advertisements and publicity through leading public figures in the field of nutrition and health. Participants are asked to complete the core questionnaires each year, based on their registration date. These yearly core questionnaires include web-based 24-hour dietary recalls as well as questionnaires assessing lifestyle habits such as physical activity levels and substance use, as well as sociodemographic characteristics, food security, and general health status. The incentive for participating in the study is a personalized basic dietary report provided to participants. The NutriQuébec project has been approved by the Ethics Board of Université Laval (2018-042 Phase II et IV A-16 / 25-04-2023) and is registered at ClinicalTrials.gov (NCT04140071).

Local food procurement behavior

The definition of local foods is highly variable between studies [10, 29, 30]. In the context of the present study, the concept of « local foods » refers to the geographic proximity, i.e. products produced regionally or provincially, as well as the social proximity between producers and consumers represented by community-supported agriculture (CSA) box scheme, farmers' market and selfproduction of food. Local food procurement behavior was assessed using the Locavore-Index Short Form questionnaire (Locavore-I-SF) developed and validated by our group for application in large cohort studies such as the NutriQuébec study. The Locavore-I-SF was derived from the Locavore-Index [31], a more in-dept questionnaire developed to assess the behavior of local food procurement in a French-Canadian population, comprising 89 questions related to 11 local food items: apple, berry, carrot, tomato, lettuce, bean, corn, egg, pork, bread and honey [32]. A face-validity approach combined with exploratory factor analysis and correlation analysis led to the retainment in the Locavore-I-SF of 3 out of the 11 original food items from the full-length Locavore-Index tool, i.e. carrot, tomato and lettuce as well as 4 dimensions of local food procurement, i.e. 1- self-production of food, 2- use of farmers' market, 3- use of CSA box scheme and 4- main geographical origin of food [31]. The first three dimensions correspond to the broader dimension of the short food supply chain. The Locavore-I-SF scores were strongly correlated with the reference Locavore-Index scores (r=0.84, P<0.0001), demonstrating the reliability of the Locavore-I-SF to measure local food procurement behavior in larger-scale population studies [31].The Locavore-I-SF therefore includes 12 questions addressing four dimensions of local food procurement during the previous month for 3 vegetables commonly produced and available in Québec. The Locavore-I-SF is scored on a 12-point scale (see Supplemental Table S1), 4 points maximum for each vegetable, with a high Locavore-I-SF score indicating a prominence towards local food procurement behavior. If a participant did not produce, purchase or consume one of the three vegetables during the previous month, they obtained a score of 0 for that vegetable. On September 2022, at the end of the harvest season in Québec, all active participants of NutriQuébec (n=3937) were invited to complete the



Fig. 1 Study flowchart

Locavore-I-SF questionnaire. They had 10 days to complete the questionnaire, and a reminder was sent on the 7th day.

Dietary intake assessment

Dietary intakes were measured annually using a selfadministered web-based 24-hour dietary recall tool (the R24W). This instrument was developed for a French-Canadian population [33] and has undergone a series of evaluation and validation studies [34-36]. Participants were asked each year by e-mail to complete the R24W for two to three unannounced, nonconsecutive days (1 weekend day and 1 to 2 weekdays). They were asked to report all the foods and beverages they had consumed in the past 24 h from a detailed list of foods and beverages or from a search engine. Each food or beverage in the R24W is linked to a nutritional value from the most recent Canadian Nutrient File [37] allowing the automatic calculation of nutrient intakes for each participant. Each participant completed their 24-hour dietary recalls each year, upon the date of enrolment in the study, as part of their annual questionnaires.

Participants

For the purposes of the present cross-sectional analysis, the sociodemographic characteristics considered for each participant are those provided in the yearly core questionnaires as the time closest to the completion of the Locavore-I-SF. It was important to select characteristics as close as possible to the completion of the Locavore-I-SF in order to be able to perform analyses between local food procurement behavior and participant characteristics. For the exclusion criteria, participants who did not complete at least one R24W (n=13) or the core questionnaires for sociodemographic characteristics (n=54) since the beginning of the NutriQuébec study and pregnant participants (n=18) at the time of the completion of the core questionnaires closest to the Locavore-I-SF were excluded, for a total of 806 participants included in this cross-sectional study (see Fig. 1).

Healthy Eating Food Index-2019

Diet quality was assessed using the Healthy Eating Food Index 2019 (HEFI-2019), which measures adherence to the 2019 Canada's Food Guide (CFG) recommendations on healthy food choices. The HEFI-2019 is composed of 10 components including Vegetables and fruits (20 points), Whole-grain foods (5 points), Grain foods ratio (5 points), Protein foods (5 points), Plant-based protein foods (5 points), Beverages (10 points), Fatty acids ratio (5 points), Saturated fats (5 points), Free sugars (10 points) and Sodium (10 points). The Saturated fats, Free sugars and Sodium components are reverse coded. The total HEFI-2019 score is on 80 points (see Supplemental Table S2), with higher scores indicating greater adherence to the 2019 CFG dietary guidelines on healthy food choices, and therefore, a better overall diet quality. The full description and evaluation of the HEFI-2019 have been described elsewhere [38, 39]. Data from all dietary recalls (R24W) completed since enrollment within the sample in the NutriQuébec project were used to generate the HEFI-2019 scores. On average, participants completed 7.1 \pm 2.4 R24W. Using several R24W instead of only one or two was more likely to reflect participants' usual diet. In addition, because of the prospective design of the NutriQuébec study, when a participant included in this study was pregnant at the time of a R24W, the recall was excluded from the HEFI-2019 scores analysis.

Statistical analyses

The total Locavore-I-SF score (/12 points) as well as the sub-scores of the two main dimensions of the Locavore-I-SF, i.e. short food supply chain (/6 points) and the main geographical origin of food (/6 points), were calculated. Participants were categorized into thirds based on Locavore-I-SF scores in the total sample. The distribution of sociodemographic variables across these groups was calculated using cross-tabulation and differences between them were assessed by chi-square tests. Sociodemographic variables considered were sex (female and male), age (18 to <30, 30 to <50, 50 to <70 and \geq 70), body mass index (BMI; normal<25.0, overweight 25.0-29.9 and obese \geq 30), education (trade school/high school/no diploma, CEGEP and university), household income (<30 000 \$CAD, 30 000 to <60 000 \$CAD, 60 000 to <100 000 \$CAD and \geq 100 000 \$CAD), smoking status (never and yes/occasionally), material deprivation index (Q1, Q2-Q3 and Q4), social deprivation index (Q1, Q2-Q3 and Q4) and Census Metropolitan Areas (CMAs; outside or in CMAs). Associations between the Locavore-I-SF score and the HEFI-2019 total score and its components' scores were assessed using Pearson correlation. Sex, age, smoking status, education and household income were added as covariates to generate partial correlations. Associations were considered strong when the Pearson correlation coefficient (r) was > 0.7, moderate when r was between 0.3 and 0.7 and weak when r < 0.3 [40]. Associations between the HEFI-2019 total score and the subscores for short food supply chain and main geographical origin of food were assessed using Spearman correlation. Finally, multiple linear regression models were used to examine the interaction of participants' characteristics and Locavore-I-SF scores on the HEFI-2019 score. Each characteristic was examined individually to determine interactions without adjustments for other covariables and Pearson partial correlation analyses were further performed to explore significant interactions in more detail. All analyses were performed using the Statistical Analysis Software (SAS) Studio version 3.8 (SAS Institute).

Results

The characteristics of study participants are presented in Table 1. A total of 891 participants completed the Locavore-I-SF questionnaire (response rate=22.6%). Supplemental Table 3 compares the characteristics of the study sample to the characteristics of the 80% who did not complete the Locavore-I-SF questionnaire, with no major differences between the two groups. The study sample comprised mostly females (86.2%) and the majority of participants had a University degree (67.9%). Nearly half of the participants (45.8%) were between 50 and 70 years old and the total annual household income was over 100 000 \$ CAD for 45.1% of participants. Participants were also mainly non-smokers (96.7%), non-vegetarian (90.6%) and lived inside CMAs, i.e. metropolitan influenced zone (78.8%). The mean Locavore-I-SF score in the sample was 6.3/12 points (95% CI: 6.1, 6.5), with a score of 2.7/6 points (95% CI: 2.6, 2.9) for the short food supply chain sub-score and 3.6/6 points (95% CI: 3.5, 3.7) for the main geographical origin of food sub-score. The mean HEFI-2019 total score in the sample was 50.5/80 points (95% CI: 49.9, 51.1).

Table 2 presents the characteristics of participants according to thirds of the Locavore-I-SF score. There was in general no association between sociodemographic variables and the Locavore-I-SF score with the exception of age and living outside CMAs. Indeed, participants aged \geq 50 years and participants living outside CMAs were overrepresented in the top third of the Locavore-I-SF score.

Table 3 shows the correlations of the Locavore-I-SF score with the total HEFI-2019 score and its components. Before adjustments, the Locavore-I-SF score correlated positively but weakly with the HEFI-2019 score (r=0.10, p=0.005). In the adjusted model, the correlation was slightly attenuated but remained significant (r=0.08, p=0.023). The association between the HEFI-2019 and the Locavore-I-SF scores was mainly due to correlations with the Vegetables and fruits (r=0.09, p=0.005), Beverages (r=0.08, p=0.04) and Free sugars (r=0.14, p<0.001) components of the HEFI-2019 in the adjusted model. The other components of the HEFI-2019 were not correlated with the Locavore-I-SF score. The short food supply chain sub-score correlated positively but weakly with the mean total HEFI-2019 score after adjustments for covariates (r=0.09, p=0.02) while the main geographical origin of food sub-score did not (r=0.04, p=0.24).

Lastly, multiple linear regression models revealed significant interactions between the Locavore-I-SF and sex (p<0.0001), age (p<0.0001), education (p<0.0001), household income (p<0.0001), vegetarian status

Table 1 Participants' characteristics $(n = 806)^1$

Characteristics	N (%)
Sex	
Female	695 (86.2)
Male	111 (13.8)
Age	
18 to < 30 y	78 (9.7)
30 to < 50 y	280 (34.7)
50 to <70 y	369 (45.8)
≥70 y	79 (9.8)
Body mass index (kg/m ²) ²	
Normal weight, < 25	397 (53.5)
Overweight, 25.0–29.9	201 (27.1)
Obese, ≥30	144 (19.4)
Education ²	
Trade school, high school, or no diploma	86 (10.8)
CEGEP	170 (21.3)
University	541 (67.9)
Household income ²	
<30 000\$CAD	51 (6.5)
30 000–59 999\$CAD	156 (19.9)
60 000–99 999\$CAD	224 (28.5)
≥ 100 000\$CAD	354 (45.1)
Smoking ²	
Never	761 (96.7)
Yes, or occasionally	26 (3.3)
Vegetarian ²	
Yes	74 (9.4)
No	710 (90.6)
Material deprivation ^{2,3}	
Q1	280 (36.7)
Q2 & Q3	372 (48.8)
Q4	111 (14.5)
Social deprivation ^{2,3}	
Q1	184 (24.1)
Q2 & Q3	385 (50.5)
Q4	194 (25.4)
Census Metropolitan Areas ⁴	
Outside CMAs (no metropolitan influenced zone)	171 (21.2)
In CMAs (metropolitan influenced zone)	635 (78.8)
CEGEP Collège d'Enseignement Général et Profession	nel· CAD Canadiar

dollars; Q, quartile

²Body mass index, n=742 (64 missing values), Education, n=797 (9 missing values); Household income, n=785 (21 missing values); Smoking, n=787 (19 missing values); Material deprivation, n=763 (43 missing values); Social deprivation, n=763 (43 missing values); Social

³Quartiles are from the Material and Social Deprivation Index of the Institut national de santé publique du Québec, where Q1 represents the least deprived and Q4 the most deprived. Q2 and Q3 were combined to obtain 3 groups. Material deprivation reflects low income, education, and employment, while social deprivation involves widowhood, separation, living alone, or single parenthood

⁴Census Metropolitan Areas (CMAs) are defined by Statistics Canada as having a total population of at least 100,000 and a core population of at least 50,000 [41]. The CMAs of the province of Québec are Saguenay, Québec, Sherbrooke, Trois-Rivières, Montréal and Gatineau (p < 0.0001) and place of residence (in or outside CMAs, p=0.0002) on the HEFI-2019 total score. Table 4 presents correlations between the Locavore-I-SF and the HEFI-2019 scores among specific subgroups of participants. The Locavore-I-SF and the HEFI-2019 scores were correlated among males (r=0.33, p < 0.001), participants aged between 50 and 70 years (r=0.16, p=0.003), participants with a greater education level (r=0.13, p=0.003), a higher household income (r=0.12, p=0.02), non-vegetarian participants (r=0.11, p=0.008) and participants living in CMAs (r=0.11, p=0.004). Mutual adjustments for sociodemographic variables had little impact on those correlations.

Discussion

This study revealed a positive but weak association between the behavior of local food procurement and overall diet quality among a sample of adults from the province of Québec. Consistent with our findings, observational studies have shown that frequency of shopping via CSA box scheme in Canada [15] and intention to purchase local foods in Puerto Rico [19] were positively associated with overall diet quality scores. Also in agreement with data from our study, CSA box scheme participation [13, 15-17] as well as shopping at farmers' market [15, 42] and gardening at home or at a community garden [18, 42] have been associated with a greater consumption of vegetables and fruits, a surrogate marker of diet quality. Indeed, we found a weak but positive association between the Vegetables and fruits component of the HEFI-2019 score and the Locavore-I-SF score. This suggests that the behavior of local food procurement may be associated, albeit weakly, with a higher proportion of vegetables and fruits in the diet, for which farmers' markets, box schemes and gardening may contribute given the wide availability of local fruits and vegetables during the harvesting season in the province of Québec. It should be stressed that although the Locavore-I-SF score correlates strongly with a more in-depth reference measure of local food procurement behavior, it is based on only three local food items, hence potentially penalizing individuals who did not procure these specific foods but procured other local foods. Also, the measurement of dietary intakes from which the HEFI-2019 scores were calculated and the measurement of the behavior of local food procurement were not carried out at the same time which constitutes a limitation of the study. These two factors may have contributed to weaken the relationship between local food procurement behavior and diet quality. Nonetheless, results of this study are consistent with findings from previous research in demonstrating that local food procurement, more precisely of fruits and vegetables, is potentially albeit weakly associated with better overall diet quality. Additional research is warranted to examine

Table 2 Sociodemographic characteristics of participants, by thirds of Locavore-I-SF score (/12 points)¹

	Locavore-I-SF score			
	(<4.5 points) n=266	(4.5-8.0 points) n = 285	(> 8.0 points) n = 255	
Characteristics (n = 806)	%	%	%	р
Sex				
Female	33.1	36.4	30.5	0.16
Male	32.4	28.8	38.7	
Age				
18 to < 30 y	59.0	33.3	7.7	< 0.0001
30 to < 50 y	36.8	31.1	32.1	
50 to < 70 y	27.6	38.5	33.9	
≥70 y	19.0	38.0	43.0	
Body mass index (kg/m ²)				
Normal weight, < 25	32.5	34.3	33.2	0.36
Overweight, 25.0–29.9	29.4	38.8	31.8	
Obese, ≥30	38.9	33.3	27.8	
Education ²				
Trade school, high school, or no diploma	19.8	41.9	38.3	0.09
CEGEP	32.9	37.1	30.0	
University	34.9	33.6	31.5	
Household income ²				
<30 000\$CAD	37.2	45.1	17.7	0.19
30 000–59 999\$CAD	36.5	29.5	34.0	
60 000–99 999\$CAD	29.5	38.4	32.1	
≥ 100 000\$CAD	33.6	34.5	31.9	
Smoking ²				
Never	32.2	35.6	32.2	0.10
Yes, or occasionally	50.0	34.6	15.4	
Material deprivation ^{2,3}				
Q1	32.5	36.1	31.4	0.92
Q2 & Q3	32.2	35.0	32.8	
Q4	29.7	39.7	30.6	
Social deprivation ^{2,3}				
Q1	28.2	36.4	35.3	0.58
Q2 & Q3	32.2	35.6	32.2	
Q4	35.1	36.6	28.3	
Census Metropolitan Areas (CMAs) ⁴				
Outside CMAs (no metropolitan influenced zone)	28.1	30.4	41.5	0.007
In CMAs (metropolitan influenced zone)	34.3	36.7	29.0	

¹ Values are percentages and are expressed by row. Locavore-I-SF, Locavore-Index Short Form; CEGEP, Collège d'Enseignement Général et Professionnel; CAD, Canadian dollars; T, tertile; Q, quartile

²Body mass index, *n*=742 (64 missing values), Education, *n*=797 (9 missing values); Household income, *n*=785 (21 missing values); Smoking, *n*=787 (19 missing values); Vegetarian, *n*=794 (22 missing values); Material deprivation, *n*=763 (43 missing values); Social deprivation, *n*=763 (43 missing values)

³Quartiles are from the Material and Social Deprivation Index of the Institut national de santé publique du Québec, where Q1 represents the least deprived and Q4 the most deprived. Q2 and Q3 were combined to obtain 3 groups. Material deprivation reflects low income, education, and employment, while social deprivation involves widowhood, separation, living alone, or single parenthood

⁴Census Metropolitan Areas (CMAs) are defined by Statistics Canada as having a total population of at least 100,000 and a core population of at least 50,000 [41]. The CMAs of the province of Québec are Saguenay, Québec, Sherbrooke, Trois-Rivières, Montréal and Gatineau

the extent to which interventions targeting local food procurement truly enhances diet quality at the population level.

The weak association between diet quality measured by the HEFI-2019 and the behavior of local food procurement behavior measured by the Locavore-I-SF was primarily driven by its short food supply chain dimension (self-production of food, use of farmers' market and use of CSA box scheme) as the sub-score for the main geographical origin of food showed no association with diet quality. This is not entirely surprising considering that the short food supply chain dimension of the Locavore-I-SF

HEFI-2019 components	Unadjusted mod	lel	Adjusted mode	Adjusted model ¹	
	r	p	r	p	
Vegetables and fruits	0.12	0.001	0.09	0.005	
Whole-grain foods	-0.02	0.55	-0.03	0.39	
Grain foods ratio	0.05	0.19	0.01	0.71	
Protein foods	0.02	0.65	0.02	0.58	
Plant-based protein foods	-0.00	1.00	0.02	0.55	
Beverages	0.07	0.046	0.08	0.04	
Fatty acids ratio	0.03	0.35	0.02	0.68	
Saturated fats	-0.01	0.81	-0.05	0.20	
Free sugars	0.15	< 0.0001	0.14	0.0002	
Sodium	-0.002	0.95	0.02	0.54	
Total HEFI-2019 score	0.10	0.005	0.08	0.023	

Table 3 Pearson correlations between the total HEFI-2019 and components scores and the Locavore-I-SF score (n = 806)

¹Adjusted for sex, age, smoking status, education and household income

Table 4 Pearson correlations between the HEFI-2019 and the Locavore-I-SF scores according to participants' sociodemographic characteristics (n = 806)

Characteristics	Unadjusted		Adjusted ¹	
	r	p	r	p
Sex				
Female (<i>n</i> = 695)	0.06	0.10	0.033	0.40
Male (n=111)	0.33	0.0004	0.28	0.005
Age				
18 to < 30 y (n = 78)	-0.08	0.50	-0.03	0.82
30 to < 50 y (n = 280)	0.08	0.16	0.05	0.43
50 to < 70 y (n = 369)	0.16	0.003	0.14	0.008
\geq 70 y (n = 79)	0.06	0.61	0.003	0.98
Education				
Trade school, high school, or no diploma ($n = 86$)	-0.02	0.88	-0.01	0.91
CEGEP ($n = 170$)	0.05	0.50	-0.00	0.99
University (n = 541)	0.13	0.003	0.09	0.03
Household income				
<30 000\$CAD (n=51)	-0.10	0.48	-0.04	0.81
30 000–59 999\$CAD (n=156)	0.06	0.49	0.01	0.89
60 000-99 999\$CAD (n=224)	0.11	0.09	0.12	0.09
\geq 100 000\$CAD (n = 354)	0.12	0.02	0.08	0.16
Vegetarian				
Yes (n = 74)	0.02	0.89	0.04	0.76
No (n=710)	0.10	0.008	0.07	0.07
Census Metropolitan Areas				
Outside CMAs (no metropolitan	0.07	0.35	-0.01	0.93
influenced zone) (n = 171)				
In CMAs (metropolitan influenced zone) ($n = 635$)	0.11	0.004	0.09	0.02

¹Adjusted for the other characteristics presented in this table

may represent a more active approach to local food procurement than relying on the geographical origin of foods. If confirmed by additional research on the topic, this suggests that promoting local food purchasing to the population should perhaps target foods that are part of a short supply chain, a more engaging dimension of a local food procurement behavior, and not just on the origin of food in supermarkets. Consistent with previous findings [17, 19, 43], older participants in NutriQuébec were more likely than younger participants to have a greater local food procurement behavior. For example, a study conducted in Puerto Rico on the intention to purchase local foods found that participants who often or always intentionally purchase local foods were older than those who rarely did so [19]. Sourcing local foods can be more time-consuming as going to the farmer's market or growing your own vegetables takes more time than going to the supermarket [44] and people at the age of retirement have generally more free time than working aged people, which may also partly explain why older people tend to procure more locally sourced food. Other studies also suggested that being older is associated with greater food skills [45] and eating home-cooked meals more often [46]. Fresh, minimally processed local products often require more food preparation, which could also potentially explain the association between age and local food procurement behavior.

Participants living outside CMAs had higher local food procurement behavior scores than those living within CMAs. Studies reported that the convenient location of farmers' markets, close to home or other stores, is a key factor influencing the frequency of visits to farmers' markets [47, 48]. With the fruit and vegetable producers in the province of Québec more likely to be found on the outskirts of major urban centers, as well as in non-urban areas [49], this could potentially explain the greater local food procurement behavior of participants living outside CMAs. Also, individuals living outside CMAs may have larger plots of land at home, allowing for gardening and self-production of food, once again potentially explaining their greater local food procurement behavior. Additional research is needed to better understand why local food procurement behavior is positively correlated with diet quality only among individuals living in CMAs.

Results also showed that the behavior of local food procurement was positively associated with diet quality among males but not among females. Bearing in mind that men generally have lower diet quality than females [38, 50], these data suggest that sourcing local food may benefit males' diet quality more than females. The crosssectional nature of our study does not, however, allow the determination of whether males with higher diet quality are simply more likely to source local foods. While privileged individuals such as those with a higher education, a higher household income and who are Caucasian were more likely to purchase local foods in previous studies [13, 14, 17, 43], no other study to our knowledge has investigated the relationship between diet quality and local food procurement behavior among different sociodemographic groups. Based on this and considering that a privileged socioeconomic status has repeatedly been associated with better overall diet quality [51–53], efforts that promote both local food procurement and diet quality may contribute to increasing health and social inequalities. These challenges will need to be taken into consideration when promoting local foods to avoid increasing social inequalities in health among the population.

Although the cross-sectional study design precludes any causal inference, data suggests that promoting local food procurement may not translate into meaningful increases in overall diet quality among adults in the province of Québec, raising doubts about the value of promoting local food from a public health perspective. This does not exclude other positive impacts at the population level. A study of vegetable producers conducted in the province of Québec, Canada, has shown increased economic benefits associated with engaging in short food supply chains (SFSCs) compared to traditional farming models of distribution [54]. This was paralleled by more employment opportunities and greater job satisfaction. Farms engaged in SFSCs also seemed to prioritize better environmental practices and participate in the creation of educational activities on farms [54]. There are therefore potential synergies in promoting the behavior of local food procurement for environmental and economic benefits, but the expected benefits in terms of diet quality should not be overemphasized until supported by convincing evidence.

Strengths, limitations and other considerations

To our knowledge, this is the first study documenting the association between diet quality and the behavior of local food procurement based on different dimensions of local food procurement. Indeed, previous studies only assessed one dimension of local food procurement, mainly the use of farmers' markets and the CSA box system. Moreover, the size of our sample was substantial, and the Locavore-I-SF had been previously validated in adults of the province of Québec.

Some limitations also need to be acknowledged. First and foremost, this is a cross-sectional analysis from which causal inference cannot be determined. Despite the use of numerous 24-hour dietary recalls, mean dietary intake data derived from repeated 24-h recalls do not reflect usual intakes. The behavior of local food procurement was assessed in the previous month i.e. in August and September, hence not providing a measure of local food procurement behavior throughout the year. It is usually during the harvest season, which runs from May to October depending on the crop and region, that there is a wide availability and diversity of local products in the province [55]. Other studies are needed to demonstrate how year-round local food procurement in the province of Québec is associated with overall diet quality. Finally, these data cannot be generalized to the Québec population as our sample was mostly females with a relatively high education and high income and the relatively high HEFI-2019 scores reflected the health consciousness of our sample. Moreover, the study population is relatively well educated and certainly health-conscious and the web-based format of the study is likely to introduce

biases related to computer literacy, a factor often exacerbated by a lower socioeconomic status. This may have contributed to a ceiling effect limiting the magnitude of the association between the local food procurement behavior and diet quality.

Conclusion

In sum, results from this study suggest that the behavior of local food procurement during the harvest season is only weakly associated with overall diet quality in adults from the province of Québec. This raises doubts about the potential impact of promoting local food from a public health perspective. This study also sheds light on the need for more diverse samples when examining the behavior of local food procurement and dietary outcomes as it is essential to establish favorable conditions for accessing local foods to prevent the widening of health inequities across various socioeconomic groups. Pending confirmation through other studies, this work should be considered by policy-makers to better orient future public health policies around diet quality in the province of Québec.

Abbreviations

Healthy Eating Food Index 2019
Locavore-Index Short Form
Community-supported agriculture
Web-based 24-hour dietary recall
Canada's Food Guide
Census Metropolitan Areas

Supplementary Information

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Supplementary Material 1

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Author contributions

The authors' contributions were as follows— BL, CL, AL, SL, AB-G, SD and VP designed and obtained funding for the NutriQuébec study. MR, GR, VP and BL contributed to conceptualizing the analyses presented in this paper. MR and GR performed statistical analysis. MR wrote the manuscript. BL had primary responsibility for final content. All authors read and approved the final manuscript.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

Participants included in this study were part of the NutriQuébec project and informed written consent was obtained from all participants. The NutriQuébec project was approved by the Ethics Board of Université Laval (2018-042 Phase II et IV A-16 / 25-04-2023).

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Author details

¹Centre Nutrition, Santé et Société (NUTRISS), Institut sur la nutrition et les aliments fonctionnels (INAF), Université Laval, 2440, Hochelaga Boulevard, Québec, QC G1V 0A6, Canada

²École de nutrition, Faculté des sciences de l'agriculture et de l'alimentation, Université Laval, Québec, QC G1V 0A6, Canada ³Département d'information et de communication, Faculté des lettres et des sciences humaines, Université Laval, Québec, QC G1V 0A6, Canada

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