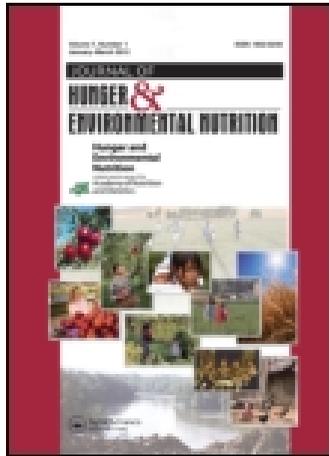


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Food Purchasing From Farmers' Markets and Community-Supported Agriculture Is Associated With Reduced Weight and Better Diets in a Population-Based Sample

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This study examines associations between local food purchasing and diet-related outcomes. A population-based sample of 2228 households containing 4902 individuals completed surveys. Multilevel linear regressions determined the extent to which purchasing foods from farmers' markets and community-supported agricultural (CSA) groups predicted individuals' diet-related outcomes. After controlling for age, sex, education, income, and car ownership, frequency of shopping at farmers' markets and CSAs predicted lower body mass index, $B = -0.34$ (0.66), $P < .05$ and $B = -0.81$ (0.37), $P < .05$, respectively, and waist circumference, $B = -1.09$ (0.40), $P < .01$ and $B = -2.31$ (0.96), $P < .05$, respectively, and better diet quality (for CSA use only), $B = 3.46$ (1.57), $P < .05$. Higher frequency of shopping at farmers' markets and CSAs is associated with reduced body mass index and waist circumference, which may have important implications for agricultural and food policy.

KEYWORDS nutrition policy, public health, food supply

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INTRODUCTION

The local food movement is growing. In Canada, over 70% of consumers would spend more on locally grown or produced groceries.¹ Municipalities have begun adopting policies that promote local food systems in their regional official plans,^{2,3} and provincial, state, and federal governments have begun considering policies aimed at strengthening local food systems.^{4,5} In Ontario, for example, a “\$10 Local Food Challenge” is being promoted as a means of improving the local economy and producing jobs.⁶ Local food systems may have additional beneficial environmental impacts, including a reduction in greenhouse gas emissions. In 2006, for example, the 13 million tonnes of food commodities imported to Canada contributed 3.3 million tonnes of CO₂.⁷ Some have argued that environmental sustainability and other concerns, such as biodiversity, local employment, fair trade, empowerment, and international social justice, should also factor into debates on local food systems.^{8–10} This article aims to contribute to the existing conversation around local food systems by examining associations between important public health outcomes and local food purchasing in a population-based sample in Ontario.

The overarching conceptual mechanism by which shopping at different outlet types is related to patrons’ diet or weight outcomes is that nutritious foods may be differentially available at different outlet types; therefore, frequent patrons of farmers’ markets are exposed to (and therefore purchase and consume) more fruits and vegetables than frequent patrons of convenience stores, where nonnutritious foods may be more likely to dominate the outlet. Several studies have examined how purchasing foods from different types of outlets impact dietary behaviors^{11–13} and weight status.^{14,15} For example, shopping at convenience stores¹¹ and independent grocers¹³ as opposed to large chain grocery stores has been associated with poorer dietary behaviors. In terms of farmers’ markets, Women, Infants, and Children participants receiving subsidies for fruits and vegetables showed increased fruit and vegetable consumption; participants who shopped at farmers’ markets showed a greater increase than those shopping at supermarkets.¹⁶ To date, interventions aiming to improve fruit and vegetable intake through fruits and vegetables subsidies at farmers’ markets have only been conducted with low-income populations. Conversely, the majority of reports in the literature describing community-supported agriculture (CSA) members have suggested that CSA members tend to have higher than average incomes.^{17,18}

In light of the recent policy developments aimed at improving access to local foods, this study begins to shed light on associations between diet-related outcomes and “buying local” motivations and purchasing habits in a population-based sample. First, sociodemographic correlates of farmers’ market use, CSA use, and motivations to buy local are examined. Second,

associations between participants' motivation to buy local and diet-related outcomes are examined. Finally, associations between participants' self-reported frequency of purchasing foods from farmers' markets and CSAs and their diet-related outcomes, including diet quality, body mass index (BMI), and waist circumference (WC) are examined.

METHODS

The Neighbourhood Environments in Waterloo Region: Patterns of Transportation and Health (NEWPATH) study characterized associations between objective and subjective aspects of built environments and health outcomes (including fruit and vegetable consumption frequency, diet quality, BMI, and WC) in a population-based sample in the region of Waterloo, Ontario, Canada. Data on food shopping behaviors and motivations were additionally collected. Data collection for NEWPATH took place from May 2009 until May 2010. Relevant methodological details from the NEWPATH project are reported below. All procedures involving human subjects were approved by the University of Waterloo Office Research Ethics and University of British Columbia's Behavioural Research Ethics Board. Written informed consent was obtained from all participants.

Procedures

The NEWPATH sample was stratified by neighborhood walkability, household income, and household size, with allocation to achieve high statistical power to detect hypothesized effects of walkability, consistent with the project's aims. The stratified random sample of households ($N = 4902$ individuals in 2228 households) was recruited to achieve representativeness in income and household size according to 2006 Canadian census data. Conditional response rates (proportion of household that completed the survey once recruited) varied between 56% and 64% over 6 phases of data collection. Households were recruited in day-pairs across all days of the week; everyone in the household over the age of 10 years participated in the study.

Participating households were randomly recruited to complete either a simple or enhanced survey package. The simple version included a telephone recruitment survey (including demographic information) and a paper questionnaire that included questions on food shopping behaviors. All participants over the age of 10 years self-reported their weight, height, and waist circumference; this study uses data from adults over 18 years. Participants who completed an enhanced survey package additionally completed food records over the 2 days of the survey. Because individuals were nested in households, individual data are considered level 1 and household-level data are considered level 2 data for the current study.

Measures

FREQUENCY OF PATRONIZING FARMERS' MARKET AND CSAs

The self-identified main food shopper in each household responded to food shopping questions. The first set of questions assessed household food purchases: "When you go shopping for household food purchases, how often do you and/or other household members go to the following types of places?" In addition to more traditionally examined food outlet types (eg, grocery stores, conveniences stores), farmers' markets and food cooperatives or informal buying clubs (which may be considered different models of CSAs) were also included. For descriptive analyses, frequency of purchasing food from farmers' market and CSAs were coded as 1 = *never or rarely*, 2 = *sometimes, up to once per month*, and 3 = *twice a month or more*. For inferential analyses, shopping frequency was coded as 0 = *once per month or less* and 1 = *twice per month or more*.

MOTIVATIONS

A second set of questions assessed participants' top 3 reported motivations for choosing different outlet types for both large and small purchases, including "I like to buy local." For the inferential analyses, responses were categorized as 1 = participant identified "I like to buy local" as a reason for patronizing any outlet type, or 0 = participant did not identify "I like to buy local" as a reason for patronizing any outlet type.

DIETARY OUTCOMES

Two distinct measures of dietary outcomes were included in the current study, the Healthy Eating Index adapted for Canada (HEI-C) and fruit and vegetable consumption frequency. HEI-C scores were derived from self-reported diet record data collected from participants completing the enhanced survey.¹⁹ Specifically, participants completed diet records over two 24-hour periods (2 survey days) as part of the NEWPATH data collection. The HEI-C is a comprehensive indicator of diet quality based on dietary adequacy (including the number of servings of vegetables and fruits, whole grains, number of grams of saturated fat) and moderation (including the proportion of energy intake from saturated fats and sodium intake). The HEI-C reflects Canadian food intake recommendations based on participants' age and sex and ranges from 0 to 100; increasing scores represent better diet quality.¹⁹ For the current study, mean HEI-C scores over the 2 days were used as a continuous individual-level indicator of dietary quality. In terms of methodology, 2 food records corresponding to two 24-hour periods (similar to two 24-hour diet recalls) were expected to provide substantially better estimates of energy intake relative to a single-day food record.²⁰

Fruit and vegetable consumption frequency was assessed through the household surveys; questions were adopted from the Canadian Community Health Survey, Cycle 2.2 (2004),²¹ which includes a juice measure. Therefore, fruit and vegetable consumption frequency was a continuous outcome assessed for each head of household. Better diet quality is associated with decreased obesity among Canadian adults;²² therefore, measures of overweight and obesity were also included as outcome variables.

BODY MASS INDEX AND WAIST CIRCUMFERENCE AS INDICATORS OF OVERWEIGHT AND OBESITY

BMI was calculated based on self-reported weight and height (kg/m^2), and WC was considered mean self-reported WC from 2 measurements (to the nearest centimeter). Though respondents generally underestimate weight and overestimate height when self-reporting,²³ estimates of health risks associated with variations in self-reported BMI are comparable to those associated with variations in measured BMI.²⁴ Self-reported WC has been found to be a satisfactorily accurate proxy for measured WC.²⁵ BMI and WC were considered continuous variables.

SOCIODEMOGRAPHIC COVARIATES

Covariates included household-level income, car ownership (yes/no), individual-level education, age, and sex. Household income was categorized into low ($< \$35\,000$ per year), medium ($\$35\,000$ to $\$85\,000$ per year), and high ($> \$85\,000$ per year) based on the sample stratification to recruit a representative sample of the population. Individual education was classified as low (high school completion or lower), medium (some college, university, or other training), and high (completed at least a university degree).

Data Analysis

Descriptive statistics included frequencies of shopping at farmers' markets and CSAs and frequency of identifying different motivations for shopping at farmers' markets and CSAs. Binomial logistic regressions were used to examine whether household income significantly predicted whether or not a participant identified buying local as an outlet choice motivation and whether a participant reported shopping at farmers' markets or CSAs at least twice per month. For both sets of analyses, low-income was the reference group. Car ownership was also examined as a potential household-level covariate of motivation and purchasing frequency. Binomial regressions were unadjusted to determine the overall association between separately entered covariates and motivation or purchasing frequency.

Because data were nested, multilevel models were employed to examine whether the exposure variables predicted diet quality, BMI, or WC. The 3 exposure variables (frequency of patronizing farmers' markets, frequency of patronizing CSAs, and whether or not participants identified "I like to buy local" as a motivation for choosing any outlet type) were entered into separate multilevel models, all of which accounted for individual age, sex, education level, and household income, and car ownership. Multivariate linear regressions were used to determine the extent to which the 3 exposure variables predicted household fruit and vegetable consumption frequency.

Descriptive statistics, correlations, and single-level linear regressions were conducted using SPSS 20.0 (IBM SPSS Statistics for Windows, Version 20.0, 2011, IBM Corp., Armonk, NY); HLM 7 (HLM 7: Hierarchical linear and nonlinear modeling, 2011, Scientific Software International, Chicago, IL) was used for the multilevel regression analyses. Because initial results indicated that both BMI and WC were skewed, Box-Cox transformations were used to improve the normality of these variables.²⁶ For all analyses, $P = .05$ was considered statistically significant. Data were weighted to reflect the income and household size distribution of the broader population according to Census 2006 totals.

RESULTS

Descriptive Statistics

Table 1 shows sample characteristics. Our sample was roughly equally split by gender (53% female). Just over 90% of households owned cars, and the sample was fairly highly educated (40.2% of adults had obtained at least an

TABLE 1 Sample Characteristics of All Respondents, Weighted Using Census 2006 Data^a

	Mean (SD) or %
Female (%)	53.2%
High household income (%)	
<\$35K/year	24.3%
\$35K to \$85K/year	44.1%
>\$85K/year	31.6%
Car ownership (%)	90.9%
Age, mean (SD)	41.4 (17.9)
Adults' education (%)	
High school or less	23.2
Some postsecondary	36.5
At least undergraduate completed	40.2
Average HEI score, mean (SD)	52.8 (9.8)
BMI, mean (SD)	27.2 (6.0)
WC (cm), mean (SD)	90.0 (16.4)

^aHEI indicates Healthy Eating Index; BMI, body mass index; WC, waist circumference.

undergraduate degree). Mean HEI was 52.8, mean BMI was 27.2, and mean WC was 90.2. “I like to buy local” was identified by 61% of respondents as being a reason for choosing any outlet type. The most frequently cited reasons for patronizing farmers’ markets included the quality of fresh produce, meat, or bread (82.8% of respondents who patronized farmers’ markets), “I like to buy local” (71.7% of respondents who patronized farmers’ markets), and that they have foods that other stores do not carry (41.4% of respondents who patronized farmers’ markets). For patronizing CSAs, the most popular reasons were “I like to buy local,” cost, and the quality of fresh produce, meat, or bread (data not shown).

Buying foods from CSAs was uncommon in our sample: only 2% of households reported ever buying foods from CSAs. Shopping at farmers’ market was more common, with 46.5% of household shopping at farmers’ market sometimes (up to once per month) and another 19.0% shopping at farmers’ markets twice per month or more (34.5% reported never shopping at farmers’ markets).

Sociodemographic Correlates of Buying Local Motivation and Purchasing Frequency

Table 2 shows income, buying local as a motivation for outlet choice and frequency of farmers’ market and CSA use. Income significantly predicted buying local as a motivation for food outlet choice (odds ratio [OR] = 1.28, 95% confidence interval [CI], 1.03 to 1.58 for mid-income relative to low-income; OR = 1.54, 95% CI, 1.23 to 1.92 for high-income relative to low-income) and frequency of farmers’ market patronage, $B = 0.637$ (0.107), $P < .001$ for high-income relative to low-income; $B = 0.496$ (0.103), $P < .001$,

TABLE 2 Household-Level Sociodemographic Predictors of Motivation and Frequency of Farmers’ Market and CSA Patronage^a

	Identified “buying local” as a motivation for patronizing any outlet type (%)	Visit farmers’ markets at least twice per month (%)	Use CSA at least twice per month (%)
Household income			
<\$35 000 per year	18.9	12.1	1.0
\$35 000 to \$85 000 per year	38.5*	20.7**	0.3
>\$85 000 per year	42.6*	20.5**	0.6
Household car ownership			
Yes	61.5	21.6	1.3
No	55.7	18.2	0.7

^aCSA indicates community-supported agriculture.

*Significant at $P < .05$. **Significant at $P < .001$.

TABLE 3 Multilevel Model Results for “Buying Local” Variables Associated With Diet-Related Outcomes^a

Variable	Diet quality (SD)	BMI (SD)	WC (SD)
Motivation to buy local	0.33 (0.66)	-0.24 (0.23)	-0.39 (0.58)
Farmers' market shopping frequency	0.49 (0.49)	-0.34 (0.16)*	-1.09 (0.4)**
CSA use frequency	3.46 (1.57)*	-0.81 (0.37)*	-2.31 (1.0)*

^aBMI indicates body mass index; WC, waists circumference; CSA, community-supported agriculture. All analyses adjust for age, sex, education level, household income, and car ownership.

* $P < .05$. ** $P < .01$.

for mid-income relative to low-income households, but did not significantly predict CSA use. Car ownership did not significantly predict respondents' motivation to buy local or farmers' market or CSA patronage.

Local Food Purchasing and Diet-Related Outcomes

Table 3 shows results from the multilevel regression analyses. After controlling for age, sex, education level of adults, household income, and car ownership, household frequency of shopping at farmers' markets was negatively associated with individuals' BMI, $B = -0.34$ (0.16), $P = .031$, and WC, $B = -1.09$ (0.40), $P = .007$, but not with diet quality, $B = 0.49$ (0.49), $P = .324$. Frequency of shopping at CSAs was similarly negatively associated with individuals' BMI, $B = -0.81$ (0.37), $P = .028$, and WC, $B = -2.31$ (0.96), $P = .012$, and positively with diet quality, $B = 3.46$ (1.57), $P = .027$. Individuals living in households that ever identified buying local as a reason for choosing particular food outlet types did not differ from individuals in households that did not identify buying local as a motivation in terms of diet quality, $B = 0.33$ (0.66), $P = .617$, BMI, $B = -0.24$ (0.23), $P = .274$, or WC, $B = -0.39$ (0.58), $P = .503$.

After controlling for household income and car ownership, all 3 exposure variables were positively associated with household frequency of fruit and vegetable consumption: farmers' market shopping frequency, $B = 0.561$ (0.079), $P < .001$; CSA shopping frequency, $B = 0.590$ (0.235), $P = .012$; identifying buying local as a motivation, $B = 0.682$ (0.117), $P < .001$.

DISCUSSION

Even after controlling for pertinent covariates, increased frequency of farmers' market and CSA patronization was associated with lower BMI and WC and increased frequency of household fruit and vegetable consumption. This was the first study to our knowledge to demonstrate that CSA use frequency is associated with better diet quality in a population-based sample,

supporting findings that CSA members report eating a greater quantity and variety of fruits and vegetables as a consequence of joining a CSA.^{17,18,27}

Given our cross-sectional design, it is possible that people who use farmers' markets and CSAs differ from those who do not in ways related to both food purchasing and diet-related outcomes, which would result in unmeasured confounding. Although we could not adjust for all possible confounders, we aimed to explore unmeasured confounding in our data by conducting follow-up analyses to determine whether including the buying local motivation variable in the original regression models decreased the predictive power of the farmers' market or CSA shopping frequency. In all cases, including respondents' motivation to buy local in the models, did not significantly reduce associations between the shopping frequency variables and diet-related outcomes. This finding seems to suggest that expressed motivations may be less meaningful than actual purchasing behavior, which may have implications for policies or programs, described below.

Buying local as a motivation to choose specific food outlets was not associated with BMI, WC, or diet quality, although it was associated with household frequency of fruit and vegetable consumption. These findings are important because they reflect the importance of actually patronizing farmers' markets and CSAs over and above participants' motivations to buy local. These findings may suggest that policies that would support actual local food purchasing may be more health promoting than simply attempting to motivate people to buy more local foods (for example, through the aforementioned \$10 local food challenge). Though there is obviously overlap between motivations and purchasing behaviors, structural supports need to be in place for motivations to result in purchasing. To be purchased, local foods need to be available where people shop, easily identifiable, affordable, and of high quality. A Waterloo region study found redundant trade, the simultaneous importing and exporting of the same product into the same region, to be substantial and common in the area; redundant trade is a barrier to local food availability.²⁸ One potential mechanism for enhancing the availability and desirability of local foods would be the creation of a designated display case that features local products and advocated partnerships between supermarkets and local producers as a way of improving residents' access to local foods.²⁹

Associations between patronizing local food sources and diet and weight-related outcomes are still unclear. One potential mechanism is that local foods at farmers' markets may be less processed than local foods available elsewhere or general foods available at a supermarket. In one local food system analysis report, components of a local food basket available at farmers' markets tended to be less processed than items that were unavailable (eg, fresh meats, eggs, multigrain bread, fresh apples, carrots, tomatoes, and strawberries were available at farmers' markets, but beef wieners, fruit

yogurt, crackers, quick cooking oats, apple juice, and potato chips were unavailable).²⁹ Processed foods tend to be higher in fat, salt, and sugar than unprocessed foods and have been implicated in the global obesity epidemic.³⁰

Another potential mechanism by which farmers' market patronization may be associated with better diet-related outcomes is the increased availability and acceptance of affordable fresh fruits and vegetables.³¹ Supermarkets or grocery stores also supply affordable fruits and vegetables, and yet one intervention study found that Women, Infants, and Children participants who used their targeted fruit and vegetable subsidy at farmers' market increased their fruit and vegetable consumption more than those who used their subsidy at supermarkets.¹⁶ Though the authors had no formal data to explain this interesting finding, they noted informal reports indicating that participants thought that the quality of the fresh produce was superior at farmers' market relative to supermarkets, which may have encouraged consumption. Alternatively, the authors mention the sense of community engendered by shopping at farmers' market, which may also have encouraged consumption. Future research examining mechanisms by which local food purchasing is associated with better diet-related outcomes will both improve our understanding of this relationship and shed light on points of intervention for program and policy development.

This study faces several limitations. As mentioned above, it is possible that frequent patrons of farmers' markets and CSAs differ systematically from nonfrequent patrons and thus selection bias may have affected our results. Another potential limitation is our use of participants' self-reports of the frequency with which they purchase foods from farmers' markets and CSAs as a proxy for their local food purchasing. Previous research in this study area suggests that though farmers' markets can be a source of local produce, they are not necessarily so,²⁸ because, as mentioned, redundant trade seems to be common and is not restricted to supermarkets. Finally, HEI-C scores were slightly lower than the national average (mean = 52.8 in our study; mean = 58.8 in Canada¹⁹). This is perhaps because some of the age categories with the highest HEI-C scores included in national estimates (eg, ages 2 to 10 years) were excluded from the current study.

Despite these limitations, this study used a population-based sample to demonstrate support for the notion that increased frequency of purchasing foods from farmers' markets and CSAs is indeed associated with higher fruit and vegetable consumption and with lower BMI and WC and that CSA use is also associated with better diet quality. Future research should examine mechanisms by which these associations exist to determine points of intervention for food system improvements.

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