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Correlates of diet quality in the Quebec population

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Abstract

Objective: To determine the correlates of a high-fat diet in urban, suburban and rural areas of Quebec, Canada.

Design: A secondary analysis of data collected as part of a 5-year multi-factorial, multi-setting, community-intervention project.

Setting: Urban, suburban and rural settings of the province of Quebec, 1997.

Subjects: Data were analysed from a sample of 5214 participants (2227 males, 2987 females). A food-frequency questionnaire was completed and a global index of food quality was calculated. Logistic regression was used to identify correlates of a diet high in total fats, saturated fat and cholesterol.

Results: In both genders, lower level of education, smoking status, French and English languages compared with other languages spoken at home, and a rural environment were associated with poor diet quality. Having no intention to eat low-fat dairy products more often was associated with a high-fat diet. In men, obesity (body mass index $\geq 30\,kg\,m^{-2}$) and absence of reported health problems were correlates of a high-fat diet, while, in women, lower physical activity was a correlate.

Conclusions: Future health interventions in Quebec should target people with low education, smokers and those living in a rural environment. Obese men and sedentary women should have access to specific dietetic resources.

Keywords
Correlates
High-fat diet
Cardiovascular diseases

Although some controversies remain, health education strategies since the 1970s have focused on the reduction of fat intake, specifically saturated fat, to decrease the incidence of cardiovascular disease (CVD). These efforts have resulted in declining fat intake in North American populations. For example, from 1970 to 1990, the population of Quebec, Canada reduced its total fat intake from 38% to 34% of energy[1]. Despite this improvement, CVD is still the leading cause of death in Quebec: in 1999, it represented 35% of all deaths in women (37% in Canada) and 33% in men (35% in Canada)[2]. From a public health perspective, new approaches are necessary to further reduce the incidence of CVD.

In this vein, factors known to be associated with diet quality are of interest. Further intervention studies may benefit by focusing on characteristics associated with poor diet quality among specific population subgroups. In previous studies, factors that have been associated with a healthy diet include: female gender[3–5], Caucasian origin[6,7], English-speaking[3,8], higher education[4–7,9,10], knowledge of heart health or nutrition[3,5,11,12], non-smoking status[13] and regular physical activity[6]. Few studies have assessed the influence of geographic setting (urban, suburban or rural) on diet quality. The objective of the present study was to determine the correlates of a high-fat diet in three geographic settings in Quebec, Canada. These correlates may help to identify population subgroups to whom programmes should be targeted, as it appears that some of them are more interested than others in heart disease prevention[14].

Subjects and methods

The objective of this study was the secondary analysis of data collected as part of the Quebec Heart Health Demonstration Project (QHHDP), a 4-year, multi-factorial, multi-setting community-intervention project aimed at improving behaviours associated with cardiovascular health. Conducted between 1993 and 1997, the QHHDP was delivered in urban, suburban and rural regions of Quebec. The urban region was one of high population density, low socio-economic status and multiethnic population in south central Montreal. The suburban region had a lower population density, was mostly middle-class and was located 20 km north of Montreal. The rural region was composed mostly of farming communities with low socio-economic status and low density population and was located 500 km east of

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Montreal. Matched control communities were selected on the basis of similarities in language and socio-economic status[15].

Self-administered questionnaires were brought home by children attending 4th to 6th grade (9–12 years old) in all elementary schools in each of the experimental and control communities. Parents, both if possible, completed a self-administered questionnaire on lifestyle and socio-demographic factors.

Data on dietary intake were collected through a 32-item food-frequency questionnaire focusing on foods high in total and saturated fat as well as cholesterol. The questionnaire, based on the Ammerman model, was adapted and validated for the Quebec population[15]. Once translated, it was pre-tested among 70 adults aged 19–65 years who completed it twice, after a 2-week interval. Fifty of the subjects completed three 24-hour dietary recalls to assess its validity ($r = 0.48$ for total fat and 0.42 for saturated fat). The questionnaire was changed slightly to increase response variability. A final validation was made among 115 adults aged 18–64 years who completed seven dietary recalls to test its validity ($r = 0.33$ for total energy, 0.40 for total fat, 0.45 for saturated fat and 0.24 for cholesterol intake). Scores of 0, 1 or 2 were attributed to the frequency choices, higher scores indicating the worst-quality diet. For example, in response to the question 'How many times a week do you usually eat hot dogs or cold cuts like bologna or salami?', a score of 0 was given to none or once a week, 1 for two or three times a week, and 2 for a frequency of four times or more a week. A global index (GI) was created as the mean of the score on each of these 32 individual items, a higher score representing a diet high in total fat, saturated fat and cholesterol. GI scores ranged from 0 to 1.50 (mean 0.756, standard deviation 0.210).

Variables

Data were collected on income, level of education, age, weight and height, language spoken at home (French, English or others), number of years living in the community, physical activity level, smoking status and reported health problems. Body mass index (BMI) was calculated from self-reported weight and height as weight (in kg) divided by the square of height (in m). BMI was categorised as <20, 20–24.99, 25–29.99 and $\geq 30\,kg\,m^{-2}$. Reported health problems (diabetes, hypertension, elevated cholesterol or cardiac problems) were combined in a single dichotomous variable (presence or not of any of these health problems). Physical activity was measured by the following question: 'Over the last 4 months, how often did you do at least 20 minutes of physical activity in your leisure time?' Response categories were never, less than once a month, about once a month, 2–3 times a month, once a week, twice a week, 3 or more times a week. This variable was dichotomised into 3 times or less a month, and once or more a week. Annual income was classified in four categories (CAN$): $<20\,000$, 20 000–39 999, 40 000–59 999 and $\geq 60\,000$; and education level represented the highest level completed: primary, high school, college or university. Smoking status was dichotomised into smokers (occasional and regular smokers) and non-smokers (past smokers and non-smokers). Intentions of improving some dietary habits were measured by five questions: 'During the next 4 months, do you intend to: (1) Eat more lean ground beef, round steak and ribs without fat? (2) Eat more chicken or fish? (3) Drink or use more skimmed milk? (4) Eat more low-fat dairy products like ice milk, frozen yoghurt, light yoghurt and low-fat cheese? (5) Eat more low-fat cold cuts like pressed chicken, smoked turkey and lean ham?'

Data analysis

To reflect the most recent trends and current correlates of food intake in the three settings, data collected in the cross-sectional sample in 1997 were used in the analysis. Individual variables suspected to influence dietary intake were tested in a bivariate logistic regression model with GI as the dependent variable. Variables tested included: education level, income, age, number of years residing in the community, language spoken at home, smoking status, BMI, physical activity, reported health problems and intentions of improving dietary behaviours. GI was divided into quartiles and analysed as a dichotomous variable, poor diet quality (highest quartile) and good diet quality (the three other quartiles combined).

Correlates found to be significantly associated with outcome in the bivariate analysis were entered in stepwise multivariate logistic regression to estimate the independent associations of test variables with the dichotomous dependent variable. Variables were considered significant at $P < 0.05$. Variables not retained were added individually to the final model to assess confounding.

Results

A total of 5214 participants were available for analysis. Table 1 describes the proportion of the sample in the highest and lowest diet quality profile by suspected correlates. For both genders, a higher proportion of people with lower education level (primary or high school) or lower family income (less than CAN$40 000) had lower diet quality. There were more men, but not women, with excess weight (BMI $\geq 25\,kg\,m^{-2}$) in the high-fat diet category. Subjects who spoke French at home had a higher dietary fat intake than did subjects who spoke English or other languages at home. A higher proportion reported a health problem in the first three quartiles of GI. As expected, there were more non-smokers and active people in the lowest quartiles of GI. Those with intentions of improving their diet had the lowest GI. Finally, a higher proportion of participants in the rural setting had a high-fat diet.

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Table 1 Proportion of respondents with high or low diet quality and independent correlates* of poor diet quality (high in total fat, saturated fat and cholesterol), Quebec, 1997

	Males (%) ($n = 2227$)			Females (%) ($n = 2987$)		
Variable	First 3 quartiles (higher quality)	Last quartile (lower quality)	Independent correlates, OR (95% CI)	First 3 quartiles (higher quality)	Last quartile (lower quality)	Independent correlates, OR (95% CI)
Education						
Elementary school	26.2	34.8	1	23.6	34.7	1
High school	28.7	35.0	0.89 (0.69–1.15)	35.2	35.8	0.64 (0.50–0.82)
College	27.0	22.3	0.60 (0.45–0.78)	27.9	23.7	0.55 (0.42–0.73)
University	16.7	7.5	0.42 (0.28–0.61)	11.9	5.3	0.38 (0.25–0.59)
P-value		<0.001			<0.001	
Income (CAN$)						
< 20 000	18.1	15.7	1	26.2	31.8	1
20 000–39 999	28.4	36.0	1.18 (0.91–1.53)	26.7	32.1	1.01 (0.79–1.29)
40 000–59 999	19.4	23.7	1.18 (0.88–1.58)	17.0	16.3	0.98 (0.73–1.33)
≥ 60 000	17.8	13.8	0.89 (0.63–1.26)	13.8	7.8	0.64 (0.44–0.95)
P-value		<0.001			<0.001	
Age (years)						
18–34	5.9	6.8	–	14.4	19.5	–
35–49	82.2	84.8		79.6	77.0	
50–64	8.6	5.9		2.4	1.7	
P-value		0.064			0.022	
Years of residence						
0–4	20.0	15.2	–	21.3	20.9	–
5 or more	80.0	84.8		78.7	79.1	
P-value		0.004			0.791	
BMI (kg m^{-2})						
20–24.99	36.3	33.8	1	49.4	53.9	–
< 20	4.4	2.6	0.58 (0.33–1.04)	12.6	13.2	
25–29.99	24.4	25.7	1.12 (0.89–1.41)	12.6	11.6	
≥ 30	10.2	13.8	1.56 (1.16–2.12)	9.4	9.3	
P-value		0.007			0.064	
Language						
French	66.6	88.6	1	69.4	85.7	1
English	3.6	3.8	1.29 (0.75–2.20)	3.8	3.2	0.96 (0.56–1.67)
Others	27.5	7.1	0.31 (0.23–0.46)	25.2	10.0	0.44 (0.30–0.65)
P-value		<0.001			<0.001	
Reported health problems						
No	74.8	80.3	1	80.9	83.1	–
Yes	25.2	19.7	0.69 (0.55–0.87)	19.1	16.9	
P-value		0.003			0.209	
Smoking status						
Non-smoker	68.4	60.9	1	72.3	58.1	1
Smoker	27.4	35.5	1.50 (1.21–1.85)	23.5	37.6	1.50 (1.22–1.86)
P-value		<0.001			<0.001	
Physical activity						
Three times/month or less	41.5	45.6	–	41.2	49.5	1
Once or more/week	57.4	53.2		57.4	49.5	0.79 (0.67–0.94)
P-value		0.159			0.001	
Intention of consuming more lean meat						
Yes	65.4	56.0	1	70.5	61.9	1
No	34.6	44.0	1.11 (0.88–1.40)	29.5	38.1	1.21 (0.96–1.52)
P-value		<0.001			<0.001	
Intention of consuming more chicken or fish						
Yes	69.8	58.4	–	74.8	67.1	–
No	30.2	41.6		25.2	32.9	
P-value		<0.001			<0.001	
Intention of drinking more skimmed milk						
Yes	34.4	17.5	1	39.2	19.8	1
No	65.6	82.5	1.88 (1.45–2.44)	60.8	80.2	2.09 (1.63–2.69)
P-value		<0.001			<0.001	
Intention of consuming more low-fat dairy products						
Yes	47.7	28.5	1	56.9	39.1	1
No	52.3	71.5	1.58 (1.25–1.99)	43.1	60.9	1.48 (1.19–1.85)
P-value		<0.001			<0.001	
Intention of consuming more low-fat cold cuts						
Yes	47.7	46.9	–	53.2	54.3	–
No	52.3	53.1		46.8	45.7	
P-value		0.007			0.064	

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Table 1 *Continued*

Variable	Males (%) ($n = 2227$) First 3 quartiles (higher quality)	Last quartile (lower quality)	Independent correlates, OR (95% CI)	Females (%) ($n = 2987$) First 3 quartiles (higher quality)	Last quartile (lower quality)	Independent correlates, OR (95% CI)
Site						
Rural	29.4	52.4	1	31.2	53.1	1
Suburban	35.6	33.6	0.62 (0.49–0.78)	33.9	25.9	0.52 (0.41–0.67)
Urban	35.0	14.0	0.48 (0.33–0.68)	34.9	21.0	0.51 (0.37–0.71)
P-value		<0.001			<0.001	
Type of community						
Experimental	45.4	48.0	–	45.0	46.7	–
Control	54.6	52.0		55.0	53.3	
P-value		0.232			0.438	

OR – odds ratio; CI – confidence interval; BMI – body mass index.
* Results of stepwise logistic regression.

Table 1 also presents the independent correlates of the highest GI for each sex. In both genders, the odds ratio (OR) of being in the last quartile of GI decreased as the level of education increased. When the university level was reached, the OR (95% confidence interval (CI)) was 0.41 (0.28–0.61) for men, and 0.38 (0.25–0.59) for women, compared with the lowest level of education. When tested alone, income was strongly related to GI. However, once adjusted for education, the variable lost significance, except in women with a family income of more than CAN$60 000 (OR 0.64, 95% CI 0.44–0.95). Men with BMI $\geq 30\,kg\,m^{-2}$ had an increased odds of being in the last quartile. Men who reported having some health problems had a lower odds of a poor diet (OR 0.69, 95% CI 0.55–0.87). For both genders, smoking status showed a similar association with diet quality. The odds of having high GI was 50% higher among occasional or regular smokers compared with past or non-smokers. Women who exercised once or more a week had an OR (95% CI) of 0.79 (0.67–0.94) compared with those exercising less than 3 times a month.

Intentions of improving diet were significant correlates of diet quality in all groups, except for the intention of consuming more lean meat in men. Women having no intention of consuming more lean meat had an OR (95% CI) of 1.21 (0.96–1.52), while having no intentions of drinking more skimmed milk and low-fat dairy products showed similar relations in both sexes with the odds ratio varying between 1.5 and 2.1.

Language spoken at home presented a strong correlation with diet quality. Compared with French- and English-speaking subjects, those speaking other languages had a lower-fat diet. The respective OR (95% CI) in men and women was 0.31 (0.23–0.46) and 0.44 (0.30–0.65). Those living in rural settings had poorer diet quality than did subjects living in suburban and urban areas. Compared with subjects from rural areas, the OR (95% CI) in suburban participants was 0.62 (0.49–0.78) in men and 0.52 (0.41–0.67) in women. Urban subjects had even lower odds, the respective OR (95% CI) being 0.48 (0.33–0.68) in men and 0.51 (0.37–0.71) in women.

Table 2 describes the correlates of poor diet quality by setting (rural, suburban and urban sites). Although the smaller size of the groups affects the confidence intervals and some associations are lost, the general directions of associations are preserved. Significant correlates are still found in each setting. The odds of having a poor diet was much lower among subjects with a university education in the rural setting compared with other settings. Obesity (BMI $\geq 30\,kg\,m^{-2}$) was a stronger correlate of poor diet in males than in females, particularly in the suburban setting. Rural men and urban women showed strong negative associations between reported health problems and GI score. Smoking was a particularly strong correlate of GI among rural men, whereas physical activity was protective in women of all three settings. Among dietary correlates, the lack of intentions of drinking more skimmed milk or consuming more low-fat dairy products were the strongest and most consistent correlates of poor diet quality in most sex and setting groups.

Discussion

This study shows associations between diet and variables such as education level and smoking status that are consistent with previously published reports in the literature. Education was strongly related to diet quality, particularly in rural men and women. Other studies found similar results. Shea *et al.*[5] demonstrated that saturated fat and cholesterol intakes, as expressed in the cholesterol–saturated fat index, were inversely related to educational attainment. In the Rotterdam study, saturated fat intake (expressed as proportion of energy) in an elderly population was also inversely correlated with educational strata[9]. In a Danish study, men and women with lower education consumed less fruits and vegetables and more energy from fat[16]. Low level of education has been related to poor health behaviours in general[17] and to higher risk of not meeting health recommendations such as a low-fat diet[18]. Income, although related to diet quality, seems to be confounded by education. Groth *et al.*[16] found that

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Table 2 Independent correlates of poor diet quality (high in total fat, saturated fat and cholesterol) by site, Quebec, 1997. Values are expressed as odds ratio (95% confidence interval)

	Males			Females		
Variable	Rural ($n = 850$)	Suburban ($n = 776$)	Urban ($n = 601$)	Rural ($n = 1077$)	Suburban ($n = 959$)	Urban ($n = 951$)
Education						
Elementary school	Ref	Ref	Ref	Ref	Ref	Ref
High school	0.68 (0.32–1.45)	0.91 (0.42–1.97)	1.12 (0.65–1.95)	0.59 (0.37–0.94)	0.86 (0.49–1.50)	0.90 (0.61–1.34)
College	0.66 (0.30–1.49)	0.87 (0.39–1.93)	1.31 (0.73–2.35)	0.63 (0.39–1.03)	0.68 (0.39–1.20)	0.44 (0.29–0.67)
University	0.16 (0.06–0.42)	0.56 (0.23–1.28)	0.93 (0.50–1.73)	0.25 (0.14–0.46)	0.58 (0.29–1.14)	0.53 (0.31–0.91)
Income (CAN$)						
$< 20\,000$	Ref	Ref	Ref	Ref	Ref	Ref
20 000–39 999	0.77 (0.48–1.23)	1.04 (0.69–1.58)	0.95 (0.64–1.42)	1.04 (0.79–1.39)	1.04 (0.8–1.36)	0.87 (0.61–1.24)
40 000–59 999	1.12 (0.68–1.86)	0.96 (0.68–1.36)	1.28 (0.73–2.25)	0.81 (0.60–1.11)	0.96 (0.75–1.23)	1.24 (0.76–2.02)
$\geq 60\,000$	1.10 (0.63–1.91)	0.99 (0.70–1.42)	0.86 (0.47–1.58)	1.10 (0.76–1.60)	1.02 (0.79–1.31)	0.89 (0.52–1.51)
BMI ($kg\,m^{-2}$)						
20–24.99	Ref	Ref	Ref	Ref	Ref	Ref
< 20	2.07 (0.24–17.62)	2.11 (0.25–18.10)	1.95 (0.78–4.89)	0.73 (0.45–1.18)	0.86 (0.51–1.44)	1.09 (0.66–1.79)
25–30	0.88 (0.46–1.67)	1.01 (0.62–1.64)	1.30 (0.78–2.16)	1.08 (0.65–1.77)	1.21 (0.74–1.96)	0.82 (0.50–1.35)
≥ 30	2.09 (0.69–6.38)	2.52 (1.06–6.02)	1.78 (0.90–3.55)	1.38 (0.64–3.00)	0.69 (0.38–1.25)	0.93 (0.60–1.45)
Age (years)						
18–34	Ref	Ref	Ref	Ref	Ref	Ref
35–49	0.35 (0.04–2.82)	0.58 (0.16–2.10)	0.45 (0.21–0.96)	0.85 (0.50–1.42)	0.95 (0.57–1.59)	0.72 (0.49–1.05)
50–64	0.26 (0.03–2.63)	1.14 (0.16–8.31)	0.27 (0.11–0.66)	1.23 (0.36–4.26)	3.34 (0.33–33.60)	0.62 (0.25–1.53)
Language						
French	Ref	Ref	Ref	Ref	Ref	Ref
English	1.23 (0.13–11.35)	1.27 (0.34–4.75)	0.67 (0.25–1.84)	0.65 (0.23–1.86)	1.16 (0.40–3.34)	0.82 (0.41–1.61)
Others	–	0.33 (0.15–0.74)	0.36 (0.22–0.61)	–	0.70 (0.37–1.30)	0.68 (0.47–0.99)
Reported health problems						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	0.30 (0.17–0.55)	0.72 (0.44–1.18)	0.96 (0.59–1.58)	0.77 (0.51–1.18)	0.96 (0.64–1.44)	0.79 (0.67–0.94)
Smoking status						
Non–smoker	Ref	Ref	Ref	Ref	Ref	Ref
Smoker	3.92 (1.58–9.72)	2.13 (0.44–1.18)	1.92 (1.20–3.05)	1.19 (0.80–1.77)	1.76 (1.20–2.57)	1.54 (1.03–2.29)
Physical activity						
3 times/month or less	Ref	Ref	Ref	Ref	Ref	Ref
Once or more/week	0.80 (0.41–1.55)	0.79 (0.63–1.0)	1.16 (0.97–1.39)	0.68 (0.52–0.88)	0.51 (0.38–0.70)	0.79 (0.67–0.94)
Intention of consuming more lean meat						
Yes	Ref	Ref	Ref	Ref	Ref	Ref
No	0.94 (0.44–1.98)	0.52 (0.29–0.91)	1.20 (0.73–1.99)	0.75 (0.48–1.18)	0.83 (0.55–1.26)	0.77 (0.51–1.15)
Intention of consuming more chicken or fish						
Yes	Ref	Ref	Ref	Ref	Ref	Ref
No	1.98 (0.88–4.47)	1.74 (0.98–3.09)	0.88 (0.51–1.54)	1.13 (0.70–1.82)	1.19 (0.78–1.81)	1.58 (1.02–2.42)
Intention of drinking more skimmed milk						
Yes	Ref	Ref	Ref	Ref	Ref	Ref
No	4.04 (1.92–8.49)	1.91 (1.13–3.21)	1.53 (0.96–2.44)	3.16 (2.15–4.64)	2.82 (1.95–4.08)	1.94 (1.37–2.74)
Intention of consuming more low-fat dairy products						
Yes	Ref	Ref	Ref	Ref	Ref	Ref
No	1.29 (0.63–2.65)	2.99 (1.77–5.04)	1.38 (0.86–2.20)	1.78 (1.19–2.67)	2.06 (1.43–2.97)	1.36 (0.96–1.93)
Intention of consuming more lean processed meat						
Yes	Ref	Ref	Ref	Ref	Ref	Ref
No	0.57 (0.29–1.11)	0.52 (0.31–0.88)	1.00 (0.63–1.60)	0.82 (0.55–1.20)	0.72 (0.50–1.04)	0.93 (0.66–1.31)

BMI – body mass index; Ref – reference category.

income was associated with a better diet in women. In our sample, only women in the highest income level were less likely to have high GI after controlling for education. Poor health status, including poor diet, seems to cluster into low socio-economic groups[17]. Less access to healthy food (unfavourable environment) and to health promotion messages, as well as familial influences (lack of social support and education), may explain this aggregation. Strategies to reduce health inequalities must include consideration of the social environment, including where people live and where they work[19].

Although older women tended to eat less total and saturated fat, age in women was no longer significant after multivariate adjustment in the combined settings analysis. A Norwegian study previously reported similar trends for age among women[20]. In the analysis by setting, age tended to be negatively associated with diet quality among urban women but this association was strong and

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statistically significant among urban men. However, in the cohort of the European Prospective Investigation of Cancer, elderly subjects ate more red meat and saturated spreads than did younger individuals[4].

Surprisingly, only obesity in suburban men (BMI $\geq 30\,kg\,m^{-2}$) was associated with increased odds of having high GI (OR 2.5). Other individuals with excess weight may underreport their fat intake or may already follow a weight-reduction diet with low-fat products. The association between obesity and diet may even be stronger, since Braam *et al.*[21] found that, in a sample of 2079 men and 2467 women aged 20–65 years, there was more underreporting of energy intake as the degree of overweight increased.

Subjects speaking languages other than French and English at home were less likely to have a high-fat diet, particularly among urban and suburban men and urban women. The better diet profile may reflect healthier lifestyles of recent immigrants who have not yet adopted North American dietary habits. Dietary changes in migrants are related to several factors, such as length of exposure to the new environment and the ability to speak the new language[22]. Contrary to our data, other American studies have demonstrated that English-speaking subjects, compared with those speaking other languages, have more favourable health profile[8] or CVD knowledge[3]. Shea *et al.*[7] reported that Blacks and Hispanics in the USA had less favourable health profiles. A similar relationship was found by Gillman *et al.*[6]. Polednak[23] showed that acculturation of US Hispanic adults was not related to fat intake. Guendelman and Abrams[24] observed that first-generation Mexican women had a lower risk of eating a poor diet than did second-generation women living in the USA. These results strongly suggest that cultural determinants influence dietary behaviours. Dietary assessment should include measures of the cultural determinants of food consumption[25].

When men self-reported a health problem, they were less likely to present a high GI. This relationship was significant in the rural setting. Although urban women also presented a significant negative association between reported health problems and GI, the strength of the association was attenuated. Wright[26] noted that patients attending a lipid clinic were more motivated, some by fear, to change their diet. In men, a diagnosis of any health problem related to diet may serve as a strong motivation to alter eating habits. Contrary to women, they are less concerned with physical appearance, and may alter their diet if they feel that their life is in danger or consider a high-fat diet as a threat[27]. The 1990 study of food habits of Quebec residents found that while 29% of women were concerned with their weight when they ate, only 22% of men reported the same concern[1].

Other lifestyles such as smoking, drinking, daily physical activity and sleeping hours are correlates of dietary habits[28]. In particular, smoking seems to be strongly associated with dietary intake. Smokers have poorer dietary habits and consume more fat than non-smokers[14,29,30]. This relationship was particularly strong in rural men, who had an almost fourfold increase in the odds of poor diet if they were current smokers. Non-smoking adults married to smokers seem to have higher intakes of total fat, saturated fat and cholesterol than those married to non-smokers. Our data are congruent with the literature, since smokers were 1.5 times more likely to have a low-quality diet.

Despite previous studies showing a relationship between healthy diet and physical activity in both genders[6,31], our sample demonstrated that physical activity was associated with diet profile only in women (all settings). Women who engage in regular physical activities may be more likely to adopt other healthy behaviours, including a low-fat diet or an energy-restrictive diet to control their weight.

Intentions of improving dietary behaviours in the following 4 months influenced actual diet. Women with no intentions of choosing more lean meat increased their odds of having a low-quality diet. Intentions of consuming lower-fat milk and dairy products were stronger correlates of GI than other measures of intention. Men and women with no intention of consuming more skimmed milk or low-fat dairy products increased their odds of having a low-quality diet. Intention of improving the diet is related to better dietary behaviours, as suggested by the Ajzen and Fishbein model[32].

Contrary to most data in the literature which report better diet in rural compared with urban areas in industrialised countries[33,34], our sample demonstrated the opposite. Rural inhabitants had the least favourable diet profile, and residents of urban areas, the best diet profile. People living in an urban environment in Quebec may have access to more health resources and have more accessibility to healthy and fresh foods. The better diet profile found in our urban site might be explained by the concentration of recent immigrants in this setting. Ethnicity may not be measured perfectly by the variable 'language spoken at home', and some residual confounding may exist. Johansson *et al.*[29] also found, in a Norwegian sample, that men and women living in the city rather than in a rural environment had higher intakes of fruits and vegetables. In males, energy from fat was also lower in the city. Our results suggest that correlates of diet quality are somewhat different among the three settings. While physical activity level offered protection in women of all settings, some correlates showed differences across setting. Smoking status was found as a correlate in rural and urban settings for men and in suburban and urban settings for women. These data suggest that the level of urbanisation may influence the choice of the intervention target in a nutritional intervention programme.

The main limitation of this study consists in its cross-sectional design, which prevents us from concluding

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about the directionality of the observed associations and restricts the interpretation of the correlates in term of risk reduction or elevation. Although knowledge of the correlates may be useful to design individual-level intervention studies for specific population subgroups, their interpretation in terms of risk of having a poor diet is limited by the lack of information on the temporality of the observed associations.

Other limitations include the use of self-reported data, particularly weight, height and health problems. Additional limitations arise from both the food-frequency questionnaire used (food list, the way food items are grouped, choices of frequency, etc.)[35] and the construction of the dietary GI. The original dietary risk assessment yielded higher correlations with validated measures of dietary fat intake than our own index[36]. Our food list may not sufficiently represent foods high in total fat, saturated fat and cholesterol consumed in the population studied. Also, food habits have probably changed since the questionnaire was developed and validated in the beginning of the 1990s, and the sample used in this study completed the questionnaire in 1997. Finally, ethnic foods are not included in the questionnaire, which may bias the results in urban communities where most recent immigrants live in Quebec.

In addition, the GI focused only on one specific aspect of diet quality – saturated fat content – and may not reflect the overall quality of the diet. However, these limitations are common to most food-frequency questionnaires. The dietary assessment instrument we used was selected within the context of the evaluation of a heart disease prevention programme and its use in the current context may lead to misclassification of study subjects.

Conclusions

Community programmes to improve diet require constant improvements, given dynamic demographic patterns and changing social and physical environments. This study, with the information gathered on factors influencing dietary intakes, provides insights for target groups on which to test new interventions, including individuals with low education attainment, smokers, obese men and those living in a rural environment. Targeting population subgroups, an intervention strategy that lies between the population-wide and the individual approach, may facilitate and support the process of behaviour change[37]. Future intervention research should address the specific needs of these subgroups, including the optimal combination of health promotion approaches to achieve public health goals.

Because they are correlated with behaviours, measures of intentions, specifically those related to low-fat dairy product consumption, may provide useful added information in dietary questionnaires. Although cross-sectional, our study supports the link between intentions and behaviours established initially by Ajzen and Fishbein[32]. However, future public health approaches to improve dietary behaviours should combine a variety of educational strategies, target individuals and entire communities, intervene to modify the social and physical environments (changing norms through the media, increasing availability of healthy foods items, etc.) and promote healthy public policies[38]. Improvement in socio-economic conditions, which generate the poor health behaviours, is essential to a broad-based public health policy[17].

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