

TITLE PAGE

Development and Validation of the Perceived Food Environment Questionnaire in a French-Canadian Population

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S. L., B. L., and J. R. contributed in designing the study. L. C. was responsible in carrying out the study. J. R. was responsible of developing the questionnaire. E. C. analysed the data and wrote the article. All co-authors revised and approved the final version of the paper.

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ABSTRACT

Objective: The aim of this study was to develop and validate a questionnaire assessing perceived food environment in a French-Canadian population.

Design: A questionnaire, the Perceived Food Environment Questionnaire, was developed assessing perceived accessibility to healthy (9 items) and unhealthy foods (three items). A pretest sample of 31 participants were recruited for a pilot testing of the questionnaire. For the validation study, 150 men and women from the Québec City area were recruited and completed the questionnaire twice. An Exploratory Factor Analysis (EFA) was performed on the items to assess the number of factors (subscales). Cronbach alphas were used to measure internal consistency reliability. Test-retest reliability was assessed with Pearson correlations.

Setting: Online survey.

Results: The pilot testing did not lead to any change in the questionnaire. The EFA revealed a two-subscale structure. The first subscale is composed of six items assessing accessibility to healthy foods and the second includes three items related to accessibility to unhealthy foods. Three items were removed from the questionnaire due to low loading on the two subscales. The subscales demonstrated adequate internal consistency (Cronbach alpha: 0.77 for healthy foods, and 0.62 for unhealthy foods) and test-retest reliability ($r=0.59$ and 0.60 respectively, $ps<0.0001$).

Conclusions: The Perceived Food Environment Questionnaire was developed for a French-Canadian population and demonstrated good psychometric properties. Further validation is recommended if the questionnaire is to be used in other populations.

Keywords: Questionnaire, Food Environment, Perceptions, Validation, French

INTRODUCTION

There is a growing body of research exploring the effects of the neighborhood environment on health behaviors, such as physical activity and healthy eating. Different methodologies are used to portray features of neighborhoods, including food availability, that influence food intake. A popular method is to use geocoding to objectively assess the distance between respondents' home and food retailers or restaurants, and to document exposure to various shop types (e.g. Aggarwal et al. ⁽¹⁾, Izumi et al. ⁽²⁾, Morland et al. ⁽³⁾, Murakami et al. ⁽⁴⁾, Paquet et al. ⁽⁵⁾, Pearce et al. ^(6,7), Thornton et al. ⁽⁸⁾). Other objective measures used are store audits, allowing to precisely report what kind of foods individuals are exposed to when grocery shopping ⁽⁹⁻¹³⁾. Despite the use of such objective measures, the relationship between the food environment and food choices is subject to conflicting results in the literature. Some studies have shown significant associations between food accessibility and/or availability and measures of food intake (e.g. Morland et al. ⁽³⁾, Sharkey et al. ⁽¹³⁾, Zenk et al. ⁽¹²⁾), while other studies have found no associations (e.g. Aggarwal et al. ⁽¹⁾, Murakami et al. ⁽⁴⁾, Paquet et al. ⁽⁵⁾, Pearce et al. ^(6,7)). The fact that consumers do not always shop at the closest food retailer from home ⁽¹⁾ may explain part of those mixed results.

Given that different people may have different perceptions of the same food environment, other authors have opted for an approach that measures perceived food environment, i.e. participants' perceptions of the availability and/or accessibility and/or affordability of healthy and unhealthy foods in their neighborhood. Generally using relatively short questionnaires, authors have once again obtained mixed results when looking at the relationship between the perceived food environment and food intakes. Many authors have reported positive associations between perceived accessibility to healthy foods and diet quality ⁽¹³⁻¹⁷⁾, but this has not been a systematic finding ⁽¹⁸⁻²⁰⁾. These mixed results may be partly explained by the diversity of items used in different studies and by the fact that most of them were not validated. Dibsall et al. ⁽¹⁶⁾ and Mujahid, Diez Roux, Morenoff et al. ⁽²¹⁾ have developed and validated very short (3 items ⁽²¹⁾) or very long scales (30 items ⁽¹⁶⁾), both assessing almost exclusively perceived access to fruit and vegetables.

In the context of a large study aiming at identifying determinants of healthy eating in the French-Canadian population of the Province of Quebec, Canada, our research team wanted to create a questionnaire in order to evaluate the potential influence of the perceived food environment on healthy eating. There is, to our knowledge, no such questionnaire that was developed and validated for a French-speaking sample. As recommended by Beaton, Bombardier, Guillemin et al. ⁽²²⁾, questionnaires should not be translated and then used without some adaptations for cultural differences between

populations. In this case, it was decided that a new questionnaire would be developed since most of the existing tools were not validated and did not assess both access to healthy and unhealthy foods. Therefore, the aim of the present study was to develop and validate a questionnaire assessing perceived food environment (i.e. perceptions of the availability and/or accessibility and/or affordability of healthy and unhealthy foods in the neighborhood) in an adult French-Canadian convenience sample. We hypothesize that the questionnaire we developed is valid and reliable for the targeted population.

MATERIAL AND METHODS

Development of the items

For the development of the questionnaire, we were mostly inspired by items developed (but never validated) by Inglis, Ball and Crawford ⁽²³⁾ and by the results obtained by Kamphuis, van Lenthe, Giskes et al. ⁽²⁴⁾ in focus groups conducted in high and low socioeconomic groups. The items generated based on factors that were mentioned by their participants are therefore relevant for both high and low socioeconomic groups. We were also inspired by items documented in several other studies having assessed participants' perceptions of their food environment ^(9, 12, 15, 16, 19, 20, 25-29). The items were developed and chosen by a team of three nutrition researchers and one health behavior researcher to ensure the face validity of the questionnaire, i.e. the extent to which the items seemed to measure what the developers claim they measure ⁽³⁰⁾.

The Perceived Food Environment Questionnaire that we developed first comprised 14 items grouped into two distinct sections (see Table 1). The first section included 12 items assessing accessibility to healthy (9 items) and unhealthy foods (3 items) and was developed to evaluate participants' perceptions of the food environment in their daily life (e.g. accessibility to healthy foods in food retailers, accessibility to healthy/unhealthy foods at the workplace, kitchen equipment). The items were rated on a five-point scale, from "strongly disagree" to "strongly agree", with the addition of a "not applicable" option for the items pertaining to the work environment. Indeed, these items will not concern unemployed individuals. The second section included two complementary questions documenting the self-reported travel time from home to the main food retailer by car and on foot. These two items did not assess food environment perceptions. They were, however, included in the questionnaire as they will be useful for the interpretation of the results obtained in the previous section, allowing the integration of subjective (i.e. perceived food environment) and more objective (i.e. travel time) measures, as it was proposed that the two types of measures can bring complementary information ^{(15,}

²⁵⁾. The questionnaire's items are preceded by a short introduction text in which participants are informed that the questionnaire aims at assessing their own perceptions of their environment, and that there are no good or bad answers. A definition of "healthy foods" is also presented: "Healthy foods are foods recommended by the Canada's Food Guide, i.e. fruit and vegetables, whole grain products, low-fat dairy and alternatives, and low-fat meat and alternatives."

Participants and procedures

The Perceived Food Environment Questionnaire's development and validation took place in the context of a research project aiming at validating a series of questionnaires on potential determinants of healthy eating and blood biomarkers of fruit and vegetable intake. The Perceived Food Environment Questionnaire was validated using a two-step process, namely a pretest and a validation study.

Pretest

In order to perform a pilot testing of the questionnaire, a convenience sample of 31 participants was recruited from an internal list of individuals interested in participating in clinical studies. Participants were 14 men and 17 women from the Quebec City metropolitan area and were aged between 18 and 65 years (mean age: 45.6 ± 13.9 years). Participants had to have at least minimal informatics skills since questionnaires were completed online. Each participant commented on the clarity of the questionnaire's items in a comment box on the internet interface, which allowed us to assess acceptability and understanding of the items.

Validation study

For the validation study, a convenience sample of 150 participants (50% female) were recruited through electronic mailing lists comprising Laval University students and employees as well as individuals interested in participating in nutritional studies at the research center. As for the pretest, participants had to be aged 18 to 65 years, and to have at least minimal informatics skills. Since blood biomarkers of fruit and vegetable intake were measured as part of the larger study of validation, participants had to be free from conditions affecting intestinal absorption. Pregnant and lactating women were also excluded.

Eligible participants came to the research center for a blood sample and anthropometric measurements. After their visit to the research center, participants were allowed a one-month period to complete the series of questionnaires to be validated on the Internet platform of the study. Questionnaires were assigned to participants in a random order. The completion time for the series of questionnaires was

approximately 40 minutes. After a two-week period, participants were asked to complete the questionnaires a second time within another 30-day window.

Participants received a financial compensation of CAN\$50 for their participation in the study. This study was conducted according to the guidelines laid down in the Declaration of Helsinki. The experiment had approval from the Research Ethics Committee at Laval University. Implicit informed consent was obtained from the pretest participants and all participants from the validation study gave written informed consent.

Statistical Analyses

The present section describes analyses performed on data derived from the validation study. An Exploratory Factor Analysis (EFA) was performed on the 12 items of the first section of the questionnaire, using data from the first completion, in order to assess the number of factors (subscales). The two items of the complementary section were planned to be interpreted separately, therefore they were not included in this analysis. The EFA procedure aims at retaining as few factors as possible while explaining most of the variation in the data. The scree plot⁽³¹⁾ and the modified eigenvalue-greater-than-one rule⁽³²⁾ were used to properly identify the number of factors in this specific section of the questionnaire. Internal consistency reliability was evaluated using Cronbach alpha coefficients with data from the first completion of the questionnaire. The test-retest reliability was assessed using Pearson's correlations between the mean scores of the two completions for each subscale. Because of the questionnaires' random order, there is a possible time interval from two to ten weeks between the two completions. To test the potential influence of this varying delay, partial Pearson's correlation analyses between the two completions, while adjusting for the time interval, were performed. Since data derived from the complementary items are categorical, the test-retest reliability of these items was evaluated using Cohen's Kappa agreement between the two completions. The Kappa coefficients were interpreted as follows: ≤ 0.2 : mediocre; 0.21-0.40: low; 0.41-0.60: moderate; 0.61-0.80: strong; 0.81-1.0: excellent⁽³³⁾. Statistical tests were two-sided and differences or associations at $p < 0.05$ were considered significant. Analyses were performed using the Statistical Analysis Software (SAS) version 9.4 (Copyright © 2013, SAS Institute Inc., Cary, NC, USA).

RESULTS

Pretest

Pilot testing. Three participants did not complete the Perceived Food Environment Questionnaire, comments from 28 participants were therefore considered in the pilot testing. The analyses of participants' answers and comments revealed that all items were well understood and not found to be ambiguous. Therefore, the pilot testing did not lead to changes in the questionnaire.

Validation study

A total of 150 participants were recruited for the validation study. One participant dropped out of the study before completing the questionnaires, and two participants did not complete the Perceived Food Environment Questionnaire. Characteristics of the 147 remaining participants are presented in Table 2. The mean completion time of the questionnaire was 2.3 ± 2.4 minutes.

Exploratory factor analysis. The 12 items of the questionnaire had adequate common variance, justifying the use of an EFA (Bartlett's test of sphericity: $\chi^2 = 356.14$, $p < 0.0001$; Kaiser–Meyer–Olkin measure of sample adequacy = 0.71⁽³⁴⁾). The analysis revealed that two factors should be considered for the set of items, accounting respectively for 73.7% and 17.5% of the variance. In order to obtain simple and interpretable factors, and since factors were not expected to covary, an orthogonal varimax rotation was used. Using a minimum loading cut-off of 0.30 or higher⁽³⁵⁾, three items did not load on any factor, and were therefore removed from the questionnaire (see Table 1). With this factor structure, six items loaded strongly on the first factor (see Table 1), and it was decided that the factor would be named “accessibility to healthy foods”. The second factor was named “accessibility to unhealthy foods” since three items pertaining to fast-food restaurant and junk foods at work loaded strongly on it (see Table 1).

Internal consistency reliability. Both subscales are considered internally reliable, with Cronbach alphas coefficient of 0.77 for the “accessibility to healthy foods” subscale and 0.62 for “accessibility to unhealthy foods” subscale.

Test-retest reliability. A test-retest reliability analysis was performed using data from participants who completed the scale twice (74 women and 71 men). Pearson's correlation coefficient between scores for the two completions for both subscales was calculated and revealed adequate reliability ($r = 0.59$ and $r = 0.60$, respectively for the “accessibility to healthy foods” and the “accessibility to unhealthy foods” subscales; $ps < 0.0001$). The mean time lapse between test and retest was 40.4 ± 11.8 days (range: 14 to 99 days). The Pearson's coefficients remained similar when adjusted for time lapse between the two completions ($r = 0.59$ and $r = 0.60$, respectively; $ps < 0.0001$). As shown in Table 3, weighted Cohen's

Kappa analyses revealed moderate agreement between the two completions for the two complementary items of the questionnaire.

DISCUSSION

The purpose of the present study was to develop and validate a questionnaire assessing perceived food environment in a French-Canadian population, more specifically assessing the perception of the access to healthy and unhealthy foods. A new questionnaire was developed because of three major issues of the existing questionnaires which made them unsuitable for our needs. First of all, to our knowledge, only two of the existing questionnaires were subject to a validation process^(16, 21). Second, only few existing questionnaires assess both access to healthy and unhealthy foods, and none of them was validated. And third, to our knowledge, no such questionnaire currently exists for French-speaking populations. Therefore, the questionnaire developed and validated in the present study addressed an important gap in this area of research. Other authors have generally assessed either access to healthy foods or to fast food using one to four non-validated items^(9, 12, 15, 17, 20, 26, 28, 36, 37). Mujahid et al.⁽²¹⁾ have validated a three-item availability to healthy foods questionnaire, measuring the internal consistency and the test-retest reliability of the scale. However, items were limited to the availability and the quality of fruit and vegetables, and to the variety of low-fat products in the neighborhood. Dibsdall et al.⁽¹⁶⁾ also proceeded to a complete validation of their 30-item scale assessing accessibility, affordability, and motivation to eat fruit and vegetables, with methods that are similar to the ones used in this study, such as the EFA and Cronbach alpha analyses. However, the length of the questionnaire, the fact that it was designed for low-income groups, and the numerous items pertaining to motivation are some of the reasons why we developed a new questionnaire instead of translating this validated one.

The questionnaire we developed assessed participants' perception of their environment, rather than assessing the environment using objective measures. According to Mujahid et al.⁽²¹⁾, one of the limitations of assessing participants' perception on the conditions in their neighborhood is the potential bias related to some personal characteristics (e.g. socioeconomic status, grocery shopping habits). However, Giskes, Van Lenthe, Brug et al.⁽³⁸⁾ and Williams et al.⁽¹⁷⁾ found that perceived availability and price of foods were associated with purchase or consumption of those foods whereas objective measures were not. Behaviors may be more likely to be influenced by an individual's perception of its environment than by the actual environment itself⁽³⁸⁾, since perceptions include notions of noticing and

understanding. Moreover, measuring perceptions is easier and less time consuming than objectively describing food environments in participants' neighborhood, particularly in large research projects where participants come from different geographical regions. Besides, Freedman and Bell ⁽³⁹⁾ observed that participants' perceptions did not significantly differ from objective measurements in terms of availability of healthy foods, suggesting similarities between results obtained from both measures. We believe that our questionnaire will help document the role of perceptions of the food environment in predicting healthy dietary habits and eating behaviors. Paired with questionnaires assessing other potential determinants of healthy eating, this newly developed tool will eventually enable the investigation of how perceived environment interacts with other factors in predicting successful adherence to dietary recommendations.

An EFA was performed on the 12 items of the main questionnaire (i.e. excluding items of the complementary section) in order to verify whether these items should be divided into different subscales, given that different concepts are assessed (e.g. variety/quality/affordability in the main food retailer, access to healthy foods at the workplace, access to fast-food restaurant). The EFA revealed a two-factor structure, accounting for more than 91% of the variance. This structure reflects the fact that items related either with perceived access to healthy or unhealthy foods. Cronbach alpha confirmed that both subscales were internally reliable. The calculation of mean subscale scores will facilitate the use of data derived from the questionnaire. However, since the items cover different concepts, it will also be possible to use items separately according to different research questions to be addressed, and to allow comparison with results from other studies, where tools generally assess availability, accessibility, and affordability with distinct items. The EFA led to the removal of three items pertaining to access to healthy foods at work, kitchen equipment, and availability of healthy foods at home. It is possible that the latter item did not load on any factor given that the home environment reflects a decision that individuals have already taken, which is to buy healthy foods and to bring them home.

In the present study, the test-retest reliability was assessed in two ways according to the nature of the data (i.e. numerical or categorical). Measures of the two subscales of the questionnaire correlated strongly when repeated in time, which is similar to results obtained elsewhere ⁽²¹⁾. The adjustment for the time lapse between the two completions did not influence the strength of the association, suggesting that the perceived food environment concept is stable at least over a one- to two-month period. For the two complementary items of the questionnaire, the weighted Cohen's Kappa coefficient showed moderate agreement between the two completions, once again suggesting a good stability over time.

Strengths and limitations

A major strength of this study is the fact that it was designed expressly for the validation of questionnaires. Two different samples, one for the pretest and one for the validation study, were recruited to assess the different steps using a rigorous validation process. Also, to our knowledge, this study led to the development of the first validated questionnaire assessing perceived accessibility to both healthy and unhealthy foods.

The main limitation of this study is its mostly Caucasian and highly educated sample, which is not representative of the whole French-Canadian population ⁽⁴⁰⁾. The fact that participants for the pretest were recruited from a list of individuals interested in participating in clinical studies constitutes another limitation since their interest in nutrition may influence their perceptions and behaviors. These sample characteristics limit the external validity of the questionnaire. Further validation is needed for uses in different populations.

CONCLUSION

The aim of this study was to develop and validate the Perceived Food Environment Questionnaire, which is, to our knowledge, the first validated tool assessing perceived accessibility to both healthy and unhealthy foods. The questionnaire demonstrated good psychometric properties and is thus considered as a valid and reliable tool for the French-speaking Canadian population. This questionnaire will help document the role of the perceived food environment and its interaction with other factors in predicting healthy dietary habits and eating behaviors.

Table 1. Questionnaire items

Items	Factor loading	
	Accessibility to healthy foods	Accessibility to unhealthy foods
1. I consider that the quantity of healthy foods offered by my main food retailer is sufficient.*	0.83	--
2. I consider that the variety of healthy foods offered by my main food retailer is sufficient.*	0.85	--
3. I consider that the quality of healthy foods offered by my main food retailer is acceptable.*	0.81	--
4. I consider that the cost of healthy foods offered by my main food retailer is affordable.*	0.41	--
5. I consider that I have easily access to a food retailer with a good variety of foods near my home.*	0.51	--
6. I consider that I have easily access to healthy foods at work.*	--	--
7. I consider that I possess the necessary equipment in order to integrate healthy foods to my meals.*	--	--
8. I consider that healthy foods are always available at home.*	--	--
9. I consider the information in the media about food and nutrition positively influences my diet. *	0.35	--
10. I consider that fast-food restaurants are easily accessible from my home.*	--	0.63
11. I consider that fast-food restaurants are easily accessible from my workplace.*	--	0.60
12. I consider that I have easily access to junk foods at work.*	--	0.60
<u>Complementary questions</u>	n/a	n/a
1. How much time does it take to get from home to your main food retailer by car? †		
2. How much time does it take to get from home to your main	n/a	n/a

food retailer on foot? †

Note: The French version of the instrument was validated. All items were translated from French to English using the back-translation procedure, and should not be used in their English version without validation.

* Response scale: a) Strongly disagree; b) Somewhat disagree; c) Neither agree or disagree; d) Somewhat agree; e) Strongly agree; f) Not applicable. The “not applicable” option is proposed only for items pertaining to the workplace.

† Response scale: a) Less than 10 minutes; b) From 10 to 20 minutes; c) More than 20 minutes.

Table 2. Validation study sample characteristics (n=147)

	n (%)
Female	74 (50.3)
Age (y)	
18-34	37 (25.2)
35-49	29 (19.7)
50-65	81 (55.1)
Ethnicity	
Caucasian	140 (95.2)
Education	
High school	14 (9.5)
College	45 (30.6)
University	88 (59.9)
Occupation	
Worker	100 (68.0)
Retired	32 (21.8)
Student	9 (6.2)
No job	3 (2.0)
Prefer nor to answer	3 (2.0)
Household annual income	
<40 000\$CA	26 (17.7)
40 000-79 999\$CA	47 (32.0)
≥80 000\$CA	62 (42.2)
Prefer nor to answer	12 (8.1)

Table 3. Weighted Cohen's Kappa

Items	Weighted Cohen's Kappa
Complementary questions	
Travel time from home to the food retailer on foot	0.59
Travel time from home to the food retailer by car	0.59

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