Difficulty buying food, BMI, and eating habits in young children

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ABSTRACT

OBJECTIVES: To determine whether parent report of difficulty buying food was associated with child body mass index (BMI) z-score or with eating habits in young children.

METHODS: This was a cross-sectional study in primary care offices in Toronto, Ontario. Subjects were children aged 1–5 years and their caregivers, recruited through the TARGet Kids! Research Network from July 2008 to August 2011. Regression models were developed to test the association between parent report of difficulty buying food because of cost and the following outcomes: child BMI z-score, parent's report of child's intake of fruit and vegetables, fruit juice and sweetened beverages, and fast food. Confounders included child's age, sex, birth weight, maternal BMI, education, ethnicity, immigration status, and neighbourhood income.

RESULTS: The study sample consisted of 3333 children. Data on difficulty buying food were available for 3099 children, and 431 of these (13.9%) were from households reporting difficulty buying food. There was no association with child BMI z-score ($p = 0.86$). Children from households reporting difficulty buying food (compared with never having difficulty buying food) had increased odds of consuming three or fewer servings of fruits and vegetables per day (odds ratio [OR]: 1.31, 95% confidence interval [CI]: 1.03–1.69), more than one serving of fruit juice/sweetened beverage per day (OR: 1.60, 95% CI: 1.28–2.00), and, among children 1–2 years old, one or more servings of fast food per week (OR: 2.91, 95% CI: 1.67–5.08).

CONCLUSION: Parental report of difficulty buying food is associated with less optimal eating habits in children but not with BMI z-score.

KEY WORDS: Child; obesity; diet; poverty; food supply

La traduction du résumé se trouve à la fin de l'article.

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Childhood obesity is an important public health problem, and a growing body of research seeks to explore the ways in which social factors contribute to childhood obesity and eating behaviours. Food security is defined by the United Nations' Food and Agriculture Organization as a state "when all people, at all times, have physical, social and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life".¹ Food security is most commonly measured in Canada using the 18-item Household Food Security Survey Model (HFSSM),² which is based upon the United States Department of Agriculture 18-item Food Security Module.³ The Canadian Community Health Survey (CCHS), which tracks food security in Canada, reported that, in 2012, 8.2% of households in Canada were food insecure, with 4.9% of children experiencing moderate or severe food insecurity; the rate of food insecurity increased to 10.8% for households with children under six years of age.⁴ The most recent prevalence of food insecurity reported, also using data from the CCHS, was 12.0% in 2014 in participating provinces and territories.⁵ Household food insecurity has been associated with multiple nutritional risk factors that may be associated with obesity in toddlers, including lower fruit and vegetable intake^{6,7} and higher sugar-sweetened beverage intake,⁷ as well as lower levels of physical activity and higher screen time in young children.⁸ Poverty has shown similar associations with nutritional risk.⁹ Recent studies have also indicated that food insecurity may lead to obesogenic feeding behaviours, such as restriction of food and pressure to eat, in infants.¹⁰ However, studies examining food insecurity as a predictor of obesity in young children have shown conflicting results.¹¹

While some studies have examined food insecurity in the US using national-level data, research specific to the Canadian population is important, as mechanisms of public income and

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nutrition assistance differ between Canada and the US: in Canada, public assistance is typically in the form of direct income assistance, whereas the US offers specific financial assistance for the purchase of food. These differences have potentially important implications for the role that food insecurity may play in childhood nutrition. A recent study by Kirpatrick et al. indicated that household food insecurity was a stronger marker of inadequate nutrient intake among Canadian adult and youth than in the US,¹² emphasizing the importance of studying the Canadian population. There is evidence that Canadian children, overall, are not meeting food guide recommendations for fruits and vegetables, and are consuming a substantial portion of their fruits and vegetables (32%–41%) as juice.¹³ The impact of food insecurity on eating habits in young children in Canada has been relatively understudied.

The primary objective of this study was to examine whether parent report of difficulty buying food, a potential marker of food insecurity, was associated with body mass index (BMI) z-score in children aged 1–5 years of age. The secondary objective was to examine the association between difficulty buying food and less optimal eating habits (low fruit and vegetable consumption, high fruit juice and sweetened beverage intake, and high fast-food intake). We hypothesized that parent report of difficulty buying food would be associated with increased BMI z-score and increased unhealthy eating habits in young children.

METHODS

Design, subject recruitment, and data collection

This was a cross-sectional study of children 1–5 years of age attending routine well-child visits recruited through the TARGetKids! primary care practice-based research network in Toronto, Canada. Participants in this study were recruited between July 2008 and August 2011 by trained research personnel on site at nine primary care paediatric and family medicine practices in urban Toronto. Children with health conditions affecting growth, children with a chronic condition (except for asthma), children born prematurely (<34 weeks' gestational age), children with severe developmental delay, and children whose families could not complete data collection in English were excluded from the study. Study personnel administered two questionnaires: the Nutrition Screening Tool for Every Preschooler questionnaire (NutriSTEP™),¹⁴ a reliable parent-administered, 17-item nutrition screening tool that has been validated in Canada in multiple populations of young children (ages 3 and 5 years); and the TARGet Kids! Nutrition and Health Questionnaire (NHQ), which is based on the Canadian Community Health Survey.¹⁵ Child weight was measured using a precision digital scale (SECA, Germany), standing height was measured using a stadiometer (SECA), and length was measured with a length board, using standardized methods.¹⁶ This study was approved by the Research Ethics Board at the Hospital for Sick Children and St. Michael's Hospital, and all parents consented to their children participating in the study.

Exposure and outcome measures

The primary exposure variable for this study was mother report of difficulty buying food, measured by response to the following

single statement from the NutriSTEP™ questionnaire: "I have difficulty buying food to feed my child because food is expensive" with the following response options: most of the time, sometimes, rarely, never.¹¹ No difficulty buying food was indicated by a response of "never"; all other responses were considered to indicate some difficulty buying food. Our research group has shown that an affirmative response to this question had a sensitivity of 84.9% and a specificity of 91.2%, compared with the Household Food Security Survey 2-item questionnaire,¹⁷ which has been shown to have high sensitivity and specificity compared with the complete US 18-item Household Food Security Survey.¹⁸ The study's primary outcome was the child's BMI z-score. BMI was calculated as the weight in kilograms divided by the height (or length) in metres squared,^{19,20} measured using the World Health Organization (WHO) growth standards. The WHO growth standards were selected as they are meant to reflect optimal growth in children and are recommended for use in this age group in Canada.²¹

Eating habits were assessed using the following statements from the NutriSTEP™ questionnaire: *My child usually eats fruit and my child usually eats vegetables: More than 3 times/day, 3 times/day, 2 times/day, once a day, not at all.* Fruit and vegetable intake was combined and then dichotomized to greater than or equal to four servings per day and fewer than four servings per day. *My child usually eats fast food: 4 or more times/week, 2 to 3 times/week, once a week, a few times a month, once a month or less.* This was dichotomized to fewer than one serving per week and greater than or equal to one serving per week. Fruit juice and sweetened beverages was measured using a question from the NHQ¹⁵: *How many cups of each drink your child has currently in a typical day: 100% Juice, sweetened drinks 0, 1/2, 1, 2, 3, 4, 5+.* This was dichotomized to less than one cup (8 oz) or greater than or equal to one cup.

Exposure and outcome measures were identified a priori based on the existing literature, and eating habit variables were dichotomized according to current Canadian nutritional guidelines. Canada's Food Guide recommends 4–5 servings of fruits and vegetables per day, and no more than 1 serving (4 oz) of fruit juice per day.²² Our cut-points for these variables were chosen to reflect a minimum acceptable intake of fruits and vegetables, and maximum of both fruit juice and sweetened beverages. While Canada's food guide does not place a limit on the amount of fast food, we dichotomized this variable to be comparable with other similar studies.²³ Covariates were identified a priori according to a review of the literature and were child's age, sex, birth weight, maternal BMI, maternal education, maternal ethnicity, maternal immigration status, neighbourhood income, and juice and sweetened beverage intake. Maternal ethnicity was collected using a geographically based ethnicity question and questions from the Canadian Census.²⁴ The immigration status of the mother was classified as non-immigrant, immigrated <10 years ago, or immigrated ≥10 years ago, given the studies showing a decline in health status in the years following immigration to Canada.²⁵ Using the Postal Code Conversion File, the median income for the neighbourhood of each family was measured by linking the family's six-digit residential postal code to Statistics Canada 2006 census tract income data. "Neighbourhood-level income" was defined as the median income for the dissemination area in which the family lived. Dissemination areas were used

because they are the smallest geographic units, composed of 400–700 household units, for which census data are reported.²⁶

Statistical analysis

Descriptive statistics were performed to describe exposure and outcome variables, including parent report of difficulty buying food, BMI z-score, and eating habit variables by age and sex. Primary analysis categorized the exposure measure, difficulty buying food, as any response other than “never”. To assess our primary outcome, a 2-sample *t* test was performed to test the association between difficulty buying food and BMI z-score. A multivariable linear regression model was developed to assess the independent effect of difficulty buying food on BMI z-score, adjusting for potential confounding variables, which were age, sex, mother’s BMI, birthweight, maternal education, immigration status and ethnicity, neighbourhood income, and juice and sweetened beverage intake, included as a potential confounder because of its association with BMI z-score in previous analyses.

To assess our secondary outcomes, three multiple logistic regression models were developed, adjusting for age, sex, mother’s BMI, birthweight, maternal education, immigration status and ethnicity, and neighbourhood income. Exploratory analyses were also undertaken using logistic regression, as above, with three categories of difficulty buying food: never, rarely, and sometimes/often. All variables were a priori specified to avoid the potential bias of low standard errors, small *p* values, and inflation of *R*².²⁷ The interaction between difficulty buying food and age was identified a priori and tested in all models. We assumed the data

were missing in an uninformative manner and therefore fit the missing at random criteria. We used multiple imputation methods with predictive mean matching to analyze data for all variables except for BMI z-score, our primary outcome.²⁸ Multi-collinearity was not significant when we examined it using correlation matrices and variance inflation factors.²⁹ R version 2.15.1, with updates from R 3.03, was used for this analysis.³⁰

RESULTS

Study population

There were 3620 parents of children 1–5 years of age who consented to participate; of their children, 3333 (92%) had a measured height and weight and were included in the study. Excluded from the analysis were 34 children >5 years of age at the time of data collection, 2 children with duplicate entries, and 1 child with missing subject identification. Data on difficulty buying food were available for 3099 children; 431 (13.9%) of the children were from households in which a parent reported having difficulty buying food (see Table 1). Compared with those reporting no difficulty buying food, children with parents reporting difficulty were statistically significantly older, had a lower neighbourhood income, lower maternal education level, higher likelihood of having immigrated to Canada, non-European ethnicity, and a higher maternal BMI.

Difficulty buying food and BMI z-score

In the unadjusted and adjusted analysis, there was no association between difficulty buying food and BMI z-score (*p* = 0.18).

Table 1. Baseline characteristics of study participants experiencing no difficulty and any difficulty buying food*

Subject	No difficulty	Any difficulty	<i>p</i> value
<i>N</i> = 3099 [†]	2668	431	
<i>Continuous: mean (SD)</i>			
Child age in months	28.7 (15.7–48.5) [‡]	36.8 (18.7–49.8) [‡]	<0.001
Birth weight (kg)	3.2 (0.6)	3.1 (0.6)	0.4
Neighbourhood income (\$10,000 CAD)	6.3 (2.7)	5.3 (2.1)	<0.001
Maternal BMI (kg/m ²)	24.8 (4.8)	26.1 (5.1)	<0.001
<i>Categorical: n (%)</i>			
Sex			0.03
Male	1346 (50.4)	242 (56.1)	
Female	1212 (49.6)	188 (43.9)	
Maternal education			<0.001
College	2391 (89.6)	320 (74.2)	
High school/grade school	210 (7.8)	99 (23.0)	
Maternal immigration status			<0.001
Born in Canada	1790 (67.1)	213 (49.4)	
Immigrant to Canada ≥10 years	409 (15.3)	76 (17.6)	
Immigrant to Canada <10 years	415 (15.6)	131 (30.4)	
Maternal ethnicity			<0.001
European	1993 (74.7)	237 (55.0)	
Latin American	104 (3.9)	21 (4.9)	
South/Southeast Asian	221 (12.1)	83 (19.2)	
East Asian	178 (6.7)	39 (9.0)	
Other	45 (1.7)	9 (2.1)	
Child weight status (z score: BMI SD) [§]			0.23
Underweight	46 (1.7)	11 (2.5)	
Normal weight	2085 (78.1)	319 (74.0)	
Overweight	417 (15.6)	77 (17.9)	
Obese	120 (4.5)	24 (5.5)	

* For continuous variables the test of association was an independent samples *t* test and for categorical variables the chi-square test or non-parametric equivalent.

[†] *N* = 3099: table excludes individuals missing data on difficulty buying food.

[‡] Median and interquartile range, Mann–Whitney test of association.

[§] SD, according to WHO Growth Standards; underweight defined as ≥2 SD below the mean, normal weight between –2 and 1 SD, overweight 1–2 SD, and obese ≥2 SD above the mean.

Table 2. Difficulty buying food and BMI z-score: Linear regression model*

Variable	Estimate (SE)	p value
Difficulty buying food: any [†]	0.01 (0.05)	0.86
Age (months)	0.01 (0.001)	<0.0001
Sex – male	0.05 (0.05)	0.16
Maternal BMI (kg/m ²)	0.03 (0.003)	<0.0001
Child birth weight (kg)	0.25 (0.03)	<0.0001
Maternal education (high school) [‡]	0.05 (0.05)	0.46
Maternal immigration (≥10 years) [§]	–0.07 (0.05)	0.18
Maternal immigration (<10 years) [§]	0.03 (0.05)	0.67
Maternal ethnicity		
Latin American	0.11 (0.1)	0.27
South/Southeast Asian	–0.21 (0.07)	0.002
East Asian	–0.12 (0.07)	0.09
African	0.07 (0.10)	0.54
Other	–0.13 (0.13)	0.39
Neighbourhood income [¶]	0.0003 (0.007)	0.97
Juice and sweetened beverage intake**	0.13 (0.04)	0.001

* Model $R^2 = 0.072$.

[†] Compared with no difficulty buying food.

[‡] Compared with some college or greater.

[§] Compared with non-immigrant.

^{||} Compared with European ethnicity.

[¶] For an increase of \$10,000 CAD.

** <1 serving compared with ≥1 serving.

After adjustment for confounders, there was no association demonstrated ($p = 0.87$), and there was no interaction by age (see Table 2). There was similarly no association between the three levels of difficulty buying food and BMI z-score. Our adjusted model showed that age, parental BMI, child birth weight, Southeast Asian ethnicity, and juice and sweetened beverage intake were statistically significantly associated with child BMI z-score.

Difficulty buying food and eating habits

Difficulty buying food was associated with each of the three eating habit outcome measures (see Table 3). After adjustment for age, sex, maternal education, ethnicity and immigration status, and neighbourhood income, compared with children from households without difficulty buying food, children from households reporting any difficulty buying food had increased odds of consuming three or fewer servings of fruits and vegetables per day (odds ratio [OR]: 1.31, 95% confidence interval [CI]: 1.03–1.69)

Table 3. Association of eating habits with any difficulty buying food*

Outcome [†]	Odds ratio	95% confidence interval
Fruit/vegetable ≤3 servings/day	1.3	1.03–1.7
Juice/sweetened beverages ≥1 cup/day	1.6	1.3–2.0
Fast food ≤2 [‡] years of age ≥1 serving/week [§]	2.9	1.7–5.1
Fast food >2 years of age ≥1 serving/week	1.1	0.8–1.4

* Compared with no difficulty buying food.

[†] Each model was adjusted for child age, sex, maternal education, maternal immigration status, maternal ethnicity, and neighbourhood income.

[‡] This age category includes children from 1 to 2 years of age.

[§] Stratified because of interaction.

Table 4. Association of eating habits with difficulty buying food rarely or sometimes/often*

Outcome	Rarely [†]	Sometimes/often [†]
	OR (95% CI)	OR (95% CI)
Fruit/vegetable ≤3 servings/day	1.22 (0.91–1.63)	1.54 (1.04–2.30)
Juice/sweetened beverages ≥1 cup/day	1.47 (1.13–1.91)	1.98 (1.32–2.97)
Fast food ≤2 [‡] years of age ≥1 serving/week [§]	2.88 (1.54–5.38)	2.98 (1.22–7.29)
Fast food >2 years of age ≥1 serving/week	1.03 (0.73–1.44)	1.14 (0.71–1.84)

* Each model was adjusted for child age, sex, maternal education, maternal immigration status, maternal ethnicity, and neighbourhood income.

[†] Compared with no difficulty buying food.

[‡] This age category includes children from 1 to 2 years of age.

[§] Stratified because of interaction.

and of consuming greater than or equal to one serving of sweetened beverages per day (OR: 1.60, 95% CI: 1.28–2.00). A significant interaction between difficulty buying food, fast-food intake, and age was identified, and we have therefore stratified fast-food intake according to age. Compared with children between 1 and 2 years of age who were from households without difficulty buying food, children from households reporting any difficulty buying food had increased odds of consuming greater than or equal to one serving of fast food per week (OR: 2.91, 95% CI: 1.67–5.08). No significant relationship between difficulty buying food and fast food was identified for children older than two years of age (OR: 1.06, 95% CI: 0.79–1.42). For all eating habit variables, analysis using three levels of difficulty buying food (never, rarely, and sometimes/often) showed similar results (see Table 4).

DISCUSSION

In this cross-sectional study of children 1–5 years old, we did not identify an association between parent report of difficulty buying food and BMI z-score. However, we did identify a significant association between difficulty buying food and three obesity-related eating habits: decreased fruit and vegetable intake, increased fruit juice and sugar-sweetened beverage intake, and increased fast-food intake in children between 1 and 2 years of age. These findings were persistent across all levels of difficulty buying food. Our study results are consistent with several large studies in the US and with the findings of a systematic review performed by Eisenmann et al., which found a mix of positive, negative, and no association between food insecurity and childhood overweight and obesity.¹¹ Our multivariable model did identify expected predictors of higher BMI, including maternal BMI and child birth weight. However, it is possible that an association between food insecurity and obesity may only emerge over time and our population may be too young to see an association. It is also possible that more severe food insufficiency is associated with obesity,³¹ and our study did not capture a population that reflects this level of severity. Studies suggest that caregivers in food insecure households will compromise their nutrition to protect young children from the effects of food insecurity.³² Our findings that households with older children and male children were more likely to report

difficulty buying food may indicate increased nutritional needs that caregivers are concerned about fulfilling, or they may indicate that these factors affect caregiver perception of their food situation.

Our results suggested that young children of parents who report difficulty buying food have reduced intake of healthy foods such as fruit and vegetables, and increased intake of unhealthy foods such as fruit juice, sweetened beverages, and fast food. Furthermore, fruit juice and sweetened beverages were also found to be associated with higher BMI z-score in our analyses. There are few other studies that have examined food insecurity or similar measures and eating habits in young children and, to our knowledge, none in a Canadian population. We also found that difficulty buying food was associated with increased fast-food intake only in our participants less than two years of age. More research involving infants and toddlers is needed to better understand how food insecurity may influence infant and toddler feeding and how the eating habits of infants and toddlers differ from those of older children.

Our study adds to the preliminary evidence that food insecurity may contribute to less optimal eating practices in early life and is one of few studies examining eating habits in Canadian pre-school aged children. Much of the literature on this topic comes from large data sets in the US, and while the results are informative we believe that it is particularly important to study the impact of food insecurity on children in Canada, given the differences in early childhood nutrition assistance, with less specifically designated public nutrition funding in Canada.

There are many possible explanations for these observed associations. Studies suggest that energy-dense foods such as fast food and sugar-sweetened beverages cost less per calorie.³³ When resources for food purchase are insufficient, parents may prioritize satiety over all other considerations. There is also early evidence that poverty and food insecurity may affect feeding practices from early infancy, with decreased rates of breastfeeding and higher use of controlling feeding styles, such as pressure on infants to feed and restriction of infant intake.^{10,34} Though children in food insecure households may be protected from hunger as a result of the sacrifices of their caregivers,³² there may still be changes in feeding behaviours that could influence child health. A better understanding of the mechanisms behind these associations, particularly in very young children, may point to targeted nutrition interventions at both the clinical and population health levels.

This study was subject to certain limitations. Given the cross-sectional study design, the causal relationship between difficulty buying food and early childhood eating habits cannot be established. The study sample was drawn from primary care paediatric and family medicine practices in urban Toronto, potentially limiting generalizability to other populations. Additionally, all study assessments were completed in English. This may serve as a meaningful source of selection bias. Our study relied on caregiver self-report of difficulty buying food and eating habits, which may subject this study to recall and reporting bias; furthermore, the version of the NutriSTEP™ questionnaire used was validated only for children between 3 and 5 years of age. A 24-hour dietary recall would have provided more detailed information about eating habits and allowed comparison of mean intake across groups. Furthermore, our chosen cut-points for

dichotomizing these categorical variables may limit the generalizability of our findings. We did not collect data using the 18-item HFSSM or the US Department of Agriculture 18-item food security survey, which are the standard measures of food security. Though our study addresses parent-reported difficulty buying food, our results may not be readily comparable with the results of studies that measure food security using the 18-item survey. We also did not include a measure of physical activity or screen time, day care or school attendance, or a measure of family structure, which may be important predictors of obesity and nutrition and which may vary with age. Neither did we include a measure of past or current breastfeeding. Future studies should explore these as potentially valuable contributors to nutritional status in early childhood.

CONCLUSIONS

Our results provide important information about the ways in which difficulty buying food may influence early eating habits, which may over time contribute to obesity or adverse nutritional outcomes in young Canadian children. Although parent-reported difficulty buying food was not associated with BMI z-score in young children in our study, importantly, it was associated with less healthful eating habits. Future research could help characterize the reasons behind this association, as well as investigate whether the findings are reproducible in other populations. Difficulty buying food, a potential marker of food insecurity, may be an important indicator of nutritional vulnerability in preschool-aged children. Further research and interventions to mitigate its impact at this early stage could provide an opportunity to improve risk factors for adverse nutritional outcomes in this population.

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RÉSUMÉ

OBJECTIFS : Déterminer si la difficulté indiquée par les parents d'acheter des aliments est associée à l'écart Z de l'indice de masse corporelle (IMC) ou aux habitudes alimentaires des jeunes enfants.

MÉTHODE : Il s'agissait d'une étude transversale menée dans des cabinets de soins primaires de Toronto (Ontario). Elle portait sur des enfants de 1 à 5 ans et leurs proches aidants, recrutés par le réseau de recherche TARGeT Kids! entre juillet 2008 et août 2011. Des modèles de régression ont été mis au point pour tester l'association entre la difficulté indiquée par les parents d'acheter des aliments en raison de leur coût et les résultats suivants : l'écart Z de l'IMC des enfants, et la consommation de fruits et légumes, de jus de fruits, de boissons édulcorées et d'aliments de restauration rapide par les enfants selon les parents. Les facteurs confusionnels étaient l'âge, le sexe et le poids de naissance des enfants, l'IMC maternel, l'instruction, l'ethnicité, le statut d'immigration et le revenu selon le quartier.

RÉSULTATS : L'échantillon de l'étude comprenait 3 333 enfants, dont 431 (14,09 %) provenaient de ménages dont les parents disaient avoir de la difficulté à acheter des aliments. Aucune association n'a été observée avec l'écart Z de l'IMC des enfants ($p = 0,86$). Les enfants des ménages disant avoir de la difficulté à acheter des aliments (comparativement à ceux des ménages n'ayant jamais de difficulté à acheter des aliments) présentaient une probabilité accrue de consommer trois portions de fruits et légumes par jour ou moins (rapport de cotes [RC] : 1,31, intervalle de confiance de 95 % [IC] : 1,03–1,69), de consommer plus d'une portion de jus de fruit ou de boissons édulcorées par jour (RC : 1,60, IC de 95 % : 1,28–2,00) et, chez les enfants de 1 à 2 ans, de consommer une portion ou plus d'aliments de restauration rapide par semaine (RC : 2,91, IC de 95 % : 1,67–5,08).

CONCLUSION : La difficulté indiquée par les parents d'acheter des aliments est associée à des habitudes alimentaires sous-optimales chez les enfants, mais pas avec l'écart Z de l'IMC.

MOTS CLÉS : enfant; obésité; régime alimentaire; pauvreté; approvisionnement en nourriture