Women's Dietary Intakes in the Context of Household Food Insecurity[1,2]

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ABSTRACT A study of food insecurity and nutritional adequacy was conducted with a sample of 153 women in families receiving emergency food assistance in Toronto, Canada. Contemporaneous data on dietary intake and household food security over the past 30 d were available for 145 of the women. Analyses of these data revealed that women who reported hunger in their households during the past 30 d also reported systematically lower intakes of energy and a number of nutrients. The effect of household-level hunger on intake persisted even when other economic, socio-cultural, and behavioral influences on reported dietary intake were considered. Estimated prevalences of inadequacy in excess of 15% were noted for Vitamin A, folate, iron, and magnesium in this sample, suggesting that the low levels of intake associated with severe household food insecurity are in a range that could put women at risk of nutrient deficiencies. J. Nutr. 129: 672–679, 1999.

KEY WORDS: • *women* • *food intake* • *food insecurity* • *nutrient deficiency*

Food insecurity, "the limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways" (Anderson 1990), has become a matter of increasing concern among western nations in recent years. The assessment of this construct typically occurs through self-reported appraisals of the adequacy and security of the household food supply and individuals' accounts of their experiences of food deprivation. However, an understanding of the relationship between household or individual-level food insecurity and dietary adequacy is imperative in appraising the consequences of food insecurity for nutritional health and well-being. Some indication that perceived adequacy of the household food supply is related to individual members' dietary intakes has come from observed associations between household food sufficiency status and dietary intake data (Cristofar and Basiotis 1992, Rose and Oliveira 1997) and between household food security status and the available household food supply (Kendall et al. 1995) and dietary intake (Kendall et al. 1996).

A study undertaken to assess food insecurity and nutritional adequacy among women in families who seek emergency food relief (Tarasuk and Beaton, unpublished data) provided an opportunity to examine the relationship between women's dietary intakes and a comprehensive, contemporaneous measure of household food security status. In this paper, women's intakes are examined in relation to reported household food security status and presence or absence of hunger in the household. To examine whether the women's intakes were in a range that suggested possible nutritional problems, the apparent prevalence of nutrient inadequacy was estimated.

METHODS

Participant recruitment and data collection. Participants were recruited on a first come, first served basis when they came to seek food assistance at one of a stratified random sample of 21 of the 77 emergency food hamper programs operating in Metropolitan Toronto. (These are ad hoc, community-based, charitable food programs that function somewhat like the food pantries found in U.S. settings, providing limited quantities of groceries to households in need.) Four strata were constructed from estimates of the total number of people served in each program, agencies were randomly selected from within each stratum, and agency recruitment quotas were set in proportion to the number of people served within each stratum. Women were deemed eligible to participate in this study if they were 19–49 y old, had at least one child under the age of 15 y living with them, were not pregnant, had received emergency food relief at least one other time in the past 12 mo, and spoke sufficient English to participate in oral interviews. Study recruitment occurred from May 1996 to April 1997. Most recruitment took place during the third and fourth weeks of the month, when requests for food assistance are at their peak. A total of 450 women were approached to participate, but 9.6% of these refused to participate and 47.8% were deemed ineligible. Of the 192 women recruited into the study, 23 failed to participate in the first interview, and 16 were subsequently dropped from the study (most because they were later found to be ineligible). A final sample of 153 women was achieved, reflecting a participation rate of 68.3%. No participant was lost to follow up.

Women choosing to participate in this study were assured of absolute anonymity. The interviewer explained that nothing they told her would be shared with workers in food assistance programs, social assistance programs, etc. No data collection occurred in the food assistance agencies. Three interviews were conducted with each participant at a location of her choosing (most commonly the woman's home). The interviews were on nonconsecutive days, typically scheduled on different days of the week (only 4% of women had two or more interviews on the same day of the week), spanning the 3 wk following recruitment. The median time between Interviews 1 and 3 was 16 d (range: 8–76 d), and 95% occurred within a 31-d window. The distribution of interviews by week of month is presented in **Table 1.**

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TABLE 1

Distribution of interviews by week of month[1]

	Proportion of interview held during week		
Week of Month	Interview 1	Interview 2	Interview 3
		%	
1	24	27	12
2	19	29	31
3	15	21	28
4	42	23	29

[1] $n = 3 \times 153$ (interviews × subjects)

At each interview, the participant completed an interviewer-administered 24-h dietary intake recall and questionnaire. The recall method followed standardized procedures, employing portion size models as a way to prompt accurate recall of food quantities (Prince Edward Island Nutrition Survey Project 1996). Interviewers were instructed to record any comments regarding the context surrounding participants' reported intakes (i.e., remarks women made about extenuating circumstances in association with notably low or high food intakes or particularly unusual food consumption patterns). Height and weight were measured at the first interview, using an extendable tape measure and portable, digital Healthometer scale (Continental Scale, Bridgeview, IL), and each participant was asked to describe any recent, perceptible change in weight. Data on household demographics, perceived health, health-related behaviors, food acquisition and provisioning practices, and household food insecurity were also collected. Food insecurity was assessed at the third interview using the 30d scale items from the USDA Food Security Module (Hamilton et al. 1997a) with minimal modifications for use in a Canadian context, and omitting one question about perceived weight loss attributed to lack of food. The study protocol was approved by the Human Subjects Review Committee at the University of Toronto.

The 24-h dietary recall data were converted into total energy and nutrient intakes using the 1996 version of the Canadian Dietary Information (CANDI)[4] System for food intake analysis (Nova Scotia Heart Health Program et al. 1993). This system is based on food composition data from the Canadian Nutrient File, supplemented with additional recipes constructed de novo or obtained from the USDA. Although nutrient intakes from supplements were recorded, these data were not included in the analyses of nutrient intakes because, although 19 women (12%) reported using nutrient supplements during one or more recall days, usage appeared inconsistent.

In examining the quality of dietary data collected in this study, extreme observations were initially checked for data entry or processing errors. Once these sources of error had been eliminated, the interviewers' notes on the recall days were reviewed. Their recordings of circumstances associated with many of the extreme intakes that were observed lent plausibility to these reports. (For example, some individuals who recalled extremely low intakes during the previous 24 h linked their consumption to specific personal or family crises or to extreme food shortages on those days.) The development of decision rules for the exclusion of any particular participants' dietary data from analysis because of concerns about validity was thwarted by this recognition of the reported context associated with extreme intakes. The application of recently proposed cut-off values to identify underreporters (Goldberg et al. 1991) was rejected because of concerns about the appropriateness of the underlying assumptions (discussed more fully later). Consequently, all reported dietary data were included in the analyses described here.

Statistical methods. All statistical analyses were performed using SAS/PC Version 6.10 for Windows (SAS Institute, Cary, NC). Stratification effects were not accounted for in any of the analyses presented here because analyses of variance revealed no differences in key variables (i.e., measures of household food security status) across strata.

Analysis of relationship between household food insecurity and dietary intake. A categorical variable with three levels was constructed to denote the severity of household food insecurity over the past 30 d, using scaling methods developed by Hamilton et al (1997b) for analysis of the USDA Food Security Module. Severity of food insecurity is defined in terms of the frequency and duration of food deprivation reported for adults and children over the time frame of interest. Households classified as food insecure with moderate hunger are those that reported reduced food intake among adult members to an extent that implies adults had repeatedly experienced the physical sensation of hunger, but did not report such reduced food intakes among the children. Households classified as food insecure with severe hunger are those reporting reduced food intake to an extent that implies the children have experienced actual physical hunger; adults have repeatedly experienced more extensive reductions in food intake at this stage (Hamilton et al. 1997a). Unlike with the 12-mo scale, the 30-d scale does not include a sufficiently broad range of questions to permit differentiation between less severe levels of food insecurity; thus households not classified as food insecure with moderate or severe hunger are merely classified as having no hunger evident.

Analysis of variance approaches (PROC GLM) were used to explore relationships between intake variables and household food security status, including only women who had completed all three 24-h recalls within a 31 d time span ($n = 145$). To examine differences in nutrient intake while controlling for quantitative differences in the total amount of food consumed, these analyses were repeated with nutrient intakes expressed as ratios of total energy (nutrients per MJ, with ratios calculated for each 24-h period and then averaged over the 3 d). Because extreme departures from normality can bias the results of F-tests (Neter et al. 1985), nutrient intake variables were screened through a visual inspection of normal probability plots and computation of the Shapiro-Wilk Statistic to assess normality. Where departures from normality were detected, data were transformed to better approximate a normal distribution using power transformations, and the analyses of variance tests rerun. In these cases, means and standard deviations are presented using the untransformed data and test statistics using transformed data, although it should be noted that the impact of the transformations on the conclusions from these analyses was trivial.

To examine the quantitative effect of hunger in the household on women's intakes while controlling for other possible influences on dietary intake, single-equation multivariate regression analyses were performed using PROC REG. In these analyses, 3-d mean energy and nutrient intakes were the dependent variables, and the independent variables included a measure of severity of household food insecurity over the past 30 d as well as variables describing household-level disposable income for the month and characteristics of the individual woman found to have some influence on dietary intake levels within this sample. The variables included were those that showed some association with at least one of the intake variables in prior univariate analyses. They encompass social structural factors, family status, and smoking behavior–all variables demonstrated to affect food behavior among adult women in other studies (Bolton-Smith et al. 1991, Ghadirian and Shatenstein 1996, Hulshof et al. 1991, Lee 1990, Roos et al. 1998, Whichelow et al. 1991). A dichotomous variable was constructed to differentiate between households reporting hunger (including both moderate and severe hunger classifications together) and those where no hunger was apparent (the reference category). The decision to collapse the two hunger categories for these analyses arose because post-hoc least-squares means comparisons of energy and nutrient intakes across food security categories (not presented here) revealed few differences between the intakes of women in these groups; rather the primary differences appeared between women in households with and without hunger. Dichotomous variables were also included in the regression models for woman's level of education (high school education or less versus some post-secondary education), woman's current smoking status, presence of a partner in the house-

[4] Abbreviations used: BMI, Body mass index, kg/m^2; BMR_{est}, Estimated basal metabolic rate; CANDI, Canadian Dietary Information; CV, coefficient of variation; EI, Individual's mean energy intake; EI:BMR_{est}, Ratio of energy intake to estimated basal metabolic rate.

hold, presence of employment income, and ethnoracial identity (represented by three variables: the first denoting blacks, the second denoting Latin Americans, and the third denoting other non-whites; whites were represented by a value of zero on all three variables). To estimate the amount of disposable income available for food and other necessities, after-shelter income (i.e., reported income minus costs paid for rent and basic utilities for the month) was adjusted for family size and composition by expressing this amount as a ratio of total daily energy requirement estimates for the family (Gibney and Lee 1993), using current age- and sex-specific estimates of average energy requirements (Scientific Review Committee 1990). An examination of the results of a series of diagnostic tests for collinearity in PROC REG indicated that multicollinearity was at most a minor source of error in the parameter estimates derived from these regression models. Lastly, to elucidate the impact of controlling for these variables on the apparent effect of hunger on intake, a simple regression model was run that omitted all independent variables except hunger, and the resultant coefficients were compared with those from the multivariate models.

Examination of relationship between energy intake, estimated energy expenditure, and hunger. To further explore the relationship between the reporting of dietary intake and household food insecurity status over a 30-d period, women's reported mean energy intakes (EI[1]) were expressed as a ratio of their estimated basal metabolic rate (BMR_{est}) (Schofield 1985). Using this ratio ($EI:BMR_{est}$), Goldberg et al. (1991) have proposed a method to estimate minimum plausible levels of intakes among normal, healthy, free-living adults for use in evaluating self-reported energy intake data. The energy intake level required for energy balance is believed to be 1.55 times the BMR, given average physical activity levels among a normal, sedentary population. The 95th percentile lower cut-off value for $EI:BMR_{est}$ is estimated by applying a number of assumptions about the magnitude and nature of variation in observed $EI:BMR_{est}$. The variation is comprised of three components estimated by Goldberg et al. (1991): a 23% within-person coefficient of variation (CV) for energy intake, an 8% CV in individual values of BMR relative to the predicted value based on the Schofield equations (Schofield 1985), and a 12.5% CV in individuals' physical activity levels. Following this approach and adjusting for the fact that our intake estimates are based on 3 d of data per individual, the Goldberg cut-off value for $EI:BMR_{est}$ for individuals in this study was calculated to be 1.04 (Goldberg et al. 1991). The odds of falling below this cut-off value, given reported household food insecurity with hunger (grouping moderate and severe hunger classifications together) was calculated using PROC LOGISTIC ($n = 145$).

Assessment of nutrient adequacy. The analysis of nutrient adequacy was conducted using the probability approach (Beaton 1994, National Research Council 1986). Although the precise nutrient requirement of any one individual is unknown, if the average requirement can be estimated and the distribution of requirements reasonably assumed, then the likelihood that any observed intake is inadequate to meet the needs of a randomly selected individual can be estimated. When this is done for each observation in the group or population and the probabilities averaged, the result is an estimate of the likely prevalence of inadequate intakes in the group or population as a whole. It should be noted that the approach does not categorize any one individual as having an adequate or inadequate intake. It is reliable only as an approach to assessing the group or population.

Prior to this assessment of nutrient adequacy, the observed distribution of intakes for each nutrient of interest was adjusted to estimate the distribution of usual intakes. Using analysis of variance (PROC GLM), the observed variance was partitioned into between- and within-subject components, and the data were screened for systematic differences among the 3 d of intake for each participant, a linear sequence effect, day of week effects, and the effect of the receipt of food assistance or income support (generally reported as a monthly social assistance check or salary payment). The only finding was a significant sequence effect for protein. The distribution of usual intakes among this sample was estimated using SIDE, version 1.0 (Department of Statistics and Center for Agricultural and Rural Development 1996), taking into account the within-subject variance and observed sequence effect (setting the first day of intake as the reference value).

Application of the probability approach requires an estimate of the mean requirement and the variability of requirement (or at least reasonable assurance that the requirement distribution approximates symmetry). Except in the case of iron, Canadian requirement estimates were used (Scientific Review Committee 1990), with mean requirements inferred for riboflavin and Vitamin A. The estimated distribution of iron requirements among premenopausal women is highly skewed, but approximates a lognormal distribution. The probability analysis was thus conducted with both intake and requirement expressed in log units. First, however, estimated dietary iron intakes were converted to estimated intakes of usable iron, assuming an iron absorption level of 15% in the mixed Canadian diet. From this, a fixed amount of 0.77 mg was deducted as the amount needed to meet basal requirements (i.e., nonmenstrual losses via dermal, urinary, and fecal routes). The residual available intake estimates were then log-transformed and compared to mean and SD of the menstrual loss distribution expressed in log units (FAO/WHO 1988). To assess the adequacy of energy intakes, the probability approach is not applicable; so, reported intakes were simply contrasted to population norms for energy.

RESULTS

Sample characteristics. Participants ranged in age from 19 to 48 y, with the mean age 33 ± 7 y. The mean body mass index (BMI) of women in this study was 27.7 ± 6.74 kg/m^2 (median 26.9 kg/m^2), and 49.0% of the sample had BMIs > 27 kg/m^2. Forty percent reported a long-standing health condition, illness, or disability, and two-thirds of these (26% of the sample) described the condition as activity-limiting. Only 28% of women in this study smoked daily, and half of these reported smoking fewer than 10 cigarettes/d.

Although 63% of the participants were born outside Canada, only 20% could be considered recent immigrants, having come to Canada in the last 5 y. The sample was heterogeneous with respect to ethnoracial identity, with 46% white, 27% black, 11% Latin American, 10% Asian, 3% aboriginal Canadians, and 2% undefined. Most (65%) women had completed high school, and 41% had at least some post-secondary training.

Sixty-five percent of the sample were presently lone parents. Household size ranged from two to ten, with a median of three persons per household. The median number of children was two. Most (69.9%) households were supported by social assistance programs (welfare); an additional 14.4% of households relied on a combination of welfare payments and employment income. Only 9.8% of households relied solely on employment incomes. The remaining 5.9% of households were reliant on savings or received income from student loans, unemployment insurance, or other sources.

All of the families in this study were housed, although only 25.5% lived in subsidized housing (i.e., not-for-profit housing where rents are determined in relation to one's income). The women's housing costs are described in detail elsewhere (Tarasuk and Beaton, unpublished data).

As a means to interpret household income relative to Canadian standards, reported income for the month was expressed as a percentage of the 1995 Statistics Canada Low-Income Cut-offs, commonly referred to as poverty lines (National Council of Welfare 1997). These cut-offs define low income in relation to average household expenditure patterns; they are dollar values below which households spend ≥56.2% of their gross income on the basic necessities of food, clothing, and shelter and are adjusted for household size and degree of urbanization. Household incomes were, on average, 52.8%

± 0.13% of the poverty line. Ninety percent of households had incomes that were 2/3 of the poverty line.

Household food insecurity and dietary intake. Household food insecurity with some hunger over the past 30 d was reported by 56.9% of the study participants **(Table 2)**. A description of observed energy and nutrient intakes among this sample is presented in **Table 3**. As the variance ratios indicate, the level of day-to-day variation in intakes observed among women in this sample generally exceeded the observed between-person variation.

Household food security status during the previous 30 d was significantly associated with mean reported intakes of energy and several nutrients **(Table 4)**. No significant differences in macronutrient composition or nutrient intakes per MJ were observed in relation to household food security status, except in the case of Vitamin A per MJ, where intakes appeared higher among women in households where no hunger was evident (F value 4.03, 2 df; $P = 0.0198$). This suggests that the differences observed in Table 4 are due primarily to the lower food intakes of women in households experiencing severe food insecurity, rather than to systematically different food selection patterns among these women compared to the others.

When women's reported energy and nutrient intakes were considered in relation to the presence or absence of hunger in the household, while controlling for other economic, sociocultural, and behavioral influences on diet, systematically lower intakes (indicated by the negative direction of the partial regression coefficients in **Table 5**) were observed among women in households reporting moderate or severe hunger compared to those where no hunger was apparent. The differences in mean intake levels were significant ($P < 0.05$) for energy and all nutrients examined except fat, vitamin C, and calcium. The partial regression coefficients derived from the multivariate model diminished only slightly for energy and most nutrients when compared to those derived from the simple (uncontrolled) regression model, suggesting that the effect of hunger in the household is largely independent of other influences on reported dietary intake.

The mean energy intake:basal energy expenditure ratio for the 145 women included in the above analyses was 1.07 ± 0.51, and 55% of individual women's ratios fell below the calculated lower cut-off value of 1.04 **(Table 6)**. Women in households characterized by food insecurity with moderate or severe hunger over the past 30 d were more than twice as likely to have EI:BMR_{est} below this cut-off value during that period when compared to those in households where no hunger was evident.

Nutritional adequacy. **Table 7** presents a summary of estimated usual nutrient intakes and the predicted prevalence of inadequacy of nutrient intakes among the entire sample of women in this study. No estimate of the prevalence of individuals with inadequate intakes can be offered for calcium because requirements have not been estimated for this nutrient. However, the estimated group mean of women in this study is only 75% of the 700 mg/d currently proposed as a suitable group mean intake (Scientific Review Committee 1990), indicating that women's calcium intakes were low.

Mean usual energy intake was estimated at 6,761 ± 3,343 kJ (1,616 ± 799 kcal). Compared to Canadian population norms, the estimated group mean is lower than the recommended averages of 8,786 kJ (2,100 kcal) for women 19–24 y, of average weight, and modest activity and 7,950 kJ (1,900 kcal) for women 25–49 y (Scientific Review Committee 1990). On average, women consumed 15.9 ± 2.86% of energy as protein, 26.5 ± 4.71% as fat, and 58.2 ± 1.95% as carbohydrate (with these proportions drawn from the estimated distribution of usual intakes).

TABLE 2

Classification of households by reported level of food security over the past 30 d[1]

Food Security Status	% (*n*)	95% Confidence Intervals
		%
1. No food insecurity with hunger evident	43.1 (66)	35.3, 50.9
2. Food insecure with moderate hunger	35.3 (54)	27.7, 42.9
3. Food insecure with severe hunger evident	21.6 (33)	15.1, 28.1

[1] Classifications based on thresholds and definitions developed for use with the USDA Food Security Module (Hamilton et al. 1997b).

DISCUSSION

In summary, the systematic variation in women's mean intakes depending on their household food security status is consistent with the results of other studies in which self-reported assessments of the adequacy of the household food supply have been contrasted to individuals' reported energy and nutrient intakes (Cristofar and Basiotis 1992, Kendall et al. 1996, Rose and Oliveira 1997). The use of a more comprehensive assessment of household food security and more complete, contemporaneous dietary assessments in the present study adds further credence to these associations. Furthermore, the negative effect of household food insecurity with moderate or severe hunger on the food intakes of women appears to be independent of many other influences on diet.

Although this study was conducted with a group of Toronto women who received charitable food assistance, there is no reason to believe that the observed relationship between household food insecurity and the women's dietary intakes is not applicable to women with children in food insecure households in other settings. The specific nature of the observed compromises in dietary intake associated with severe household food insecurity would likely vary across populations because of differing food consumption patterns and differences in the relative availability and affordability of specific classes of foods, but some difference in women's intakes by household food security status appears likely.

The analytic approach employed here to obtain quantitative estimates of the difference in intakes among women in households with and without hunger has been applied in other examinations of food insecurity and related issues (Rose and Oliveira 1997, Rose et al. 1998). Whereas the approach has the advantage of enabling the effect of household food security status to be examined while controlling for other possible influences on women's dietary intakes, its limitations must be recognized. The partial regression coefficients reported here could be affected by the omission of some important, but as yet, unidentified confounding variable. Further, random error in the measurement of intake (as evidenced by the high within-subject variance components noted in Table 3) would reduce the statistical power of tests of significance associated with partial regression coefficients (Liu 1988), lessening our ability to detect significant differences in intake between the two groups. As well, the precision of the estimated coefficients must be affected by our limited sample size, although their direction is unlikely to be affected by this.

TABLE 3

Women's observed intakes over 3 × 24 h dietary intake recalls and estimated partitioning of variance for energy and selected nutrient variables[1,2]

Nutrient	Means ± SD, $n = 153 \times 3$	Between-person CV	Within-person CV	Variance Ratio
		%		
Energy, *kJ/d*	6498 ± 2766	36.8	36.9	1.0
Protein, *g/d*	59.0 ± 26.9	35.2	50.5	2.1
Fat, *g/d*	49.1 ± 28.1	46.8	56.9	1.5
Carbohydrate, *g/d*	220 ± 97.1	38.3	38.1	1.0
Folate, *µg/d*	174 ± 96.5	39.9	66.8	2.1
Vitamin C, *mg/d*	92.5 ± 72.8	56.6	94.7	2.8
Vitamin A, *RE/d*	925 ± 1199	56.6	202.1	12.7
Calcium, *mg/d*	506 ± 305	50.1	55.9	1.2
Iron, *mg/d*	10.0 ± 5.34	41.5	58.3	2.0
Magnesium, *mg/d*	210 ± 92.3	36.9	41.3	1.3
Zinc, *mg/d*	7.99 ± 4.06	36.2	61.8	2.9

1 No adjustments have been made to the intake data.
2 $n = 153$.

The low food intakes reported by some women in this study and the comparison of reported energy intakes with estimated basal energy expenditures raise the question of whether the results presented here can be explained by underreporting. Underreporting has been repeatedly observed when self-reported intakes (assessed with 24-h recall or food record methods) were contrasted to other estimates of intake using the doubly labeled-water technique (Bandini et al. 1990; Bingham 1994; Martin et al. 1996, Sawaya et al. 1996, Schoeller 1990) and various other biological markers (Bingham et al. 1995, Bingham and Day 1997, Heitmann and Lissner 1995, Heitmann et al. 1996). In the absence of a biological marker of food intake, underreporting has been identified by comparing reported energy intake to an estimate of energy expenditure (Black et al. 1991, Briefel et al. 1997, Carter and Whiting 1998, Goldberg et al. 1991, Stallone et al. 1997). Further, a recent examination of 7-d diet diaries among a sample of UK civil servants suggested that the prevalence of underreporting was inversely related to socio-economic status (Stallone et al. 1997).

However, there are serious problems with the application of standard cut-off values of EI:BMR_{est} to identify underreporting among individuals, and their appropriateness for use in specific population subgroups that differ markedly from the popula-

TABLE 4

Comparison of women's mean energy and nutrient intakes with their 30-d household food security status[1]

Nutrient	No hunger evident ($n = 62$)	Food insecure with moderate hunger ($n = 52$)	Food insecure with severe hunger ($n = 31$)	*F*-value[2] (2 df)
Energy, *kJ/d*	7182.58 ± 3207.33	6164.08 ± 2370.20	5696.84 ± 2388.81	3.29[3]
Protein, *g/d*	67.78 ± 31.78	55.78 ± 22.17	47.56 ± 20.49	6.28[3]
(*g/MJ*)	(168.48 ± 46.42)	(160.74 ± 45.43)	(152.42 ± 49.00)	
Carbohydrate, *g/d*	242.61 ± 113.56	203.81 ± 76.97	203.07 ± 94.46	2.46
(*g/MJ*)	(599.46 ± 99.02)	(600.89 ± 105.79)	(625.11 ± 105.52)	
Total Fat, *g/d*	54.33 ± 31.62	46.51 ± 26.91	41.68 ± 21.25	2.27
(*g/MJ*)	(127.54 ± 34.27)	(124.04 ± 39.41)	(125.12 ± 34.90)	
Vitamin A, *RE/d*	1339.40 ± 1683.93	594.97 ± 528.67	732.18 ± 641.97	6.80[3]
(*RE/MJ*)	(3477.91 ± 4666.05)	(1830.44 ± 1749.73)	(2750.47 ± 3095.16)	
Vitamin C, *mg/d*	108.44 ± 82.34	84.07 ± 68.06	76.37 ± 61.57	2.10
(*mg/MJ*)	(299.85 ± 257.55)	(255.84 ± 186.19)	(241.17 ± 219.82)	
Folate, *µg/d*	197.69 ± 116.20	156.32 ± 78.99	153.08 ± 70.38	3.02
(*µg/MJ*)	(505.64 ± 241.28)	(490.58 ± 342.11)	(493.06 ± 206.26)	
Calcium, *mg/d*	560.49 ± 355.01	469.05 ± 289.10	440.77 ± 231.19	1.91
(*mg/MJ*)	(1361.25 ± 469.46)	(1354.95 ± 588.00)	(1421.44 ± 647.81)	
Iron, *mg/d*	11.52 ± 6.90	9.18 ± 3.73	8.25 ± 3.53	4.30[3]
(*mg/MJ*)	(27.77 ± 6.75)	(27.64 ± 9.62)	(26.72 ± 7.90)	
Magnesium, *mg/d*	237.49 ± 99.50	194.13 ± 81.66	187.99 ± 89.92	4.55[3]
(*mg/MJ*)	(610.42 ± 155.41)	(586.50 ± 224.08)	(619.30 ± 183.49)	
Zinc, *mg/d*	9.37 ± 4.78	7.24 ± 3.11	6.30 ± 3.25	7.27[3]
(*mg/MJ*)	(23.01 ± 6.67)	(21.04 ± 6.98)	(19.97 ± 6.72)	

1 Values are means ± SD, $n = 145$.
2 Based on analysis of transformed data in cases where the original distribution failed to approximate normality.
3 Indicates significant ($P < 0.05$) difference between groups defined by food security status. No significant differences were detected for the nutrient per MJ intakes (except Vitamin A).

TABLE 5

Differences in energy and nutrient intake between women in households reporting hunger over the past 30 d and those reporting no hunger[1]

	Model adjusted for other influences on intake		Unadjusted model	
Nutrient	Intake difference[2] (SE)	*P*-value[3]	Intake difference[4] (SE)	*P*-value[3]
Energy, *kJ/d*	−1058.00 (484.20)	0.0307	−1193.01 (463.32)	0.0110
Protein, *g/d*	−13.58 (4.65)	0.0041	−15.07 (4.45)	0.0009
Carbohydrate, *g/d*	−34.64 (16.96)	0.0431	−39.08 (16.35)	0.0181
Total fat, *g/d*	−8.45 (4.91)	0.0876	−9.62 (4.70)	0.0423
Vitamin A, *RE/d*	−634.51 (195.84)	0.0015	−693.18 (198.49)	0.0006
Vitamin C, *mg/d*	−20.29 (12.40)	0.1042	−27.25 (12.28)	0.0280
Folate, *μg/d*	−35.43 (15.59)	0.0247	−42.58 (15.95)	0.0085
Calcium, *mg/d*	−73.59 (53.46)	0.1071	−101.98 (51.71)	0.0505
Iron, *mg/d*	−2.35 (0.93)	0.0122	−2.68 (0.89)	0.0030
Magnesium, *mg/d*	−39.02 (15.88)	0.0082	−45.65 (15.30)	0.0033
Zinc, *mg/d*	−2.23 (0.69)	0.0153	−2.49 (0.66)	0.0002

1 $n = 145$.

2 Differences in 3-d mean intakes between women in households with hunger and those without, while controlling for other factors affecting diet. These are partial regression coefficients estimated from a single-equation, multivariate regression model in which each intake variable was regressed on an indicator of household food insecurity with hunger, disposable income (adjusted for family size and composition), presence of employment income in the household, presence of a partner in the household, and woman's level of education, smoking status, and ethnoracial identity.

3 *P*-value represents the probability of these results occurring under the null hypothesis that there is no difference in intakes between women categorized by household hunger status. A *P*-value of ≤ 0.05 is generally considered grounds for rejection of the null hypothesis.

4 Differences in 3-d mean intakes between women in households with hunger and those without, derived from a simple linear regression model in which intake was regressed on an indicator of household food insecurity with hunger.

tions upon which the approach was developed, is questionable. Because calculated basal metabolic rates systematically overestimate true rates among the obese (Bernstein et al. 1983, Zurio et al. 1990), the EI:BMR_{est} is lower than the true ratio for these individuals, and the likelihood of apparent underreporting increases. This is a serious bias in the present study where the prevalence of obesity is so high. The need to assume a reference level of physical activity in calculating cut-off values for underreporting is also problematic. The use of population norms undoubtedly overestimates true physical activity levels in this sample, given that 26% of women reported some activity limitation. Lastly, the proposed evaluation criteria assume that habitual intake is being assessed, and individuals are in energy balance during the time frame of observation. This may be a reasonable assumption in samples where household resources are not severely constrained (e.g., UK civil servants), but it is not applicable to studies of dietary intake in the immediate context of severe household food insecurity. This is not to suggest that such studies are somehow immune to problems of underreporting, but rather that additional factors underlie the reporting of low energy intakes in these settings and the application of standard population-level assumptions about energy expenditure and energy balance is not an appropriate means to differentiate reporting effects in these data.

In the present study, the observed association between intake and household food security status implies that some women's low reported intakes reflect actual food deprivation in the context of scarce household resources. This is further borne out by the heightened probability of low EI:BMR_{est} among women in households with hunger. The intake data would appear to simply be mirroring the behaviors women have described on the Food Security Module (i.e., cutting portion sizes, skipping meals, going hungry, going whole days without eating). The interviewers' records of the women's descriptions of extenuating circumstances in association with their reports of extreme intakes lend further credence to the dietary data presented here, suggesting that the findings are not simply a function of underreporting. Insofar as underreporting of intake is present, it would be unlikely to affect the direction of the observed association between intake and household food security status but, if the underreporting was correlated with one or more variables in the regression model, it might affect the magnitude of the partial regression coeffi-

TABLE 6

Relationship between the ratio of women's reported energy intake to estimated basal metabolic rate (EI:BMR_{est}) and their reported household food security status[1,2]

	Number of women with reported EI:BMR_{est} < 1.04	Number of women with reported EI:BMR_{est} ≥ 1.04
Household food insecurity with moderate or severe hunger evident	54	29
No household food insecurity with hunger evident	26	36

1 Odds ratio for EI:BMR_{est} < 1.04 vs EI:BMR_{est} ≥ 1.04 if household food insecurity with moderate or severe hunger was reported: 2.578 (95% Confidence Intervals: 1.310, 5.073). See Methods for explanation of the derivation of this cut-off value.

2 $n = 145$.

TABLE 7

Estimated usual intakes, average requirements and prevalence of inadequacy for selected nutrients[1]

Nutrient	Estimated usual intake[2]	Requirement[3]	Prevalence of Inadequacy[4]
			%
Protein, *g/d*	64.6 ± 22.2	41.2 ± 5.2	14.5
Vitamin A, *RE/d*	1058 ± 759	600 ± 100	28.4
Vitamin C, *mg/d*	106 ± 63.3	20 ± 5	3.0
Folate, *μg/d*	189 ± 72.4	132 ± 35	22.5
Calcium, *mg/d*	532 ± 261	n/a	n/a
Iron, *mg/d*	10.7 ± 4.05	See text.	38.2
Magnesium, *mg/d*	224 ± 79.3	180 ± 10	31.2
Zinc, *mg/d*	8.62 ± 3.03	4.6 ± 2.0	12.2

1 The mean ± SD are presented, n = 153.

2 The observed distribution of intakes, based on 3 × 24 h recalls, was adjusted to estimate the distribution of usual intakes, taking into account sequence effects and within-person variance.

3 Mean requirement estimates ± SD are based on the 1990 Canadian requirement estimates (Scientific Review Committee 1990) for all nutrients except iron.

4 Predicted % of women with usual intakes below own requirement.

cients. Underreporting could also lead to some overestimation of prevalences of inadequacy for specific nutrients.

The systematically lower energy and nutrient intakes observed among women in households with more severe food insecurity suggest that these women may be particularly susceptible to nutrient deficiencies. The high estimated prevalence of inadequacy for iron, magnesium, vitamin A, and folate, and the apparently high proportion of women with low calcium intakes, point to potential nutritional problems associated with intake levels in the observed range. Although the immediate impact of inadequate intakes of these particular nutrients may be minimal, the long-term impact of chronically low intakes is of concern insofar as the nutrients are implicated in chronic diseases (e.g., calcium and osteoporosis).

In conclusion, the study findings confirm that women's dietary intakes are compromised in the context of reported household food insecurity and that their subjective appraisals of household food security are reflected in the adequacy of their own dietary intakes. The study's focus on adult women living with children was chosen because qualitative research findings suggest that in times of severely constrained resources, women may deprive themselves of food to spare their children food deprivation (Campbell and Desjardins 1989, Fitchen 1988, National Council of Welfare 1990, Radimer et al. 1992, Tarasuk and Maclean 1990). Women's intakes may thus be adjusted according to their understanding of their household food security. Dietary assessments were not conducted with other family members, but the results of the present study beg the question of the effect of household food insecurity on the diets of children and other adults.

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