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How is household food insecurity and maternal nutritional status associated in a resource-poor setting in Ghana?

Mahama Saaka*

Abstract

Background: Population-based studies show household food insecurity is associated with increased body mass index (BMI) and an increased risk of overweight in adult women in developed countries. However, there is insufficient empirical evidence of the association between food insecurity and maternal nutritional status in resource-poor settings. This study investigated the relationship between household food insecurity (HFI) and maternal nutritional status in a resource-poor setting of Ghana, where some households suffer from some form of food insecurity during the year.

Methods: A community-based cross-sectional cluster study was conducted in June 2015. The study communities were selected using probability proportionate to size. The study population comprised non-lactating and non-pregnant women who were selected using a two-stage cluster sampling procedure. HFI was quantified using the Household Hunger Scale. Multiple regression analysis was conducted to test whether HFI significantly predicts maternal nutritional status, controlling for potential confounding factors. BMI was used to assess the nutritional status.

Results: The prevalence of moderate to severe household hunger was 46.9 %. In analysis of covariance, while adjusting for household size, place of residence and household wealth index, the mean BMI for women from food-secure households was 1.4 kg/m^2 significantly higher than the mean BMI for women from food-insecure households (25.7 ± 5.3 vs. 24.3 ± 4.0) (95 % CI 0.54–2.35), $p = 0.002$. Multivariable regression analysis showed that, after adjusting for potential confounders, there was a significant negative association between moderate to severe household hunger and BMI ($\beta = -0.16$, $p < 0.001$).

Conclusions: In conclusion, food insecurity in the study population was prevalent and was associated with low maternal BMI. Household food insecurity was negatively associated with maternal overweight and obesity. Women in food-secure households were more likely than food-insecure households to consume milk, pulses, oily and sugar-based foods.

Keywords: Household Hunger Scale, Maternal nutrition, Household food insecurity, Body mass index, Ghana

Background

Food security is necessary for nutrition security. The concept of food security has been defined variously over the years. According to the Food and Agriculture Organization (FAO), "Food Security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life" [1]. Food insecurity therefore exists whenever people are not able to access sufficient food at all times for an active and healthy life. Food insecurity refers to limited or uncertain availability of nutritionally adequate and safe foods, or limited or uncertain ability to acquire food in socially acceptable ways [2]. Food insecurity is an important global public health problem, having adverse consequences for individuals in both resource-poor and

*Correspondence: mmsaaka@gmail.com
School of Allied Health Sciences, University for Development Studies, P O Box 1883, Tamale, Ghana

resource-rich environments [3]. Though food insecurity can affect any one, its effect on women deserves special attention because of their social vulnerability to it.

Findings from some population-based studies suggest that food insecurity is associated with increased body mass index (BMI) and an increased risk of overweight or obesity in adult women in industrialized countries [4–9], but not all studies have reported this relationship [10]. Furthermore, the extent this holds in resource-poor settings of developing countries is inconclusive [9, 11]. Studies from developing countries among adults and children have produced mixed results. For example, in Malaysia, household food insecurity was associated with obesity among rural women [12], while in Trinidad and Tobago, household food insecurity was associated with underweight among adults [13]. In Guatemala, BMI of women from households classified as moderate to severe food insecure was significantly lower than BMI of women from food-secure households [11].

The purpose of this study was to determine the relationship between household food insecurity (HFI) and maternal nutritional status in the Wenchi Municipality of Ghana.

Methods

Study design, study population and sampling

A community-based cross-sectional cluster study was conducted in June 2015. To collect information from this group of people, a two-stage cluster sampling procedure was used to include households within clusters that were selected based on probability proportionate to size (PPS) method.

A sample size of 192 was required to ensure that the estimated prevalence of the main outcome variable was within plus or minus 5 % of the true prevalence at 95 % confidence level. Assuming a correction factor of 2 (the "design effect") for cluster sampling, the sample size was increased to 384. But, 10 % of the estimated sample was calculated to take care of missing values and damage questionnaire, which was 38.4. So, the sample size (*N*) was 422.

The basic primary sampling unit was the household in which there was non-lactating or non-pregnant woman. In each cluster, a complete list of all households was compiled and systematic random sampling used in selecting study households. All the households in each cluster were serially numbered. To get the sampling interval, the total number of households in a cluster was divided by the cluster size. The first household was then randomly selected by picking any number within the sample interval. Subsequent selections were made by adding the sampling interval to the selected number in order to locate the next household to visit. If the selected household does not have a target respondent, then next household was selected using the systematic sampling procedure.

Data collection

Household interviews were conducted to collect quantitative data from a cross-sectional sample of mother–child pairs on maternal and child anthropometry, maternal dietary intake, household wealth index and other socio-demographic determinants of nutritional status. Food intake was assessed by the 24-h recall method. Data collection was carried out among households in the rural and urban areas of Wenchi Municipality.

Assessment of dietary intake and household food security

The FAO validated 11-item food groups frequency questionnaire (FFQ) was used to quantify maternal dietary intake [14] in the past 24 h prior to the study.

Household food insecurity was quantified using the Household Hunger Scale (HHS). The HHS comprises three subset questions from the Household Food Insecurity Access Scale (HFIAS) that pertain to insufficient food quantities [15]. Scores of 0–1 are classified as "little to no household hunger," 2–3 as "moderate household hunger" and 4–6 "severe household hunger" [15]. Women with scores 2–6 are therefore classified as experiencing "moderate or severe household hunger." For logistic regression analyses, the three classes were regrouped into two (none/mild and moderate/severe household food insecurity).

Determination of household economic status

A household wealth index based on household assets and housing quality was used as a proxy indicator for socioeconomic status (SES) of households. An absolute measure of household wealth (wealth index) used in this study is based on an earlier concept developed by Garenne and Hohmann [16], whereby the sum of dummy variables is created from information collected on housing quality (floor, walls and roof material), availability of potable water and type of toilet facility, and ownership of household durable goods and livestock (e.g., bicycle, television, radio, motorcycle, sewing machine, telephone, cars, refrigerator, mattress and bed). These facilities or durable goods are often regarded as modern goods that have been shown to reflect household wealth. A household of zero index score, for example, means that household had not a single modern good. The wealth variable categorized respondents into quintiles according to the household's score on the demographic and health survey (DHS) wealth index, which is based on the household's amenities, assets and living conditions [17].

Determination of body mass index

The nutritional status of adult non-pregnant and non-lactating women was assessed using BMI. Maternal weight was measured twice, to the nearest 0.1 kg, with a digital scale, while the subjects were wearing light clothing and no shoes. BMI as an indicator of the nutritional status of adults reflects chronic energy deficiency that was assessed by dividing an individual's weight (kg) over height in metres squared (m^2). Maternal nutritional status was classified according to BMI categories as underweight (<18.5), adequate (18.5–24.9), overweight (25–29.9) or obese (≥30) [18].

Data analysis

The analysis of data took into account the complex design of multistage cluster surveys. The data were coded for statistical analysis using SPSS Complex Samples module for windows 21.0 (SPSS Inc, Chicago). This was done in order to make statistically valid population inferences and computed standard errors from sample data. For continuous outcomes, statistical significance was assessed using analysis of variance (ANOVA). For categorical and dichotomous outcomes, Chi-square tests were performed to assess statistical significance. Multiple regression analysis was used to assess the independent contribution of food insecurity to maternal nutritional status. Independent variables considered for entry into the regression models were identified during bivariate correlations analysis. Multi-collinearity between independent variables was checked and eliminated.

Ethical considerations

The study was approved by the School of Allied Health Sciences, University for Development Studies, Ghana. Written approval was obtained from the local health authorities in the district. All participants were informed about the purpose of the study and their right to decline participation in the study, and verbal consent was obtained from all participants.

Results

Socio-demographic characteristics of study sample

The study comprised 422 households out of which 49.8 % (210) were resident in rural setting. The mean age of the women respondents was 29.4 ± 6.3 years. The other details of the sample characteristics including maternal age distribution and maternal educational level are given in Table 1. Food-insecure households had generally lower socioeconomic status as measured by household wealth index than food-secure households. A greater proportion of mothers from food-insecure households had no formal education, compared with mothers from food-secure households. More food-insecure households than food-secure households were resident in rural areas. In comparison with food-secure households, households with food insecurity have less access to protected potable water.

Table 1 Characteristics of households stratified by household food insecurity status as measured by Household Hunger Scale (*N* = 422)

Factor	*N*	Food-secure households *n* (%)	Food-insecure households *n* (%)	Test statistic
Household wealth index				
Low	181	75 (41.4)	106 (58.6)	$\chi^2 = 17.3$, $p < 0.001$
High	241	149 (61.8)	92 (38.2)	
Place of residence				
Urban	212	135 (63.7)	77 (36.3)	$\chi^2 = 19.2$, $p < 0.001$
Rural	210	89 (42.4)	121 (57.6)	
Maternal education level				
None	104	38 (36.5)	66 (63.5)	$\chi^2 = 24.4$, $p < 0.001$
Low	259	141 (54.4)	118 (45.6)	
High	59	45 (76.3)	14 (23.7)	
Source of potable water				
Protected	24	8 (33.3)	16 (66.7)	$\chi^2 = 3.9$, $p = 0.001$
Unprotected	398	216 (54.3)	182 (45.7)	

Magnitude of household food insecurity and malnutrition

Table 2 shows the prevalence of maternal malnutrition and household food insecurity. Out of the 422 mothers, 2.6 % (11) were underweight (BMI < 18.5 kg/m^2), 54 % (228) were normal (BMI 18.5–25 kg/m^2), 32.8 % (134) were overweight (BMI 25^+–30) and 11.6 % (49) were obese (BMI > 30 kg/m^2). Overall, 46.9 % (198) of households were classified as food insecure.

Determinants of maternal nutritional status

Bivariate analyses showed that household wealth index, household food insecurity, type of residence and occupation of mother were associated with the mean BMI (Table 3).

Table 2 Prevalence of maternal malnutrition and household food insecurity (*N* = 422)

Indicator	*N*	Prevalence (%)
Moderate to severe household hunger	198	46.9
BMI classification		
Underweight	11	2.6
Normal	228	54.0
Overweight	134	31.8
Obese	49	11.6

Table 3 Determinants of mean BMI

Determinant	*N*	Mean	SD	95 % confidence interval for mean		Test statistic
				Lower bound	Upper bound	
Household Wealth Index						
Low	181	23.10	4.47	23.34	24.65	$F(1, 421) = 16.0, p < 0.001$
High	241	25.86	4.93	25.24	26.49	
Household food security						
Food secure	224	25.99	5.27	25.29	26.68	$F(1, 421) = 18.2, p < 0.001$
Food insecure	198	24.02	4.03	23.45	24.58	
Type of residence						
Urban	212	26.25	5.67	25.48	27.02	$F(1, 421) = 27.5, p < 0.001$
Rural	210	23.86	3.40	23.40	24.33	
Religion						
Islam	110	26.08	6.42	24.86	27.29	$F(2, 421) = 3.9, p = 0.02$
Christianity	296	24.78	4.07	24.31	25.24	
Traditional	16	23.39	3.89	21.31	25.46	
Potable water sources						
Unprotected	24	23.23	3.22	21.88	24.59	$F(1, 420) = 3.7, p = 0.056$
Protected	398	25.17	4.88	24.69	25.65	
Occupation of mother						
Farmer	128	23.75	3.34	23.17	24.33	$F(6, 421) = 2.8, p = 0.01$
Trader	164	25.78	5.22	24.98	26.59	
Civil servant	24	25.52	4.82	23.48	27.56	
Seamstress	69	24.96	4.74	23.82	26.09	
Housewife	19	26.46	7.07	23.06	29.87	
Student	14	26.52	6.41	22.82	30.22	
Hair dresser	4	24.73	4.74	17.18	32.27	
Maternal age						
Under 20 years	7	24.64	3.16	21.72	27.56	$F(2, 421) = 2.5, p = 0.09$
20–34 years	329	24.80	4.53	24.31	25.29	
At least 35 years	86	26.09	5.83	24.84	27.34	

Household food consumption

The food consumption score of specific food types consumed in both food-secure and food-insecure households is given in Table 4. There was no difference in cereal consumption between food-secure and food-insecure households. However, women in food-secure households were more likely than in food-insecure households to consume milk, pulses, oily and sugar-based foods. On the other hand, food-insecure households were more likely than food-secure households to consume green vegetables and roots and tubers.

Relationship between household food insecurity and maternal nutritional status

Multiple regression analysis was conducted to test whether household food insecurity significantly predicts maternal BMI, controlling for potential confounding factors.

Independent variables considered for entry into the regression models included the variables that were significant during bivariate analysis (Table 3).

Using the enter method, the results of the regression indicated the three predictors explained 10.0 % of the variance ($R^2 = 0.10$, $R^2_{\text{Adjusted}} = 0.094$, $F(3,418) = 15.56$, $p < 0.001$). The analysis shows that there was a significant negative association between moderate to severe household hunger and BMI ($\beta = -0.16$, $p < 0.001$) (Table 5).

In analysis of covariance (ANCOVA), while adjusting for household size, place of residence and household wealth index, the mean body mass index (BMI) for women from food-secure households was 1.4 kg/m^2 significantly higher than the mean BMI for women from food-insecure households (25.7 ± 5.3 vs. 24.3 ± 4.0) (95 % CI 0.54–2.35), $p = 0.002$.

Table 4 Food consumption score stratified by household food insecurity status (*N* = 422)

Food type	*N*	Mean	SD	95 % confidence interval for mean		Test statistic
				Lower bound	Upper bound	
Cereal consumption score						
Food secure	224	7.53	4.03	6.10	8.06	$F(1, 421) = 0.22, p = 0.6$
Food insecure	198	7.71	3.90	7.16	8.25	
Total	422	7.61	3.96	7.23	7.99	
Roots and tubers consumption						
Food secure	224	8.52	4.24	7.96	9.08	$F(1, 421) = 8.9, p = 0.003$
Food insecure	198	9.79	4.50	9.16	10.42	
Total	422	9.11	4.40	8.69	9.54	
Milk consumption score						
Food secure	224	10.13	8.92	8.95	11.30	$F(1, 421) = 9.7, p = 0.002$
Food insecure	198	7.49	8.37	6.32	8.67	
Total	422	8.89	8.75	8.05	9.73	
Pulse consumption score						
Food secure	224	7.55	5.81	6.79	8.32	$F(1, 421) = 6.4, p = 0.01$
Food insecure	198	6.24	4.71	5.58	6.90	
Total	422	6.94	5.35	6.43	7.45	
Vegetable consumption score						
Food secure	224	5.99	1.79	5.76	6.23	$F(1, 421) = 6.0, p = 0.02$
Food insecure	198	6.39	1.52	6.18	6.60	
Total	422	6.18	1.68	6.02	6.34	
Meat and fish consumption						
Food secure	224	21.02	9.25	19.80	22.24	$F(1, 421) = 5.6, p = 0.019$
Food insecure	198	23.03	8.16	21.89	24.17	
Total	422	21.96	8.80	21.12	22.80	
Sugar consumption score						
Food secure	224	2.31	1.08	2.17	2.45	$F(1, 421) = 22.6, p < 0.001$
Food insecure	198	1.79	1.16	1.63	1.95	
Total	422	2.07	1.15	1.96	2.18	
Oil consumption score						
Food secure	224	2.28	0.88	2.17	2.40	$F(1, 421) = 4.2, p = 0.04$
Food insecure	198	2.10	0.96	1.96	2.23	
Total	422	2.20	0.92	2.11	2.29	
Over all food consumption score						
Food secure	224	82.47	15.64	80.41	84.53	$F(1, 421) = 25.3, p < 0.001$
Food insecure	198	75.05	14.52	73.01	77.08	
Total	422	78.99	15.56	77.50	80.48	

Table 5 Determinants of mother's body mass index (BMI)

Variable	Unstandardized coefficients		Standardized coefficients Beta	*T*	Sig.	95.0 % confidence interval for β		Collinearity statistics	
	B	Std. error				Lower bound	Upper bound	Tolerance	VIF
1									
Constant	27.14	0.96		28.22	<0.001	25.25	29.03		
Household hunger	−1.57	0.46	−0.16	−3.43	0.001	−2.48	−0.67	0.95	1.05
Household size (>4)	1.19	0.45	0.12	2.65	0.008	0.31	2.07	1.00	1.002
Residence type (rural)	−2.07	0.46	−0.22	−4.52	<0.001	−2.968	−1.17	0.95	1.05

Predictors of household food insecurity

Pearson's Chi-square test was used to test the association between household food insecurity and selected factors. Household food insecurity was significantly higher in rural settings, compared with urban (57.6 % vs. 36.3 %), but no significant association was observed with size of household. Low household wealth index and maternal educational level were strong predictors of household food insecurity (Table 6).

Discussion

This study assessed the relationship between household food insecurity and maternal nutritional status within the Wenchi Municipality located in Ghana. This is one of the first studies to report a significant association between food insecurity and mother's nutritional status in Ghana. The adjusted BMIs of the food-insecure women were significantly lower than those of the food-secure women.

Relationship between food insecurity and maternal BMI

The relation between food insecurity and maternal weight appears to be a complex one. Research on whether there is a relationship between food insecurity and obesity has produced mixed results [10, 19]. Poverty appears to be a strong underlying force that put people at greater risk of unhealthy food habits. Available evidence suggests that in developed economies, poor people are more likely to be fatter than rich people. In cross-sectional studies conducted in the developed countries including the USA, food-insecure women tend to have higher BMI than women who were food secure [6, 20–22], whereas other studies have found no relationship, or even a lower risk of obesity, with food insecurity [23–25]. In a randomly selected sample of 8169 women in California, obesity was more prevalent in food-insecure (31.0 %) than in food-secure women (16.2 %) and was more likely to occur in non-white women [5]. This infers that the percentage of women overweight or obese in severely food-insecure households was greater than the proportion of women overweight or obese in moderately food-insecure households.

In contrast, in resource-poor countries, poor people in most situations are not fat but apparently usually leaner than rich people. In this study, evidence showed that food insecurity was independently associated with maternal BMI. Women from food-insecure households had lower mean BMI than women who were food secure.

Women's BMI has been used in Africa as an indicator of food security [26]. Studies that have been conducted in developing countries among adults have produced mixed results. In one study, poor maternal nutritional status was common and women in households experiencing moderate to severe household hunger had statistically significantly lower BMI [27]. Household food insecurity was positively associated with obesity among rural women in Malaysia [12, 28], while in Trinidad and Tobago, household food insecurity was positively associated with underweight among adults [29].

A study conducted in Bogotá, Colombia, showed that food insecurity was associated with underweight but not overweight in adults and concluded that food insecurity does not necessarily predict overweight in countries undergoing the nutrition transition [30].

Another study that used the Radimer/Cornell Scale to measure food insecurity found no significant association between food insecurity and body mass index in rural Malaysia [31].

The evidence is that in low-income countries, obesity is associated with affluence but in high-income countries obesity is more often associated with lower socioeconomic status, which had been reported earlier [32].

Household wealth index (a proxy for socioeconomic status) was also associated with greater odds of overweight or obesity. These associations are consistent with what is commonly seen in developing countries where individuals of higher socioeconomic classes are at greater

Table 6 Bivariate analysis of the predictors of household food insecurity

Variable	N	Household food security status		Test statistic
		Food secure *n* (%)	Food insecure *n* (%)	
Household size				
2–4	220	121 (55.0)	99 (45.0)	Chi-square (χ^2) = 0.7, $p = 0.4$
5–10	202	103 (51.0)	99 (49.0)	
Total	422	224 (53.1)	198 (46.9)	
Type of residence				
Urban	212	135 (63.7)	77 (36.3)	$\chi^2 = 19.2, p < 0.001$**
Rural	210	89 (42.4)	121 (57.6)	
Total	422	224(53.1)	198 (46.9)	
Household wealth index				
Low	181	75 (41.4)	106 (58.6)	$\chi^2 = 17.3, p < 0.001$**
High	241	149 (61.8)	92 (38.2)	
Total	422	224 (53.1)	198 (46.9)	
Education				
None	104	38 (36,5)	66 (63.5)	$\chi^2 = 24.4, p < 0.001$**
Low	259	141 (54.4)	118 (45.6)	
High	59	45 (76.3)	14 (23.7)	
Total	422	224 (53.1)	198 (46.9)	
Incidence of diarrhea				
Yes	50	18 (36.0)	32 (64.0)	$\chi^2 = 6.6, p = 0.01$*
No	372	206 (55.4)	166 (44.6)	
Total	422	224 (53.1)	198 (46.9)	

*significant at $p < 0.05$; **significant at $p < 0.001$

risk of overweight and obesity. One possible explanation for these relationships is that wealthy households in developing countries are more likely of purchasing foods especially those that are energy dense and less likely to exercise. On the other hand, poor families may have less access to such foods and may do more exercise through walking. In the developed countries, the opposite appears to occur, where the wealthy families are able to access more healthy diets including vegetables and less concentrated energy dense foods.

Conclusions

Household food insecurity was negatively associated with maternal BMI. Women in food-secure households were more likely than food-insecure households to consume milk, pulses, oily and sugar-based foods.

Policy implications of findings

The major finding is that even among less vulnerable women (i.e., non-pregnant and lactating), household food insecurity adversely affected their nutritional status and that poverty was key determinant of food access. Therefore, policy makers and programme managers should focus on interventions (e.g., cash transfer programmes) targeting women to protect their food consumption and livelihoods, thereby reducing their vulnerability to the adverse effects of household food insecurity. Food insecurity information systems should be central to successful implementation of interventions.

Limitations of the study

Our design was a cross-sectional study, and as with all such studies, causality cannot be inferred. In cross-sectional studies, one-point time measurement is not an appropriate method for judging the association between household food insecurity and nutritional status of the mother. This means multiple measurements in prospective studies would allow investigators to establish the true association.

Abbreviations

ANCOVA: analysis of covariance; ANOVA: analysis of variance; BMI: body mass index; FAO: Food and Agriculture Organization; HFI: household food insecurity; HFIAS: Household Food Insecurity Access Scale; HHS: Household Hunger Scale; PPS: probability proportionate to size; SES: socioeconomic status.

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Competing interests

The authors declare that they have no competing interests.

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