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Food insecurity and perceived stress but not HIV infection are independently associated with lower energy intakes among lactating Ghanaian women

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Abstract

HIV seropositive women living in low-income communities may have difficulty meeting the increased energy requirements that are associated with both lactation and HIV infection. Data on household food security and maternal socio-demographic characteristics, perceived stress, anthropometry, reported illness, dietary intakes and preferences, and exposure to nutrition education were collected from 70 lactating women (16 seropositive (HP), 27 seronegative (HN), and 27 who refused to be tested and had unknown HIV status (HU)). Diet was assessed with three 24-hr recalls (one market day, one weekend day, and one non-market weekday). Data were collected at 8.4 (SD=4.7) months postpartum. Most women (74.3%) reported being in good health at the time of study. Three-day mean energy intakes did not differ by HIV status (HP: 12000 kJ (SD=3600), HN: 12600 kJ (SD=5100), and HU: 12300 kJ (SD= 4800); p=0.94). Protein, fat, vitamin A, thiamin, riboflavin, niacin, vitamin C, calcium, iron, and zinc intakes also did not differ by group (p>0.10). There was a higher proportion of women with high stress levels in food insecure households compared to food secure households (55.6% vs. 26.5%; p=0.01). Energy intake was independently negatively associated with food insecurity (high: 11300 kJ (SD=3500) vs. low: 13400 kJ (SD=5400), respectively; p=0.050) and stress (high: 10800 kJ (SD=2800) vs. low: 13400 kJ (SD=5300), p=0.021). These results suggest the need to integrate multi-dimensional interventions that address economic and mental health constraints which may limit some women's ability to meet their dietary needs.

Keywords

HIV; human lactation; diet; food security; maternal mental health; low income countries

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Introduction

Lactation is an energy-demanding physiological process that increases maternal energy expenditure by 25–30%, a need that can be met partially by the mobilization of fat stores accumulated during pregnancy (Dewey 1997; Hytten 1959, 1979). These fat reserves are present in women who gain at least 11–12 kg during pregnancy and they provide 419 – 628 kJ/day during the first six months of lactation (Hytten 1979). To meet the energy demands of milk production, it is recommended that well-nourished lactating women with adequate gestational weight gain increase their energy intake by 2.1 MJ/day for the first six months to complement the energy from fat reserves (FAO/WHO/UNU 2001). Women who are undernourished or those with inadequate gestational weight gain should increase their energy intake by 2.8 MJ/day. In the second six months postpartum, additional energy requirements depend on the rate of milk production which varies greatly among women and populations. The average energy cost of lactation during this period is 1.9 MJ/day.

Women who are infected with the Human Immunodeficiency Virus (HIV) tend to have additional energy requirements as a result of higher resting energy expenditures, even in the absence of secondary infections (Grinspoon et al. 1998). To maintain body weight, the World Health Organization (WHO) recommends that people living with HIV increase their energy intakes by 10–30%, depending on the stage of infection (WHO 2003).

Adequate nutrition is essential to maintain a healthy immune system, sustain physical activity, and assure optimal quality of life. In Ghana, adult HIV prevalence was 1.9% at the end of 2007, with about 150,000 women living with HIV/Acquired Immunodeficiency Syndrome (AIDS) (UNAIDS 2008). To date, there have been few studies which have examined the diet of Ghanaian women infected with HIV (Wiig and Smith 2007), and there is a dearth of information on the diets of HIV-infected lactating women. The objective of this study was to evaluate the diet of Ghanaian lactating women living in a region with relatively high HIV prevalence and assess the determinants, including HIV infection, of energy intake.

Materials and Methods

Study area

This research was conducted in Manya and Yilo Krobo, semi-urban districts in the Eastern Region of Ghana, about 60 km east of the capital, Accra, with a population of about 154,000 in 2000 (Ghana Statistical Service 2000). These districts were chosen because the area had the highest HIV prevalence among pregnant women in Ghana at the time of study initiation (7.8% in 2000) (National AIDS/STI Control Programme and Disease Control Unit 2001).

Study design

This was an observational cross-sectional study embedded in an infant health cohort study, entitled “Research to Improve Infant Nutrition and Growth” (RIING). The RIING project examined factors that alter households’ ability to provide optimal feeding and care-giving for infants. Inclusion criteria for the RIING project included: 1) pregnant at time of recruitment, 2) offered voluntary counseling and testing (VCT) service at a participating hospital, 3) if the woman chose to receive VCT (*opt-in*), she agreed to have HIV results released to the project, 4) free at enrollment from obvious physical conditions that would limit ability to care for the child, including AIDS, 5) at least 18 years of age, and 6) resident in the study area. Enrollment was completed by VCT nurses at three hospitals in the district; the nurses were not part of the study staff. Mothers were stratified by VCT attendance and

HIV status: completed VCT and tested HIV seropositive (HP), completed VCT and tested HIV seronegative (HN), and refused VCT and had unknown HIV status (HU). This opportunistic sample included a total of 70 lactating women (16 HP, 27 HN, and 27 HU) who were active RIING participants during the four months of data collection (May to August, 2005) when this cross-sectional study was completed. No woman refused participation. Setting α at 0.05 and power at 0.80, this attained sample would be sufficient to detect a significant model for energy intake only if the effect size of HIV status were large (Cohen, 1988). The project was approved by the Institutional Review Boards at Iowa State University, University of Connecticut and the Noguchi Memorial Institute of Medical Research at the University of Ghana, Legon. Written informed consent was obtained from all participants.

Data Collection

The following household and maternal data were obtained from the RIING data set: household food security status, maternal HIV status (extracted from hospital VCT records by the field supervisor for those women who were tested), background characteristics (age, ethnicity, education, live births, and marital status), perceived stress, and anthropometry. Additional information on maternal recent health and dietary intakes were collected exclusively for this study. For the RIING study, stress was measured every three months, weight and mid-upper arm circumference (MUAC) were measured monthly and height was measured six months postpartum. For stress, weight and MUAC, this study used the data point closest in time to when the dietary data were collected (maximum difference in time between data collected for this study was 45 days for stress and 15 days for weight and MUAC). All questionnaires were administered in the mothers' preferred local dialect (Krobo, Twi or Ewe).

Household characteristics

Household food security was measured with a 19-item survey, which was adapted from the United States Department of Agriculture (USDA) Household Food Security Core Module (Bickel et al. 2000). The USDA module is based on the Radimer/Cornell measure, which has been validated elsewhere in Africa (Lenya et al. 2007). This tool documented for the past month maternal experiences and perceptions of household food availability, access and utilization and also coping mechanisms used during times of food scarcity. The module wording was slightly modified to enhance the participant understanding, e.g., "we couldn't afford to eat balanced meals" in the original module was reworded into "we couldn't get the kinds of foods that give us good health".

Maternal characteristics

Maternal perception of stress was assessed using the Perceived Stress Scale (PSS) which measures the frequency for the following four perceptions: 1) confidence about one's ability to handle personal problems; 2) ability to cope with important changes occurring in one's life; 3) feeling that difficulties are piling up so high that one could not overcome them; and 4) inability to control the important things in one's life (Cohen et al. 1983). Possible responses referred to the last month and included never, only once or twice, at least once a week, more than once a week, and almost daily (scored as 1 [never] to 5 [almost daily]). Although the scale originated in the United States, it was designed for wide use. It is relatively context-free and the group items and response options are general, simple, and easy to understand. This scale has been used previously with women in Africa (Beard et al. 2005).

Body weight and height measurements were taken to the nearest 0.1 kg and 0.1 cm, respectively, using a Tanita BWB 800S scale (Tanita Corporation of America, Inc., Arlington Heights, IL) and an adult stadiometer (Shorr Productions, Olney, MD). MUAC was measured to the nearest 0.1 cm at the midpoint between the olecranon and the acromion process using a non-stretchable tape measure (TR 20 Tape Measure, Toledo, Ohio). Women were measured without shoes and with light clothing, using standard methodology (Lohman et al. 1988). All anthropometric measurements were collected in duplicate and the average values were used for analysis.

A pre-tested semi-structured questionnaire was used to obtain information on maternal self-reported illnesses in the past two weeks (malaria, fever, and gastrointestinal disease (GIT) symptoms including stomach aches, diarrhea, and vomiting). Food preferences and exposure to and source of nutrition education during pregnancy or lactation were documented. In addition, to capture a representative picture of the diet, three nonconsecutive 24-hr dietary recalls were collected from each participant, one on a weekday (Tuesday or Friday), one on a market day (Wednesday or Thursday), and one on a weekend day (Saturday or Sunday). All three recalls were completed within a three week period. Visits were not pre-announced and food intakes were not measured on festive days. Portion sizes were estimated using common household measures of known volume (drinking cups, ladles, teaspoons, and tablespoons). Food portions were weighed directly to the nearest 1 g using a food scale (Ohaus LS2000 Portable Standard Scale, Pine Brook, NJ) if the food was available at the time of interview. For purchased foods, the researcher noted the vendor location and the amount purchased, then bought and weighed the food. For traditional foods that were not cooked in the participant's home, common recipes were prepared by at least two participants per recipe to estimate ingredients.

Analysis

Body mass index (BMI) was calculated using weight and height measurements (kg/m^2). Adult BMI classification guidelines were used to categorize weight status: BMI < 18.5 as underweight, BMI ≥ 18.5 and < 25 as normal weight, BMI ≥ 25 and < 30 as overweight, and BMI ≥ 30 as obese (WHO 1995). Women with MUAC measurements < 22 cm were classified as malnourished (National Center for Health Statistics 1996). Composite variables were developed for household food security and maternal perceived stress. For food security, assessment of Cronbach's alpha for the scale indicated that our questionnaire had high internal consistency (alpha = 0.931) (Santos 1999). In the final analysis only the eight adult items from the original USDA scale were used, to be consistent across households with and without children under 16 years of age (excluding infants not yet consuming complementary foods). Based on the additive total score, participants were categorized into one of four levels: food secure (0 positive responses), mild food insecurity (1–3 positive responses), moderate food insecurity (4–5 positive responses), or severe food insecurity (6–8 positive responses). Similar categories have been used previously (Perez-Escamilla et al. 2004).

For maternal perceived stress, PSS scores were obtained by reversing the response values for the first two items that were worded positively (e.g., *In the last month, how often have you felt that you were effectively coping with important changes that were occurring in your life?*) and then summing across all four items. Possible total score ranged from four (least stressed) to 20 (most stressed). The PSS score was converted into a dichotomous variable for descriptive purposes; above the median (> 7) was considered 'high stress', at and below the median (≤ 7) was considered 'low stress'.

Energy and nutrient content of foods was calculated using ESHA Food Processor Plus, FPRO (Version 6.02. Esha Research, Salem, OR), which includes local food composition tables for Ghana and other published food composition information (Eyeson et al. 1975;

Ferguson et al. 1993b). Energy intake was reported in kJ (1 kJ = 0.239 kcal; 1 kcal = 4.186 kJ).

One-way analysis of variance (ANOVA) was used to test between-group differences for normally distributed continuous variables (using Bonferroni post-hoc tests for HIV group comparisons), non-parametric (Kruskal-Wallis) test was used for skewed continuous data, and Pearson's chi-square test was used for categorical data. Then, multiple linear regression analysis was used to build a model for energy intake on those predictor variables that were statistically significant in the bivariate analyses or were in an *a priori* model based on published literature. Diagnostic graphs of the residuals vs. predicted values of the final model indicated that the final model was a poor fit. As the regression analysis provided no additional information beyond the bivariate analyses, it is not presented here. Significance was set at alpha ≤ 0.05. Data are reported to the number of significant figures as suggested by Kelley (1924). Statistical Package for Social Sciences software (SPSS Inc., version 15.0, 2005, Chicago, IL) and SYSTAT (Systat Software, Inc., version 12, 2007, Chicago, IL) were used for all analyses.

Results

Demographic and anthropometric characteristics

Seventy women ranging from 18 to 42 years of age participated in this study; HP women were on average 5 y younger than HN women (Table 1). Most women were married or living with a partner; however, over twice as many HP women were single compared to HN women. Thirty percent (n=18) of all women surveyed had completed only primary school while 4% (n=3) had no formal schooling. The predominant ethnic group was Ga/Adangbe (71%; n=50), followed by Ewe (17%; n=12) and Akan (10%; n=7). A large proportion of the women (86%; n=60) were self-employed, engaging in professions such as trading, catering, dressmaking, and hairdressing. Only 6% (n=4) were salaried workers, while 9% were unemployed (n=6). There were no ethnic or employment differences by HIV status in this sample.

Overall, 7% (n=5) of women were classified as malnourished or underweight (three of whom were HP), while 22% (n=15; 2 HP) were overweight, and 12% (n=8; no HP) were obese. Mean BMI for the HP and HU women were within the normal range, while that for the HN women was classified as overweight (Table 1). MUAC ranged from 21.4 – 41.4 cm. Only one woman, who was HP, was considered to be malnourished (MUAC < 22 cm).

Maternal health

Malaria and fever in the past two weeks were reported by a small proportion of the participating women (Table 1). Eighty-two percent (n=9) of the women who reported having malaria, 60% (n=6) of the women who reported fever, and 80% (n=4) of the women who reported GIT illness also reported a decrease in appetite due to illness. Among the total sample of relatively healthy women, there were no significant differences in illnesses, treatment of illness, or effect of illness on appetite among the three HIV categories.

Maternal perceived stress

Almost half (46%; n=32) of the study participants felt they were unable to control the important things in their lives, while 37% (n=26) of the women said that difficulties piled on them to an extent that they could not overcome them. The analysis was unable to detect a HIV-status group difference in the mean score for perceived stress (Table 1) or in the proportion of women who reported high stress (HP: 43.8%, n=7; HN: 37.0%, n=10; HU:

44.4%, n=12; p=0.839). Energy intake of high stress women was significantly lower than that of low stress women (10800 kJ (SD=2800) vs. 13400 kJ (SD=5300), p=0.021).

Household food security

Twenty-one percent (n=15) of the women reported reducing the amount of food they ate or skipping meals because there was not enough food available, while 16% (n=11) reported losing weight because there was not enough food to eat. Overall, about half of the women lived in food insecure households (Table 1). The analysis did not identify an association between household food security and HIV status in this group of women. Women from food insecure households had a lower energy intakes than those from food secure households (11300 kJ (SD=3500) vs 13400 kJ (SD=5400), respectively; p=0.050). Women from food insecure households had significantly higher PSS scores than those from food secure households (8.9 (SD=3.3) vs.6.9 (SD=2.9), respectively; p=0.008). Also, over half of women from food insecure households had high stress levels (55.6%, n=20 out of 36) whereas about one-quarter of women in food secure households had high stress levels (26.5%, n=9 out of 34; p=0.014).

Nutrition education

The majority of women surveyed (84%; n=59) reported receiving nutrition education in the form of dietary recommendations from personnel at the Ghana Health Services, whose dietary recommendations encouraged lactating women to eat more carbohydrate- and protein-rich foods, energy-dense soups and stews, and fruits, vegetables and snacks. Women reported complying most with the recommendation to increase the intake of soups and stews (88%; n=52). Almost two-thirds of the women also reported increasing intake of carbohydrate-rich foods (63%; n=37), and fruits and vegetables (60%; n=33). Differences by HIV status on reported compliance with Ghana Health Services nutrition recommendations did not reach significance (HP: 68.8%, n=11; HN: 92.6%, n=25; HU: 85.2%, n=23; p=0.114); however, these differences would be statistically significant if the sample were slightly (1.5-fold) larger.

Food preferences

Fifty-eight percent (n=41) of the women purposively sought specific foods during lactation to: 1) enhance breast milk production (54%; n=22), 2) promote health for themselves and their infants (32%; n=13), or 3) satisfy a craving (15%; n=6). Advice to seek specific foods during lactation was obtained from multiple sources, including family members, neighbors, and the media.

Dietary intakes

The one-way ANOVA analysis was not able to determine statistically significant differences in energy intake by HIV status (Table 2) or day of week (weekday: 11700 kJ (SD=4900), weekend day: 12600 kJ (SD=5600), market day: 12700 kJ (SD=6200); p=0.52). The overall mean energy intake was not statistically different from the estimated mean energy requirement (12300 kJ (SD=4600) vs. 12600 kJ, respectively; p=0.62) for women with an active or moderately active lifestyle, using the sample median age (27 y), weight (60 kg), months postpartum (10 mo), and average energy cost of lactation for the second six months postpartum (1925 kJ/d) (FAO/WHO/UNU 2001). Only GIT, and no other illness, was significantly associated with decreased energy intake (GIT: 8800 kJ (SD=2700) vs. no GIT: 12600 kJ (SD=4600), p=0.031).

The analysis also was not able to determine differences in nutrient intake (protein, fat, vitamin A, thiamin, riboflavin, niacin, vitamin C, calcium, iron and zinc) by HIV status

($p>0.10$; Table 2). Mean protein intake was approximately twice the recommended intake (FAO/WHO/UNU 1991), while mean vitamin A intake was three times the recommended intake (FAO and WHO 2001), indicating that intake of these nutrients was most likely adequate. Thiamin and riboflavin intakes were slightly below the RNI ($p=0.016$ and $p<0.001$, respectively). Mean calcium intake was approximately 300 mg above the recommended intake ($p=0.018$). Average iron and zinc intakes were approximately five mg above the RNI for low bioavailability diets ($p=0.003$ and $p=0.005$, respectively).

Discussion

This study is the first to report dietary intakes of Ghanaian lactating women in relation to HIV status. The analysis was not able to identify any differences in energy and nutrient intakes of HIV infected women as compared to women who were uninfected or had not been tested for the virus. Similarly, Vorster et al. (2004) found no difference in dietary intakes (energy, macronutrients and micronutrients) between 'apparently healthy' HP and HN people in South Africa. Another South African study also found no difference in energy intake between HP and HN non-pregnant women aged 35 to 44 years, although among younger women (25 to 35 years of age), HP women had significantly higher energy intakes compared to HN women (Hattingha et al. 2006). These findings may seem contrary to the authors' assumption that HP persons have lower dietary intakes than their HN counterparts. However, diet is determined by a variety of population-specific socio-cultural, economic and medical factors, which should be taken into account when interpreting the results.

One factor is health status. Similar illness rates between study groups suggest that HP women in this study were in the early stages of infection (also, being diagnosed with AIDS was part of the exclusion criteria) and hence dietary intake may not have been limited by symptoms of opportunistic illness or clinical HIV symptoms known to be associated with decreased intakes, such as reduced appetite (Kim et al. 2001). HP women in this study did, however, have lower body weight and BMI than HN women, which may be a reflection of higher resting energy expenditures in HIV-infected individuals (Grinspoon et al. 1998). The WHO recommends an increase in energy intake of 10% among asymptomatic and 20–30% among symptomatic HIV-infected persons (WHO 2003). Hence energy intake that is equal to uninfected women would be expected to result in lower weights among HP women, as was seen here. In addition, women in this study may have made conscious decisions to increase dietary intakes, for example to follow HIV-specific dietary advice, which could also explain the lack of between-group difference seen in intakes. We do not think that the absence of group differences in energy intake was due to inadequate power due to the small sample size. To pick up a statistically significant difference in the energy intakes observed in this sample, a very large sample size of over 3000 individuals would have been needed. In addition, the average group difference between HP and HN women was small, only 600 kJ (144 kcal) or about 5% of total intake.

This study did not collect information on HIV treatment, duration of infection, detailed illness symptoms, or have access to clinical or laboratory data such as CD4+ counts or viral load. Future studies will add to our understanding of dietary intakes in this and other similar populations by including laboratory information and stratifying participants by progression of disease.

Energy intakes seen in this study were higher than those of HIV-uninfected Ghanaian lactating women attending an ante-natal clinic in Accra (7400 kJ (SD=600)) (Kluvitse and Lartey 1999). Energy intakes were also higher than what has been observed among lactating women in similar studies among South African, Brazilian, and Guatemalan women (8500 kJ (SD=2000); 9100 kJ (SD=2200); and 8100 kJ (SD=1500), respectively) (Gracas Tavares do

Como et al. 2001; Kesa and Oldewage-Theron 2005; Schutz et al. 1980). However, mean energy intakes for women in this study were no different from their estimated energy requirement, indicating intakes were appropriate for their activity level, weight and duration of lactation. Further, the BMI values suggested that many of the women were overweight, a finding consistent with higher energy intakes. Recent research in Ghana has shown that being overweight is prevalent (reaching as high as 16% in Accra) and rates are higher in women than men (Biritwum et al. 2005). This is a serious cause for concern for Ghanaian women's health; overweight and obesity are linked with an increased risk of health conditions such as high blood pressure and diabetes (Must et al. 1999) as well as mortality (Solomon and Manson 1997).

Intakes of several micronutrients in this study appear high compared to the recommended values. The influence of social desirability may lead some people to overestimate their intake of 'socially desirable' foods (Maurer et al. 2006). Research in the U.S. has demonstrated that 24-hour dietary recalls, compared to weighed food records, overestimated intake of fruits and vegetables (Fisher et al. 2008), foods of high social value in North America. In the Ghanaian setting, socially desirable and relatively expensive foods include animal source foods and palm oil (unpublished observations). Overestimation of these energy- and micronutrient-dense items may have led partially to the high intakes observed in this study.

High energy and nutrient intakes seen in this study could also be attributed to the actual intake of specific energy- and nutrient-dense foods during lactation, especially traditional soups and stews. It is a cultural practice in Ghana for lactating mothers to be given such foods to enhance breast milk production. Ghana Health Services recommends lactating women eat more energy-dense soups and stews, and the large majority of women in this study reported complying with this recommendation. Preferred dishes sought by lactating women in this study included palm soup, peanut butter soup, *light soup* (tomato soup), and *palaver sauce* (green leafy vegetable stew). These traditional soups and stews are energy-dense, and are rich in micronutrients such as s-carotene, a precursor of vitamin A. For example, a typical adult serving is 332 g of palm soup served with 242 g of *fufu* (pounded cooked cassava and plantain; together this provides 3100 kJ energy and 2200 RE vitamin A) and 125 g of *palaver sauce* served with 446 g of boiled rice (together providing 3300 kJ energy and 2200 RE vitamin A).

Although intakes of some micronutrients appear high, the actual amount absorbed may be much lower, especially for iron and zinc. In the Ghanaian diet, starchy staples such as maize and cassava are the major sources of energy and several micronutrients including iron and zinc (Ferguson et al. 1993a). These foods are high in phytates (Ferguson et al. 1993b), which greatly reduce iron and zinc absorption (Hallberg et al. 1989; International Zinc Nutrition Consultative Group (IZiNCG) 2004). Although the nutrient recommendations used in this study account for low bioavailability (FAO/WHO 2001), data were not available to calculate absorption rates which, if lower than expected would increase the required intakes.

The perceived stress level of women in this study ranged widely and the analysis was not able to determine a difference by HIV status. Moore et al. (1999) reported no difference in the number of adverse (or stressful) life events, nor depressive symptoms, between HIV infected and uninfected women and suggested that, for women in the early stages of the disease, socio-economic factors may be more important than HIV infection in determining negative psychosocial outcomes. Another reason for our findings could be extended family or existing support systems in the area. Solomon et al. (1998) reported indicators of access to healthcare which may buffer stress, such as health insurance, were higher in HP women compared to HN women. It may be that additional stress associated with the knowledge of being HIV infected is offset by additional services or care received by this population (Moore et al. 1999). The Eastern region has the highest HIV prevalence in Ghana (Ghana Ministry of Health 2002), and therefore may have evolved more support systems for HP persons. All three hospitals included had VCT programs in place and offered antiretroviral therapy. At the time of this study, two non-governmental organizations in the region provided free food packages including wheat, milk, and vegetable oil for individuals with HIV/AIDS. However, it is not known if HP women in our study received these packages.

Findings showed that food insecurity was associated with reduced energy intake. This is not surprising, considering the household food security instrument measured experiences and perceptions of food availability, accessibility and utilization. Similar findings have been previously reported (Rose 1999). Results also showed that maternal perceived stress was negatively associated with energy intake. Previous research in adults and students in England and students in China has shown that perceived stress is associated with higher intakes of energy, snack and sweet foods (Liu et al. 2007; Oliver and Wardle 1999; Wardle et al. 2000). There are different theories on the effect of stress on eating, and how the effect is modulated by an individual's weight. One theory postulates that in normal-weight individuals, stress leads to decreased eating whereas there is no change in eating among obese individuals (Schachter et al. 1968). Although data are lacking to support this theory, it is consistent with this population, which was on average of normal weight. Food insecurity was highly related to stress, therefore the association between stress and energy intake could be partially reflective of the relationship between stress and food insecurity.

Because this was a cross-sectional observational study, it is not possible to separate out or understand the direction of the relationships between food insecurity, stress, and diet. However, it seems likely that food insecurity, in addition to other factors, is causing stress as stress has been identified as a psychological manifestation or consequence of household food insecurity (Hamelin et al. 1999). Regardless of the relationship between the two, both food insecurity and stress were present and common in this population and both should be addressed. To the authors' knowledge, this is the first study to report that high perceived stress is associated with reduced energy intakes in lactating mothers. Reduced dietary intakes may have detrimental effects on maternal health, especially for HP women. Maternal stress may also pose a risk on the infant because it can suppress lactation (through reduced milk synthesis and ejection) (Chantal 2001) and may have a negative effect on the way mothers interact with their children (Gordon et al. 1989). Knowledge of at-risk groups is important when planning interventions, especially in low-resource settings such as Ghana. Community interventions that integrate economic as well as mental and physical health components may be more effective in addressing barriers to healthy diets of lactating mothers thereby promoting the health and well-being of mothers and their children.

In conclusion, energy and nutrient intakes among these relatively healthy Ghanaian lactating women were not associated with HIV status in this analysis; however, energy intake was associated independently with both food insecurity and perceived stress. The lack of significant associations in some cases in this analysis may be due to the small sample size. Further research on maternal diets with larger, representative samples, will provide a more complete understanding of the associations among maternal HIV status, diet, stress, and food insecurity in this population.

Since this was the first study examining the diets of Ghanaian women who were infected with HIV at the time of lactation, additional research is needed to substantiate these findings and to validate them for other populations in Ghana. Longitudinal follow-up would be useful to understand the dietary challenges faced by women as the HIV disease progresses.

Key messages

- In this sample of lactating Ghanaian women who are HIV seropositive, seronegative, or of unknown status, average energy intakes were similar to WHO estimated energy requirements.
- Household food insecurity and perceived maternal stress were common and highly related; both were independently associated with lowered energy intakes among lactating Ghanaian women.
- Adult overweight and obesity is a growing concern in Ghana; nutrition education should include information on maintaining healthy weights as women age.

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Table 1

Demographic and anthropometric characteristics, perception of health and reported illness of Ghanaian lactating women, by HIV status

Characteristic	All (n=70)	Seropositive (n=16)	Seronegative (n=27)	Unknown status (n=27)	p[1]
			mean (SD)		
Postpartum period (mo)	8.4 (4.7)	7.0 (4.9)	9.9 (4.8)	7.7 (4.2)	0.087
Age (y)	28.0 (5.5)	25.8 (4.7)[a]	30.5 (6.0)[b]	26.7 (4.4)[a]	**0.006**
Education (y)	8.1 (3.1)	7.7 (3.2)	8.5 (3.0)	8.0 (3.1)	0.685
Live births (#)	1.3 (1.5)	1.3 (1.7)	1.8 (1.5)	0.9 (1.1)	0.063
BMI (kg/m^2)[2]	24.4 (4.7)	21.0 (3.3)[a]	26.4 (5.3)[b]	24.2 (3.6)[b]	**0.001**
MUAC (cm)[3]	28.8 (4.1)	25.6 (3.0)[a]	30.7 (4.7)[b]	28.8 (2.9)[b]	**<0.001**
Perceived stress score	8.0 (3.3)	7.3 (2.4)	7.6 (2.6)	8.7 (4.1)	0.306
			% (n)		
Marital status					**0.007**
Married	37.1 (26)	12.5 (2)	63.0 (17)	25.9 (7)	
Cohabitating	40.0 (28)	50.0 (8)	22.2 (6)	51.9 (14)	
Single	22.9 (16)	37.5 (6)	14.8 (4)	22.2 (6)	
Perceived health as poor	25.7 (18)	31.2 (5)	25.9 (7)	22.2 (6)	0.807
Household food security status					0.186
Food secure	48.6 (34)	62.5 (10)	44.4 (12)	44.4 (12)	
Mild food insecurity	30.0 (21)	18.8 (3)	44.4 (12)	22.2 (6)	
Moderate food insecurity	10.0 (7)	12.5 (2)	7.4 (2)	11.1 (3)	
Severe food insecurity	11.4 (8)	6.2 (1)	3.7 (1)	22.2 (6)	
Reported illness (past 2 wk)					
Malaria	15.7 (11)	12.5 (2)	14.8 (4)	18.5 (5)	0.920
Fever	14.3 (10)	18.2 (3)	11.1 (3)	14.9 (4)	0.907
Gastrointestinal illness	7.1 (5)	6.3 (1)	11.1 (3)	3.7 (1)	0.837

[1] p-values compare groups by HIV status using Pearson's chi-square test for proportions and one-way ANOVA for means (with Bonferroni post-hoc tests for significant ANOVA tests)

[a,b] Values with same superscript in a row are not significantly different from each other ($p \geq 0.05$)

[2] BMI= body mass index; n=15 (seropositive), 27 (seronegative), 25 (unknown status)

[3]MUAC = mid-upper arm circumference

Table 2

Energy, protein, fat, vitamin A, thiamin, riboflavin, niacin, vitamin C, calcium, iron and zinc intake of Ghanaian lactating women, by HIV status

	All (n=70)		Seropositive (n=16)		Seronegative (n=27)		Unknown status (n=27)		
	mean (SD) 50th centile (25th,75th)								
Energy, kJ[1]	12300 (4600)	11200 (9400,14000)	12000 (3600)	11400 (9600,13400)	12600 (5100)	11300 (9600,14600)	12300 (4800)	11200	(9400,13300)
Protein, g	126 (75)	103 (83,141)	108 (34)	102 (86,122)	126 (82)	96 (73,140)	137 (85)	110	(85,170)
Fat, g	87 (43)	80 (61,112)	86 (49)	69 (56,111)	95 (51)	82 (61,123)	80 (28)	80	(63,102)
Vitamin A, µg	2540 (1330)	2510 (1480,3500)	2690 (1170)	2760 (1880,3490)	2430 (1500)	2380 (1260,3660)	2570 (1280)	2460	(1540,3660)
Thiamin, mg	1.28 (0.76)	1.09 (0.91,1.41)	1.12 (0.34)	0.98 (0.84,1.44)	1.42 (1.07)	1.12 (0.92,1.41)	1.23 (0.52)	1.08	(0.95,1.36)
Riboflavin, mg	1.31 (0.52)	1.21 (0.94,1.60)	1.24 (0.43)	1.21 (0.86,1.51)	1.34 (0.61)	1.21 (0.96,1.60)	1.32 (0.50)	1.22	(0.94,1.68)
Niacin, mg	23.2 (9.0)	22.2 (16.5,27.7)	23.2 (9.8)	22.1 (15.9,30.7)	22.9 (9.6)	20.8 (15.8,26.3)	23.6 (8.2)	24.8	(18.2,29.7)
Vitamin C, mg	134 (65)	129 (94,168)	142 (66)	132 (90,190)	120 (56)	111 (76,164)	143 (73)	130	(111,163)
Calcium, mg	1320 (1090)	980 (610,1480)	1110 (590)	1020 (700,1380)	1230 (1010)	860 (540,1460)	1520 (1360)	980	(570,1930)
Iron, mg	36.2 (16.7)	32.4 (26.6,40.1)	34.3 (9.1)	34.3 (27.9,37.5)	36.8 (18.5)	32.8 (24.7,37.9)	36.8 (18.5)	30.1	(26.6,42.4)
Zinc, mg	19.0 (13.5)	15.6 (11.7,21.8)	16.5 (94.7)	16.5 (14.0,18.3)	18.7 (14.1)	15.4 (9.8,19.0)	20.9 (16.3)	15.6	(11.6,27.9)

Note: There were no statistically significant differences between HIV groups

[1] 1 kJ = 0.239 kcal; 1 kcal = 4.186 kJ

Recommended intakes: estimated energy requirement 12600 kJ/d; protein recommended nutrient intake (RNI) 58 g/d; vitamin A adequate intake (AI) 850 µg; thiamin recommended nutrient intake (RNI) 1.5 mg/d; riboflavin RNI: 1.6 mg/d; niacin RNI 17 mg/d; vitamin C RNI 70 mg/d; calcium recommended intake 1000 mg/d; iron RNI 30 mg/d (low bioavailability); zinc RNI 14.4 mg/d (low bioavailability) (FAO & WHO 2001; FAO/WHO/UNU 1991, 2001)