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Relationship between HIV infection and the dietary intakes of Ghanaian pregnant and lactating women

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Relationship between HIV infection and the dietary intakes of Ghanaian pregnant and lactating women

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Signatures have been redacted for privacy

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ABSTRACT

Maternal energy and nutrient deficiencies increase the risk of poor pregnancy outcomes and, among women with HIV, hasten the progression of disease. We identified factors associated with dietary intakes of Ghanaian women by HIV status. We also assessed women's dietary habits, food beliefs and compliance with nutrition recommendations received from the Ghana Health Services (GHS). A total of 92 pregnant and lactating women (23 HIV-infected, 33 HIV-uninfected, and 36 of unknown status) completed the study. Most women (86%) reported receiving nutrition recommendations. The recommendations most complied with included eating more protein foods and consuming more soups and stews, especially palm soup and *kontomire* (a green leafy vegetable) stew. The latter two foods are rich in β-carotene, a precursor of vitamin A. About 9% of participants in this study practiced pica, 59% sought specific foods, and 24% avoided certain foods. Nearly half (47%) of the women believed some foods were beneficial for HIV infected individuals. Reported energy intake did not differ by HIV status (2780 ± 800; 2980 ± 1140; and 2880 ± 1020 kcal for infected, uninfected, and unknown, respectively) or by physiological status (2670 ± 570 and 2960 ± 1100 kcal for pregnancy and lactation, respectively). Protein and micronutrient intakes (vitamins A, B_1, B_2, and C, calcium, and iron) were also similar by HIV and physiological status. After controlling for health, economic, and dietary recommendation indicators, being unmarried was negatively associated with intake of energy, protein, thiamin, and niacin ($P < 0.04$), while stress was associated with decreased intake of energy, fat, iron, vitamins A, B_1,

B_2, B_3, and C ($P < 0.03$) and tended to be associated with protein intake ($P < 0.06$). Absence of gastrointestinal discomfort was also positively associated with energy intake ($P < 0.02$) and tended to be associated with fat intake ($P < 0.06$). Ghanaian women were amenable to nutrition recommendations given by Ghana Health Services. However, food beliefs that could limit women's dietary intakes need to be examined. This is especially true for HIV-positive pregnant and lactating women who may have higher nutrient requirements than their contemporaries who are HIV-uninfected.

CHAPTER 1. GENERAL INTRODUCTION

Thesis organization

This thesis begins with a general introduction which includes the rationale behind this research. Following the general introduction is a review of relevant literature, objectives and specific aims of this study, research questions, conceptual framework and a thorough description of all materials and methods used. The following two chapters are manuscripts prepared for submission to scientific journals, each with an introduction, study design, discussion of results, and conclusions. The thesis finishes with overall conclusions, future directions, acknowledgement, references cited, and appendices.

Introduction

Maternal nutritional status is one of the strongest predictors of pregnancy outcome. Inadequate dietary intake among HIV-infected pregnant and lactating women is a public health concern primarily because maternal dietary deficiencies can exacerbate the progression of HIV and increase the odds for mother-to-child transfer of HIV. HIV infection can also result in malabsorption and excess nutrient loss (Singhal and Austin, 2002). The increased nutritional demands of pregnancy and lactation can also accelerate weight loss making it a risk factor for reduced survival in HIV infection (Baum et al., 1997).

Global estimates show that at the end of 2005, about 17 million women worldwide were infected with HIV; about 13.5 million of whom are from sub-Saharan Africa (UNAIDS/WHO, 2005). In Ghana, HIV awareness is over 95% but this awareness has yet to translate into substantial preventive behavioral change (Ghana Demographic and Health Survey, 2003). Sentinel data for the Ghana indicate that the mean HIV prevalence for pregnant women reporting at ante-natal clinics over the last five years (2000-2004) is 3.1% (110,000 – 300,000 pregnant women are HIV-infected (MOH/DCU: HIV/AIDS Sentinel Surveillance Data, 2004). Given that this many HIV-infected women become pregnant each year, it is imperative that the energy and nutrient intakes of women, especially HIV-infected women, be examined.

CHAPTER 2. LITERATURE REVIEW

Nutrition during pregnancy

Adequate maternal weight gain during pregnancy is essential to ensure optimal growth and survival of the developing fetus (Ramakrishnan et al., 1999). Inadequate weight gain has been associated with preterm delivery, intrauterine-growth retardation (IUGR) and birth of low birth weight infants (Scholl et al., 1992, Norton 1994; Lechtig and Shrimpton, 1997). Studies shave shown that while women in western countries gain an average of 10-12 kg during pregnancy, women in low-income countries gain weight within the range of 2-7 kg (Ghassemi, 1990). This suggests that women in low income countries may be more vulnerable to poor birth outcomes. Components of weight gain can be divided into two parts: products of conception and maternal tissue accretion (Hytten and Leitch, 1980). Conponents of conception include the fetus, placenta, and amniotic fluid (Table 1). Fetal growth, which contributes about one-fourth of the total weight gained during pregnancy, usually follows a sigmoid curve with growth slowing in the final weeks of gestation. Placental development and amniotic fluid accounts for about 5% and 6%, respectively, of total weight gain during pregnancy. But this value also declines towards the latter part of pregnancy. Expansion of maternal tissues is a major contributing factor (about two-thirds) to the increase in weight gain during pregnancy and this is usually accompanied by an expansion in blood volume, which in turn accounts for approximately 10% of the total weight gain in pregnancy (Table 1). Hytten (1980) estimated that on average, fat and protein contribute about 30% and 8%, respectively, of the total weight gain at term. Most of the total protein accretion

is located in the products of conception (described above); the rest is accounted for by the increase in maternal uterine, mammary and blood tissues. Fat on the other hand may be stored for two purposes: either as a maternal energy reserve in case food supply becomes limited, and for lactation.

Table 1. Components of average weight gained in normal pregnancy

Component	**Amount gained (g)**			
	10 weeks	20 weeks	30 weeks	40 weeks
A. Total gain of body weight	650	4,000	8,500	12,500
Fetus	5	300	1,500	3,300
Placenta	20	170	430	650
Amniotic fluid	30	250	600	800
Increase of: Uterus[a]	135	585	810	900
Mammary gland[b]	34	180	360	405
Maternal blood	100	600	1,300	1,250
B. Total (rounded)	320	2,100	5,000	7,300
C. Weight not accounted for (A-B)	330	1,900	3,500	5,200

Source: Hytten and Leiteh, 1980 [a]Blood-free uterus [b]Blood-free mammary glandular tissue

Table 2. Recommended dietary intakes of some selected nutrients for pregnancy and lactation

Nutrient (recommended intake per day)	Non-pregnant woman	Pregnant woman	Lactating woman
Energy (kcal)	2200	No change in 1st trimester Additional 300 kcal/d for 2nd and 3rd trimesters	Additional +500 kcal/d during 1st 6 months
Protein (g)	50	71	71
Calcium (mg)	800	1000	1000
Phosphorus (mg)	800	700	700
Iron (mg)	15	27	9
Thiamin (mg)	1.1	1.4	1.4
Riboflavin (mg)	1.3	1.4	1.6
Niacin (mg NE)	15	18	17
Zinc (mg)	12	11	12
Iodine (µg)	150	220	290
Selenium (µg)	55	60	70
Vitamin A (µg RE)	800	770	1300
Vitamin D (µg)	5	5	5
Vitamin E (µg TE)	8	15	19
Vitamin C (mg)	60	85	120
Vitamin B-6 (mg)	1.6	1.9	2.0
Vitamin B-12 (µg)	2	2.6	2.8
Folate (µg)	180	600	500

Source: Dietary Reference Intakes: Recommended Intakes for Individuals. National Research Council, National Academy of Sciences, 1999, 2000, 2001, 2002 Institute of medicine, 2002; NE = Niacin Equivalent; RE = Retinol Equivalent; TE = Tocopherol Equivalent

Energy requirements in pregnancy and lactation

Pregnancy imposes additional energy needs because of added maternal tissues, growth of the fetus, and the placenta. For a full term pregnancy in which a mother gains about 12.5 kg and gives birth to a baby weighing 3.3 kg, the total energy cost of pregnancy has been estimated to be about 80,000 kcal (Hytten and Leitch, 1971). This is primarily due to extra energy requirements (approximately 350 kcal / day) needed during the last two trimesters of pregnancy. The amount of fat deposited in the body of a healthy pregnant women has an energy equivalent which Hytten and Leitch postulated as being almost half of the total extra energy cost of pregnancy i.e. about 167 MJ (40,000 kcal) (Hytten and Leitch, 1971). Accumulated fat, which is mostly in the mother but also in the fetus during the last weeks of pregnancy, accounts for over 36,000 Kcal of the stored energy.

The World Health Organization (WHO) in 1985 estimated the energy allowance for pregnant women by dividing the gross energy cost (80,000 kcal) by the approximate duration of pregnancy (250 days following the first month). This yielded an average of 300 kcal / day. This amount of energy added to the requirement for a non-pregnant woman is considered sufficient to maintain a pregnancy, especially during the second and third trimesters (Table 2). However, if a woman begins pregnancy with depleted body reserves, additional energy intake is required from the first semester.

Several studies have examined the energy intakes of pregnant women in various parts of the world with the aim of assessing what the optimum energy intake should be for pregnant women in different countries. In a longitudinal study involving five countries (Scotland, Gambia, Netherlands, Thailand and The Philippines), researchers found that total fat gain in pregnant women was less than the average 3.5 kg proposed by Hytten and Leitch (Durnin, 1987). In terms of total energy intake, the average total energy cost of pregnancy was about 60,000 kcal, except for Gambian women who had energy costs of only 19,200 kcal. Also, with the exception of Thai women whose mean daily increase in energy was 240 kcal / day over the baseline value, energy intakes of women from all the other countries did reach the theoretical value expected. Even though the Gambian women did not meet the recommended intakes, they seemed to experience a physiological adjustment during pregnancy, which allowed them to save energy in the form of basal metabolism. Thus, they were in positive energy balance for the duration of their pregnancy. Durnin's study concluded by suggesting that for women in developing countries, relatively smaller increases in energy intake (approximately 100 kcal / day) may be adequate to satisfy requirements.

Energy requirements for lactation are estimated based on the amount of fat deposited during pregnancy as well as the quantity of milk produced (Hytten, 1980; WHO, 1985). Average milk secretion during the first six months of lactation is about 750 ml / day and decreases to about 600 ml / day in the second six months. The average energy content of human milk is estimated to be around 70 kcal / 100 ml of

breast milk while the efficiency with which maternal energy is converted to milk is about 80% (WHO, 1985; Sadurkis et al., 1988). Based on these estimates, the Institute of Medicine in 2002 recommended that the average lactating woman increase her energy requirements by at least 500 kcal / day for the first six months. Additional increases after the first six months should be based on the mother's nutritional status. Energy needs during lactation may be partially met by way of the extra fat stored during pregnancy. However, such reserves (2-3 kg) are only present in women who gained about 11-12 kg during pregnancy. These reserves can provide about 100 to 150 kcal /day during a 6 month lactation period. Additional energy is therefore required to ensure appropriate lactation. The recommended energy allowance for lactating women who do not achieve adequate weight gain during gestation or whose weight falls below the standard for their height and age is estimated to be about 650 kcal / day during the first six months (Dewey et al., 1996).

Requirement for other nutrients during pregnancy and lactation

Protein is essential in pregnancy because it is incorporated into fetal tissue and maternal sites such as the uterus. Protein stores account for over 5000 kcal of the total energy cost during pregnancy (Hytten, 1980). The maximum daily accretion of protein in the final weeks of pregnancy is estimated to be about 6 g per day. Maternal under-nutrition can affect milk output and protein content of breast milk (Prentice et al., 1983). Low protein intakes may also alter certain fractions of milk nitrogen. The recommended increment in protein intake during lactation has been estimated to be about 20 g/day (Table 2) (IOM, 2002). This estimate took into

account the milk protein concentration of human milk which is about 15 g/liter, as well as the cost of non-protein nitrogen in human milk (which is approximately 26% of total nitrogen in human milk) (Dewey et al., 1996). Even in a well nourished individual, additional intake of specific vitamins and minerals (e.g. vitamin E, vitamin C, vitamin B6, vitamin B12, folate, and iron) is required during pregnancy and lactation. Vitamin D supplementation may be required by some Arab and Asian women who cover up their bodies most of the time hence have little exposure to sunlight (Glerup et al., 2000; Alfaham et al., 1995). Because the fetus in womb and the breast-feeding infant are dependent on maternal stores of calcium for their total calcium load, inadequate maternal calcium intake can negatively affect fetal bone health and breast milk production (Thomas and Weisman, 2006; Dewey et al., 1996). The extra requirement for calcium is about 2 g / day for both pregnant and lactating women and this requirement can be attained through the diet by the consumption of dairy products, greens leafy vegetables, and the consumption of calcium fortified foods. Iron requirements have received much attention because globally, it is estimated that around 20% of women begin pregnancy in an iron deficient state (Hallberg and Rossander-Hulten, 1991). Iron deficient anemic women are known to have shorter pregnancies than non-anemic pregnant women (Scholl et al., 1992). Some studies have also shown that anemic pregnant women have a higher risk of pre-term delivery as compared to non-anemic women (Garn et al., 1981; Murphy et al., 1986). In both studies cited, the iron-deficient, anemic group had twice the risk of those without anemia; however, iron-deficient non-anemics did not differ from other non-anemics. These results were significant even after

controlling for maternal age, parity, ethnicity, prior low birth weight or pre-term delivery, bleeding at entry to health care, gestational age at initial blood draw, number of cigarettes smoked per day, and pre-pregnancy body mass index. Unfavorable pregnancy outcomes (e.g. high rates of fetal death and abnormalities, premature deaths, and low birth weight of newborns) are also more common among anemic mothers than non-anemic mothers (Murphy et al., 1986). The causality of anemia in these undesirable pregnancy outcomes has been established by studies that showing improvements in birth weights and reductions in perinatal deaths as a result of the successful treatment of anemia with iron and folic acid. For instance, low birth weight was reduced from 50% to 7% and perinatal mortality dropped from 38% to 4% in a study in Nigeria (Fleming, 1991).

Reproductive aged women tend to be more at risk of developing iron deficiency anemia due to their increased iron needs because of menstruation and the substantial iron demands of pregnancy (Table 3). Median requirements of absorbed iron are estimated to be about 15 mg / day among adult menstruating females. Iron needs exhibit a marked increase during the second and especially during the third trimesters when median daily needs increase up to 27 mg / day (that is 7 mg above pre-pregnancy needs). This amount of absorbed iron needs cannot be met from the ordinary diet even if iron fortification is in place. While some controlled trials have showed that iron supplementation in pregnancy only corrects normal hematological changes but offers no clinical benefits, other studies have shown that iron supplementation increases Hb and serum ferritin levels during pregnancy and also

improves the maternal iron status even in women who enter pregnancy with adequate iron stores (Mahomed and Hytten, 1989; Svanberg et al., 1976; Puolakka et al., 1980; Milman et al., 1991). There is no evidence that iron deficient or anemic mothers are less competent than their normal counterparts in the process of lactation, and milk composition. Iron deficiency during lactation is mostly a residual of pregnancy and delivery and can be partially alleviated because of lactational amenorrhea.

Table 3. Iron costs of pregnancy

Factor	Milligrams of iron	
	Range	**Median**
Fetal iron	200-450	270
Placental iron	30-170	80
Partum and puerperium losses	90-310	250
Hemoglobin and tissue expansion	130-430	200*
Maintenance during amenorrhea	160-220	190
Subtotal 1 (total iron costs)	610-1580	990
Postpartum involution iron	130-430	200
Total	480-1150	790

*Iron-unsupplemented women. For iron-supplemented women this value is 450 mg
Source: Hallberg, 1988

Folate deficiency during pregnancy has also been extensively documented: and is often thought to result in combined iron-folate deficiency anemia (Marti-Carvajal et al., 2004; Xiao et al., 2005; Tamura and Picciano, 2006). This is particularly among lower socio-economic groups consuming mostly cereal-based diets that are poor in folate, aggravated by prolonged cooking and reheating (Sirikululchayanonta et al., 2004). Folate requirements increase to almost three times the normal requirement in the second and third half of pregnancy and during the first six months of lactation; however, there is not enough evidence to evaluate whether folate supplementation during pregnancy has any beneficial effects on clinical outcomes for mother and baby.

Review of literature on energy and nutrient intake in pregnant and lactating women

Inadequate energy intake is quite common among pregnant women from low-income countries (Andersen et al., 2003). Kesa , 2004, suggested that the cause of this problem is usually food insecurity in the homes (Kesa, 2004). One study in India which examined food and nutrient intakes among pregnant women in their last trimester suggested that without supplementation, women's diets were insufficient in energy and all nutrients except fat as compared to Indian dietary recommendations (Andersen et al., 2003). The study also found that the diets of most of the women were predominately cereals (mainly rice), followed by vegetables (mainly green leafy vegetables) and fruits. Micronutrients that were notably deficient included vitamin A, vitamin C, riboflavin, calcium, and iron. In this study, eating customs appeared to

influence the women's food choice negatively. Cultural beliefs regarding nutrition during pregnancy led about half of the women to avoid foods such as potatoes, cabbage, and beans. Reasons for avoiding these foods were that the foods were not beneficial for the mother or baby's health, and might even hinder safe delivery. Others also believed that these foods produced gas or induced vomiting. Discussing what they would do if they had more money, one-third of the women reported that they would eat more fruits, vegetables, fortified drinks, bread and milk. Another study with pregnant women from farming and non-farming rural villages in India showed that while the income level of the women did not have any significant effect on nutrient intakes, educational level of the women was positively associated with vitamin intakes (Panwar and Punia, 1998). Among Muslim-Thai women in their third trimester, it was also found that while mean intakes of niacin, vitamin A, and vitamin C were above the recommended level but for calcium, phosphorus, thiamin and iron were less than 50% of the recommended levels (Piammongkol et al., 2004). The under consumption of nutrients in this study was attributed to poor education, poverty and food availability.

It is universally accepted that energy and nutrient intake should be increased during pregnancy and lactation to support fetal and infant growth and development along with alterations in maternal tissues and metabolism. However, there is limited data available on actual energy and nutrient intakes of lactating women; in particular there have been very few reports concerning African women. Kesa and Oldewage-Theron, 2005, reported that the diets of the women in the Vaal Triangle of South

Africa consisted primarily of plant-based foods. Animal foods were scarce except for milk and most of the foods ingested were low in iron. Some of the commonest foods eaten by lactating women in the study were milk, maize meals, bread, rice, and yoghurt. Mean daily intakes for lactating women were, energy (2032.7 ± 488.8 kcal), carbohydrate (294.4 ± 64.2 g), protein (76.2 ± 25 g), fat (61.9 ± 22.3 g), and iron (10.5 ± 4.0 mg). The results of this study also showed that almost all of the women (98%) resided in towns and were unemployed (79.3%). Unemployed women tend to be low income as well and this could have been a reason for the low nutrient intakes that was observed.

Another cross-sectional study which examined the components of energy balance during lactation in a population of economically disadvantaged women in an urban developing country (Colombia), showed that while there were no significant differences among lactating and non-pregnant/non lactating women in terms of anthropometric dimensions, lactating women in this study had higher energy intakes compared to non-pregnant-non-lactating women (Dufour, 2002). There were however no significant differences between the two groups in terms of energy expenditure variables. Lactating women in the above study also showed significant decreases in waist to hip ratio and lean body mass with time. It has been suggested that weight loss during lactation may not be harmful because once lactation is established, women especially those who are overweight may restrict their energy intake by about 500 kcal/day to promote a weight loss of 0.5 kg / week without affecting the growth of their infants (Lovelady, 2004).

Nutrient supplementation trials and infant/mother outcomes

Observational studies on food supplementation in pregnancy have reported a positive association between energy/protein supplementation and gestational weight gain/ birth outcomes. In a study with pregnant Arab women, extra energy supplementation of about 400 kcal / day was achieved using traditional foods (Kaseb, 2002). These foods included rice-milk porridge, lentils, porridge, cheese, yogurt, eggs, and milk with bread. The study showed a statistically significant ($P <$ 0.02) increase in weight gain in the experimental compared to the control group. Women in the experimental group gained about 11.0 ± 2.9 kg /day compared to 8.5 ± 3 kg in the control group (the difference was about 29.4%). Birth weights in experimental group were about 8.1% higher than the control (3.3 ± 0.4 vs. 3.08 ± 0.3 kg respectively; $P < 0.05$) (Kaseb, 2002).

Supplementing the diets of pregnant women to balance energy and protein requirements has proved to be effective in several ways. It improves fetal growth and may reduce the risk of fetal and neonatal death (Kramer, 2000). It can also increase maternal weight gain, increase mean birth weight of infants, and reduce the risk of giving birth to infants who are small-for-gestational-age (Kramer, 2003). Micronutrient supplementation in the form of vitamin A and beta-carotene has also shown positive results among pregnant and lactating women in Nepal. While supplementation with vitamin A only (7000 µg / day retinol equivalents of vitamin A as retinyl palmitate) during pregnancy (> 28 wk) reduced the symptoms of nausea, faintness and night blindness, supplementation with beta-carotene (42 mg of all-

trans ß-carotene) only reduced symptoms of high fever postpartum (Christian et al., 2000). The mean number of days of any reported illness was higher in the placebo than in the supplementation group. In women receiving vitamin A supplements, the total number of days of illness symptoms accrued over the last 12 weeks of pregnancy was lower by 5 days compared with the placebo recipients. The study findings suggest that feeding a diet that is adequate in Vitamin A could be effective in improving the reproductive health of women.

Non-food items and its effect on maternal nutrition

The name "pica" comes from the Latin word for magpie, a bird that is famous for eating anything and everything. Pica can be described as an abnormal craving or appetite for nonfood or non-nutritive substances, such as dirt, paint, or clay (Merriam-Webster's Medical Dictionary, 2002). Various hypotheses have been proposed to explain pica. One of the most favored explanations is that pica diminishes gestational nausea (Hunter, 1993). Pica is also seen as a means to dealing with excess acidity in the digestive tract. Some scientists have also suggested that clay-rich soil absorbs plant metabolites or diarrhea-causing enterotoxins from the intestines (Dominy et al., 2004). Dominy and colleagues showed that kaolin (a commonly ingested clay product) reduced the bioavailability of quinine (an alkaloid) and tannin (a digestion inhibitor) by $\leq$30%: thus aiding gastrointestinal adsorption of diarrhea-causing enterotoxins (Dominy et al., 2004). Clay-based products like NovaSil clay have also been investigated as a dietary

supplement to prevent aflatoxicosis and reduce toxic residues in foods of animal origin (Phillips, 1999; Afriyie-Gyawu, 2004; Pimpukdee et al., 2004).

Generally, pica is a lifestyle choice that does not harm the individual. However, if practiced for long, it may cause undesirable effects such as lack of bowel movements and abdominal distention, all of which suggest the substance being ingested has formed an indigestible mass that has blocked the intestines (Ukaonu et al., 2003). Several forms of pica exist, but the commonest one seen in pregnant women is geophagia; a practice of eating earthy substances such as clay and earth (Corbet et al., 2003). The prevalence of geophagia during pregnancy has generally been underestimated. A study in Western Kenya reported that 56% of antenatal clinic population reported eating clay regularly with consumption as high as 45 g during pregnancy and 25 g during lactation (Geissler et al., 1998). Women ingesting clay during pregnancy have been known to complain of fatigue and muscle weakness (Ukaonu et al., 2003). Clay also binds potassium in the intestines, leading to hypokalemic myopathy (Ukaonu et al., 2003).

The consumption of clay in pregnant and lactating women is of concern because pica has been associated with parasitic and worm infestations, lead poisoning, and iron deficiency anemia (Minnich et al., 1968; Committee on Nutrition of the Mother and Pre-school Child, 1982; Geissler et al., 1998). Parasites such as *Ascaris*, *Trichuris* and hookworm have been found in the stools of individuals consuming clay from termite mounds (Saathoff et al., 2002). Some studies have also hypothesized

that ingestion of clay impairs absorption of iron thus having a causal effect on iron deficiency and anemia; however, studies on this mechanism have provided conflicting evidence (Minnich et al., 1968; Halsted, 1968; Talkington et al., 1970; Danford, 1982; Geissler et al., 1998).

Malnutrition in HIV

Malnutrition is a common complication of HIV infection and plays a significant and independent role in its morbidity and mortality. HIV can affect nutrition in several ways. First, it can cause a reduction in the amount of food consumed. The decreased food consumption may be due to painful sores in the mouth and throat or from fatigue, depression and changes in mental state. It could also be due to side effect of some medications, causing nausea, vomiting, metallic taste in the mouth, diarrhea, abdominal cramps and loss of appetite (National Institute of dental and craniofacial research, 2005; South African national guidelines on nutrition for people living with TB, HIV/AIDS and other chronic debilitating conditions, 2001).

Second, infection with HIV can alter an individual's metabolism, or the way the body transports, uses, stores and excretes many nutrients (Singhal and Austin, 2002). Studies suggest that poor absorption of fats and carbohydrates occurs at all stages of HIV infection in both adults and children and results in excess nutrient loss (Singhal and Austin, 2002). The poor absorption is caused by HIV-infection of the intestinal cells which may damage the gut, or by diarrhea, which is a common cause of weight loss in people living with HIV.

HIV-infection increases energy requirement because of elevated resting energy expenditures (Mulligan et al., 1997; Brocklehurst and French, 1998; Coley et al., 2001). The World Health Organization recommends that HIV-infected individuals increase energy intake by 10-30% (WHO, 2003). Ten percent increase in energy requirements is thought to be best during asymptomatic HIV infection while 20 - 30% increase is appropriate during symptomatic HIV infection. This additional increment in energy is added to the basic energy requirement for age/activity/weight, not to the additional energy for pregnancy or lactation. Currently, there is no recommendation to increase protein or micronutrient intake because of HIV-infection.

Insufficient dietary intake, malabsorption, diarrhea, impaired storage and altered metabolism of micronutrients can contribute to micronutrient deficiencies in HIV infected populations. Some of the most commonly recognized micronutrient deficiencies in HIV-infected individuals are vitamin A, B_1, B_2, B_6, B_{12} and E, folate and iron (Semba et al., 1994; Semba, 1997; Baum et al., 1997; Dreyfuss and Fawzi, 2002). Low serum vitamin E levels have been associated with an increase in oxidative stress in HIV-infected individuals and studies addressing early supplementation of vitamin E have suggested that vitamin E may have important immuno-stimulatory properties (Dreyfuss and Fawzi, 2002). Studies of vitamin A deficiency in HIV-infected populations have reported that low serum vitamin A levels are associated with increased mortality, rapid disease progression, and increased maternal-fetal transmission (Baeten et al., 2002; Semba et al., 1994; Semba, 1997).

Among HIV-positive pregnant women, micronutrient status has been shown to affect the proper growth of the infant. Semba and colleagues demonstrated that at the age of one year, infants whose mothers were vitamin A deficient during pregnancy were shorter compared to infants whose mothers were vitamin A sufficient (Semba et al., 1997). For HIV-positive lactating women, malnutrition as a result of vitamin A deficiency may increase their risk of mother-to-child-transmission (MTCT) since vitamin A deficiency is associated with increased HIV viral load in blood and breast milk (Semba et al., 1994).

Recent studies have associated vitamin B_{12}, zinc, and selenium deficiency with decreased duration of survival in HIV infected individuals and these were independent of CD4 cell counts (Baum et al., 1997). In addition to impaired immune function, it has also been postulated that vitamin B_6 deficiency might have a harmful effect on appetite and food intake (Baum et al., 1991; Robson et al., 1980). Improving nutrition can strengthen the immune system, help prevent weight loss, and ultimately, delay the progression of the disease.

Weight loss and wasting in HIV

Appropriate weight gain during pregnancy indicates whether sufficient energy is being consumed. HIV infection is often accompanied by wasting, a progressive loss of body mass manifested in weight loss. HIV/AIDS-related wasting syndrome occurs when an HIV infected individual losses weight consistently without deliberate effort. The causes of wasting in HIV are complex and not totally understood. Some

researchers have hypothesized that changes in food intake, absorption and metabolism of nutrients play a role. Among Tanzanian pregnant women who are HIV, investigators found that the risk of wasting associated with HIV infection was highest among pregnant women with low level of education or unable to contribute to the household income (Villamor et al., 2002). Wasting is a cause of stillbirth, pre-term delivery and intra-uterine growth retardation (IUGR) yet it is unknown whether maternal nutrition and anthropometry (height < 145 cm) play a role in the pathogenesis of these adverse outcomes among HIV infected women (Ticonni et al., 2003; Ellis et al., 2002; Ayisi et al., 2003). Weight loss during pregnancy is likely to occur at the expense of maternal rather than fetal tissues and may therefore be an indicator of maternal wasting in the course of HIV disease. Among Tanzanian women infected with type-1 HIV, weight loss during pregnancy especially during the second trimester was related to a high risk of fetal death (Villamor et al., 2004). Weight loss during the third trimester was, however, more related to pre-term birth than weight loss during the second trimester. Among this same population, low weight gain during pregnancy was related to a low mean birth weight, length and a high risk of LBW.

Effect of nutrient inadequacies among HIV-infected and uninfected pregnant and lactating women

A systematic review and meta-analysis of seven cohort studies from 1983 to 1996 suggested that there was an association between adverse maternal outcomes and HIV-infection in pregnant women (French and Brocklehurst, 1998). HIV remains as

one of the major causes of maternal mortality all over the world. For women living in African and other low-income countries, the disease becomes more deadly due to increased susceptibility to opportunistic infections such as pneumonia, tuberculosis and malaria (McIntyre, 2003).

The maternal mortality ratio (MMR) in resource-poor settings is 10–100 times that of industrialized countries (UNAIDS/WHO, 2002). Rates in these countries can be over 1000 per 100,000 live births compared to less than 10 in resource-rich settings. HIV/AIDS-related deaths were the primary cause of death in mothers in the Republic of Congo in 1993 (Iloki et al., 1997), while AIDS was the fourth highest cause of maternal mortality in a Tanzanian district (MacLeod and Rhode, 1998). Another study conducted in Zambia reported that the rates of maternal mortality have increased 8-fold over the past two decades despite the provision of better obstetric services (Ahmed et al., 1999). In South Africa, where maternal mortality rates are lower than in most African countries, the MMR from the country's first national report on maternal deaths in 1998 was 12.3 times higher than that of the United Kingdom, and this was mostly attributable to HIV/AIDS (Mantel and Moodley, 2002). In the Rakai district of Uganda, maternal mortality was five times higher in HIV-positive women than in HIV-negative women, with mortality rates reaching over 1600 per 100,000 live births in the infected group (Sewankambo et al., 1994). In Malawi and Zimbabwe, pregnancy-related mortality is reported to have increased 1.9 and 2.5 times respectively, in parallel with the increasing AIDS epidemic (Bicego et al., 2002). In another prospective study of anti-malaria prophylaxis in over 4000 mothers

in Malawi, the maternal mortality rate was 370 per 100,000 women and the mortality rate between 6 weeks and 1-year post-partum was 341 per 100,000 live births. AIDS and anemia were the major causes of post-pregnancy mortality in this study (McDermott et al., 1996). In Zaire, maternal mortality rates in HIV-infected women were 10 times those of HIV-negative women, with 22% of HIV-infected mothers dying within a 3-year follow-up period (Ryder et al., 1994).

Micronutrient supplementation in HIV

Some studies have suggested that micronutrient deficiencies and disease progression during HIV have synergistic effect on each other in relation to disease progression and vertical transmission (Fawzi and Hunter, 1998). One study in Kenya showed that HIV infected women tend to have lower retinol concentrations as compared to those who are HIV uninfected (Baeten et al., 2002). Semba et al., 1997, also found that deficiency of fat-soluble vitamins such as vitamin A was associated with decreased circulating CD4 T cells, higher MTCT of HIV-1 and increased infant mortality. There is little information on the effect of supplementation in pregnant HIV infected women. However, a study with HIV sero-negative pregnant women in Nepal was able to show that supplementing the diets of rural women who are poor and undernourished with a recommended dietary amount of vitamin A or its equivalent as beta-carotene can lower maternal mortality, presumably by reducing the severity of conditions such as sepsis and diarrhea diseases (West et al., 1999). An adequate intake of beta-carotene may also reduce some maternal health risks related to oxidative stress (West, 2004).

Although micronutrient supplementation for HIV infected women has not been shown to reduce MTCT, it however produced other benefits. In South Africa, post-partum supplementation of Vitamin A resulted in maintenance of postnatal weight in HIV infected women (Kennedy-Oji et al., 2001). In rural Malawi, supplementation with vitamin A in pregnant HIV infected women improved birth weight, neonatal growth, and reduced anemia (Kumwenda et al., 2002). Multivitamin and vitamin A supplementation have also been shown to increase weight gain in Tanzanian pregnant HIV-infected women (Villamor et al., 2002). Multivitamins including vitamin A were also protective against low weight gain during the second trimester compared with multivitamins alone (Villamor et al., 2002). Fawzi et al., 2002, have also showed that multivitamin (B, C, and E) supplementation significantly reduces breastfeeding transmission in infants of mothers with low baseline lymphocyte compared with infants of mothers with higher counts (Fawzi et al., 2002). Supplementation also protected against transmission among mothers with a high erythrocyte sedimentation rate, low hemoglobin, and low birth weight babies. Multivitamin supplementation in this study reduced death and prolonged HIV-free survival among children born to women with low maternal immunological or nutritional status.

Anemia and HIV

Anemia (defined as Hb < 12 g / dL) is a common complication in HIV-infected individuals and studies have indicated that women with HIV infection have a greater risk of anemia compared with HIV-uninfected women (Vlahov et al., 1991). In 1994,

studies in East Africa reported a positive association between iron deficiency anemia and HIV infection among pregnant women but these were not stratified by severity of the disease, thus it was not clear whether an association existed between anemia and asymptomatic HIV infection (Zucker et al., 1994). Since then, several studies in HIV affected populations have reported an association between anemia and increased progression of HIV, increased risk of pre-term delivery, poor pregnancy outcome, and maternal morbidity and mortality; especially in developing countries (Allen, 1997; Koblinsky, 1995; Schwartz and Thurnau, 1995). Anemia is currently seen as an independent risk factor for decreased duration of survival among HIV-infected women ($P < 0.001$) (Berhane et al., 2004). Some factors responsible for the high rates of anemia in women with HIV include regular monthly blood losses, low CD4 cell counts, and high viral loads (van der Werf et al., 2000). While some studies have implicated the use of anti-retroviral treatment (ART) in the development of anemia in HIV-infected women, others have found opposing results (Sullivan, 2002; Semba et al., 2002; Semba et al., 2001). Semba et al., 2001, examined the impact of highly active antiretroviral therapy (HAART) and combination ART on anemia in a multicenter cohort of HIV-positive women. Their results showed that at 1-year follow-up the rates of anemia went down among women receiving HAART or ART compared to the controls (the prevalence of anemia [Hb <120 g/L] at baseline was 38.3, 36.9, and 43.6%, respectively and after 1-year, it was 26.1%, 36.9%, 45.2%, respectively). Mean Hb levels at baseline was 125 ± 16, 122 ± 16, and 122 ± 18 g/L, respectively ($P = 0.29$) and at 1-year follow-up was 128 ± 14, 123 ± 16, and 119 ± 20 g/L, respectively ($P< 0.0001$). They concluded that after 1 year of treatment, HAART

was associated with a 32% reduction in anemia among HIV-infected women (P = 0.01), whereas there was no significant change in the prevalence of anemia among the controls (those not on HAART or ART treatment).

Routine iron supplementation during pregnancy may be a safe strategy to prevent maternal anemia in developing countries, where traditional diets provide inadequate iron and where malaria and other infections causing increased iron losses are endemic. Iron supplementation has been shown to increase hemoglobin and serum ferritin levels during pregnancy and also improve the maternal iron status even in women who enter pregnancy with adequate iron stores (Corbet et al., 2003).

Malaria in HIV

HIV is thought to increase the risk of malaria in women of all gravidities, although the mechanism is unclear. Ayisi et al., 2003, found that in the absence of malaria, maternal HIV status was associated with a 99 g reduction in mean birth weight among all gravidae. In this study, malaria was associated with both intra-uterine-growth-retardation (IUGR) and pre-term delivery, resulting in a reduction in mean birth weight of 145 g among HIV seronegative and 206 g in seropositive primigravidae but not multigravidae. Also, HIV seropositive women with malaria were twice as likely to have anemia as HIV seronegative women, with or without malaria. The control of malaria is necessary not only for HIV infected pregnant women but for HIV uninfected mothers as well. Preventive strategies may include regular

chemoprophylaxis, intermittent preventive treatment using anti-malaria drugs, and insecticide-treated bed nets.

Over the last couple of years, there has been increasing evidence of an association between malarial infection during pregnancy and HIV transmission (Ladner et al., 2003; Leroy et al., 1998; van Eijk et al., 2003; Ayisi et al., 2003; Verhoeff et al., 1999). In 1994, a study on HIV infected pregnant women in the Rakai district of Uganda showed that co-infection of HIV with malaria significantly increased the risk of MTCT before or during birth (Sewankambo et al., 1994). According to this study, HIV infected pregnant women had nearly three times the risk of transmitting the HIV virus to their babies if they concurrently had malaria and if the malaria parasite had infected their placentas.

HIV-related opportunistic infections

Several opportunistic infections associated with HIV may complicate pregnancy and cause maternal mortality. Diarrhea is a common ailment that has been known to affect HIV infected individuals especially in developing countries (Kotler et al., 1984). Studies from African countries where HIV infection is prevalent have shown that infection with intestinal parasites is usually associated with diarrhea in both children and adults (Johnson et al., 2000; Lebbad et al., 2001). It is also well-known that the organisms that cause diarrhea in HIV infected individuals are similar to those found in HIV sero-negative individuals. These include hookworm, *Clostridium difficile* and *rotavirus* (Keshinro and Musa, 2003).

Tuberculosis (TB) is another leading infectious cause of death in women of reproductive age worldwide (Connolly and Nunn, 1996; Diwan and Thorson, 1999). It is also one of the most common opportunistic infection associated with HIV, and the two have a synergistic effect on each other in relation to maternal mortality. In South Africa, the mortality rate for HIV and TB co-infection was found to be 121 / 1000; three times that of TB without concurrent HIV infection. An association between maternal mortality and TB was first reported in Zambia in 1994 (Ahmed et al., 1999). A further study in Durban, South Africa, showed that in 101 maternal deaths out of 50,518 deliveries, 54% of maternal deaths due to TB were also attributable to HIV infection (Khan et al., 2001). In this same study, the maternal mortality ratio was 323 / 100,000 live births for HIV-infected mothers and 148 / 100,000 live births for HIV-negative mothers.

CHAPTER 3. RESEARCH DESIGN AND METHODS

Study rationale

HIV prevalence among pregnant women in Ghana is 3.1% (MOH/DCU: HIV/AIDS Sentinel Surveillance Data, 2004). Studies examining the dietary habits of HIV infected women are lacking in Ghana. Since nutrient deficiencies are closely linked with disease progression and duration of survival, it is important to assess the dietary intakes of HIV infected Ghanaian women to identify sub-optimal practices amenable for intervention.

Main objective and study aims

The overall objective of this research was to determine whether HIV infection is associated with the dietary intakes of Ghanaian pregnant and lactating women.

Quantitative aim

This first aim of this study was to determine whether HIV-infected women had significantly different energy and nutrient intakes compared to HIV-uninfected women and women with unknown HIV status.

Hypotheses underlying quantitative aim

- The diet of HIV-infected pregnant and lactating women will be lower in specific micronutrients (e.g. vitamins A, B_1, B_2, C, and iron) compared to the diet of women who are HIV-uninfected or of unknown status (Semba et al.,

2002; Semba, 1997; Baum et al., 1997; Dreyfuss and Fawzi, 2002; Baeten et al., 2002).

- The energy intakes of HIV-infected women will be lower than that of HIV-uninfected and women of known status. This is because the effect of illness on dietary intake will be greater among HIV-infected women than HIV-uninfected women (i.e., there is an interaction between health status and HIV infection) (see figure 3).

Qualitative research questions

The second aim of this research was to examine the dietary habits of Ghanaian women who are HIV-infected, HIV-uninfected, or with unknown HIV status. The following research questions were constructed to capture reported dietary practices and perceptions.

1. How knowledgeable are Ghanaian women who are HIV-infected, HIV-uninfected or of unknown status about nutrition in HIV?
2. What is the prevalence of food aversions and preferences among these three groups of women?
3. Is pica a common practice among Ghanaian women?
4. What are some of the sources of nutrition education for Ghanaian pregnant and lactating women?
5. How well do women comply with nutrition recommendations received from the Ghana Health Services?

Description of study site

Ghana is a west-African country bordering the Gulf of Guinea; border countries include Burkina Faso (North), Cote d'Ivoire (West), and Togo (East) (Figure 1). The general climate is that of a tropical region; hot and dry in north, warm and comparatively dry along south east coast, hot and humid in south west, and mostly low plains with dissected plateau in south-central area. The current population of Ghana is estimated to be about 21,029,853 (Population and Housing Census, 2002).

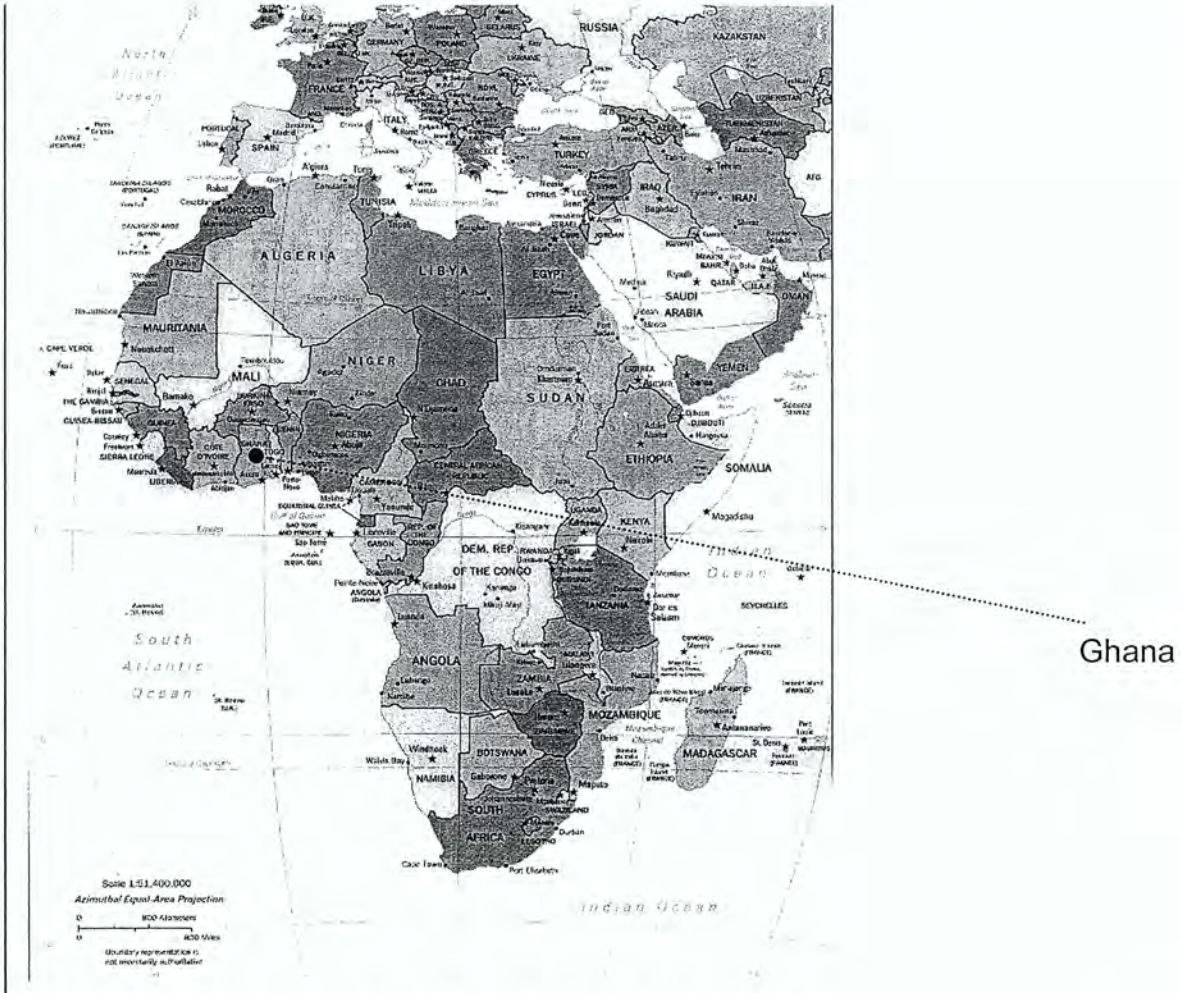

Figure 1. Map of Africa showing location of Ghana

This research was conducted in Manya Krobo, which is a peri-urban district located in the Eastern Region of Ghana. The Eastern Region is one of Ghana's ten administrative regions. It has a total population of 2,106,696 individuals inhabiting an area of 19,323 km² (Figure 2). Manya Krobo is one of a total of 17 districts in the Eastern Region and it has a population of 154,226 (Population and Housing Census, 2002).The district capital is Odumase Krobo.

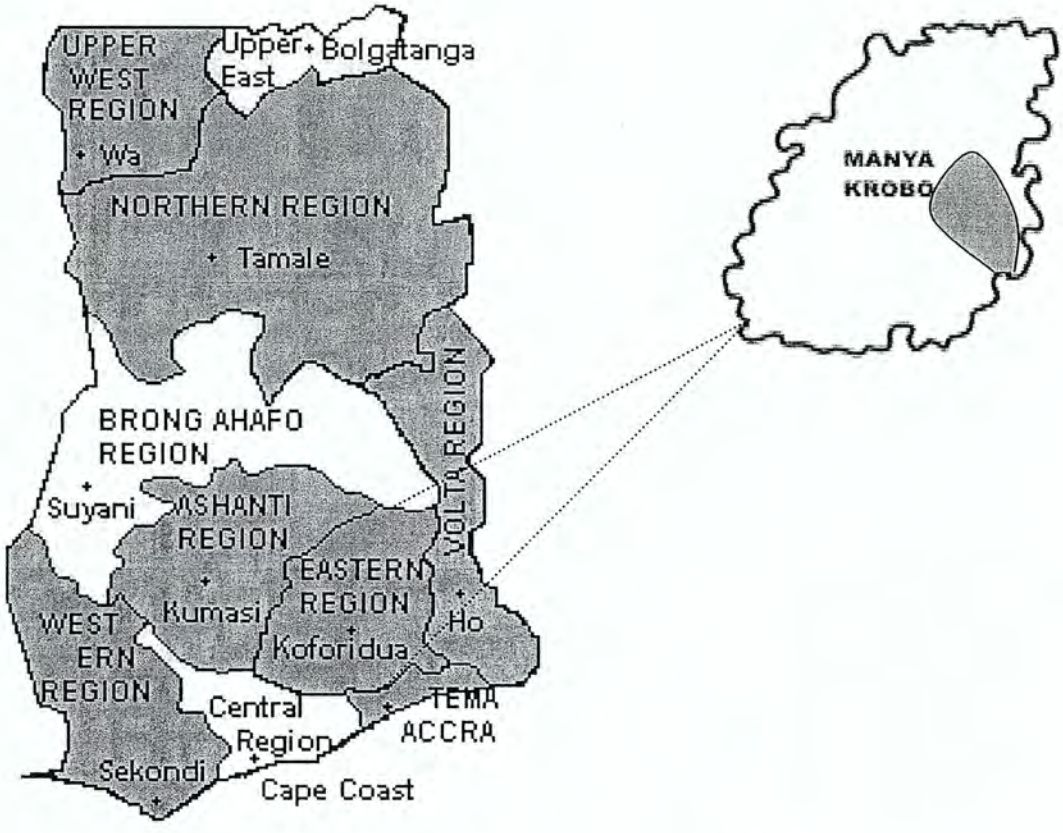

Figure 2. Location of Manya Krobo district in the Eastern Region of Ghana

Demographic and socio-economic data on Eastern Region were obtained from the Ghana Statistical Service: Population and Housing Census, 2000 and the 2003 GDHS report. The Eastern region, which is the third largest region, houses about 11% of Ghanaians. Of this number, 1.4 million live in the rural areas while 700,000 live in the urban areas. The most common avenues of employment for women are agriculture, fishing, trading, manufacturing of local fabrics (tie and dye), mining and quarrying. The Eastern Region was chosen as the site for this study because it has the highest rate of HIV prevalence (4%) in Ghana. In Manya Krobo, HIV prevalence among pregnant women is 7.4% (MOH/DCU: HIV/AIDS Sentinel Surveilance Data, 2004). This figure is much higher than the mean prevalence for the country, which is 3.1%, thus making Manya Krobo an excellent site for this research. In addition to the above justification, the Research to Improve Infant Nutrition and Growth (RIING) project is being carried out in Manya Krobo, hence facilitating recruitment of participants.

Relevant on-going research in Manya Krobo, Ghana

Presently, there is an on-going infant-health research project in Manya Krobo. This project titled Research to Improve Infant Nutrition and Growth (RIING) is being conducted under the leadership of Iowa State University (lead institution) together with the University of Ghana (local lead institution). In addition to the University of Ghana and Iowa State University, researchers from the University of Connecticut and Noguchi Memorial Institute for Medical Research are involved with the administration of the RIING project. Other partners of RIING in Ghana include the

Ghana Health Services (Nutrition & Reproductive and Child Health units), Manya-Krobo District Director's Office of Health Services, Atua Hospital, and St. Martins de Porres Hospital, Agormenya.

RIING is a five-year project funded by the National Institutes of Health (NIH) that addresses the issue of high rates of infant morbidity and mortality in Ghana. The goal of RIING is to employ research and provide training to create an environment in which infant and child nutrition can be improved. A longitudinal cohort study is being conducted to study the effect of HIV on a household's ability to care for children and maintain food security. The RIING project has two main aims. The first one is to identify factors that alter households' ability to provide optimal feeding and care-giving for infants. The second aim is to develop feeding and care-giving strategies that will support child health and growth and these strategies should be feasible for all families to carry out. This research project took advantage of the existing study's field logistics including project offices, staff and access to pregnant women to facilitate data collection.

Justification for this study

This research was designed to contribute additional knowledge to the RIING project by examining the dietary habits of mothers whose infants are part of the RIING project. The information obtained regarding the influence of HIV on the dietary habits of Ghanaian pregnant and lactating women would serve as baseline information for developing nutrition education programs to improve nutritional status of mothers, especially those who are HIV-infected.

Ethical clearance and informed consent

Ethical approval for the RIING project was obtained from the Institutional Review Boards at Iowa State University, University of Connecticut and the Nogouchi Memorial Institute of Research: University of Ghana, Legon. A hospital staff member, separate from the field staff, is responsible for the sample selection process and enrollment. Women, who receive voluntary counseling and testing (VCT), are informed of the study and those who express interest in participating receive a more detailed explanation of the study. Consent forms are then given to the prospective participant to read or they are read to her (Appendix 1). Those consenting, sign (or place a thumb print on) a written informed consent allowing home visits, release of their HIV results, and the extraction of information from their clinical records. Since this study was incorporated in the RIING project, no additional ethical clearance or informed consent document was sought.

Confidentiality

To ensure confidentiality of study participants, the following measures were taken. Women were assigned a unique code and that code was used on forms instead of their names. Only project principal investigators and the researcher had access to records linking women's' names and codes. Other study staff that was recruited to help with data collection was educated on the need for confidentiality and did not have access to information about the HIV status of participants. Records were kept in a locked filing cabinet and digital information was kept in password-protected computer files. Files linking women's' name with a unique code will be destroyed at

the end of the RIING project and when the results are published, identity of participants will not be disclosed.

Study design

This was a cross-sectional study using mixed methods (quantitative and qualitative). Data collection was comprised of three sets of questionnaires, a health status questionnaire, a dietary habits questionnaire and a 24-hr food recall questionnaire. Data collection took place May 2005 to August 2005.

Study participants

Study participants were selected from the RIING project. This included both pregnant and lactating mothers. Mothers in the RIING project are purposively selected to fall within one of three categories;

- Has tested and is HIV infected
- Has tested and is not HIV infected
- Does not know her status because of refusal to test

Sample size

Ability to recruit enough participants from the RIING project was a major problem for this study. To be able to observe any significant difference between all the groups, a sample of about 65 participants was required for each category making a total of 195 women was proposed. However, only 92 participants completed this study. This

was due to the limited time available for data collection (3 months) and the limited number of women who were enrolled in the RIING study at the time.

Components involved in sample size estimation

Using Epi Info version 6.0: the following *variables* were used to calculate sample size for a cross sectional study

* Probability that if two samples (H_1: H_2, H_1: H_3, H_2: H_3) differ, this reflects a true difference in the two populations (confidence level or 1-α): 95%

  Probability that if two populations (H_1: H_2, H_1: H_3, H_2: H_3) differ, the two samples will show a significant difference (Power or 1-β): 80%

** Ratio (Population unexposed: Population exposed): 1:1

Expected frequency of health event in unexposed group: 50.0%

Risk ratio or relative risk, closest to 1.0: 0.5; Odds ratio, closest to 1.0: 0.33

* H_1 = Has tested and is HIV infected, H_2 = Has tested and is not HIV infected, H_3 = Does not know her HIV status

** For the purposes of this study, exposed is HIV-infected population while unexposed is HIV-uninfected population.

Table 4. Unmatched cohort and cross sectional studies (exposed and non exposed). Sample size estimation based on 50% probability of health event in unexposed group

Confidence	Power	Unexposed: Exposed	Risk Ratio	Odds Ratio	Sample size Unexposed: Exposed
95	80	1: 1	0.50	0.33	65: 65

Data collection

Information on maternal background characteristics, pregnancy records, maternal morbidity, food security, stress, and maternal anthropometry (e.g. height, weight, mid upper arm circumference, and calf measurement (Appendix 2a – 2d) was extracted from the RIING data set. Additional information was collected using the following tools:

- Health status questionnaire (Appendix 3-a)
- A dietary habits questionnaire (Appendix 3-b)
- A 24-hr food recall questionnaire (Appendix 3-c)

Dietary intake was evaluated by the 24-hour dietary recall method which has been validated as a reliable measure for estimating nutrient intakes (Persson et al., 2001). Participants were asked to recall all foods eaten 24 hours prior to the time of interview. Three non-consecutive recalls (1 week day, 1 market day and 1 weekend day) were administered for each participant. Recalls obtained on Tuesdays, and Fridays were considered as weekday recalls; while those obtained on Mondays were considered as weekend recalls. Wednesdays or Thursdays recalls were considered market day recalls. Visits were not pre-announced, however, participants were made aware that the researcher will visit sometime that week. Food intakes were not measured on festive days when special foods are consumed. Portion sizes were estimated using common household measures such as drinking cups, ladles, teaspoons and tablespoons. In instances where samples of the food eaten were available, it was weighed directly. Where the food was purchased, the women gave

the location of the food vendor and the amount purchased so the researcher could buy the food later and obtain its weight. Common recipes were developed by several participants to estimate ingredients for traditional foods that were not prepared in the participant's home. Volunteers were fully compensated for all groceries purchased and they kept the food prepared for themselves and their families. This procedure was beneficial in two ways. First, it allowed the researcher to obtain different weights corresponding to one household measure; for instance, a ladle of palm soup prepared by participant A might weigh 70 g whereas that for participant B might weigh 80g because of different preparation styles. The means of all these measures (including that of the purchased foods) was used to estimate the intake of participants who could not provide samples of the food consumed. Second, the procedure facilitated development of recipes which was beneficial in estimating ingredient composition of purchased foods.

The RIING project provided information on maternal age, educational background, socioeconomic status and reproductive history. A pre-tested semi-structured questionnaire was used to elicit information on dietary habits and self reported illness (e.g. diarrhea, malaria, parasitic infections, and gastrointestinal diseases). This was done through face-to-face interviews with the women in a private corner of their homes.

Data quality

- To ensure uniformity in the way questions are asked, both the researcher and research assistant were trained on how to administer the questionnaires in local dialects (Krobo, and Twi).
- As a quality control measure, the researcher examined all completed questionnaires and dietary records at the end of each day, and then discussed anything that was unclear with the assisting fieldworker the next morning before that days work begun.
- To ensure consistency in data entry, the researcher entered all data into databases at the end of each week.

Data analysis

Nutrient composition of the foods consumed was calculated using Ghanaian Food Composition Databases, which had been previously tested for consistency and validity (Dewey and Lartey, 1994). Energy, protein and fat intakes as well as intakes of some selected micronutrients (calcium, phosphorus, iron, zinc, vitamins A and C, thiamin, riboflavin, and niacin) were determined for all foods recorded. Statistical analyses were computed using SPSS version 11.5 and Epi-Info version 6.0 (Center for Disease Control and Prevention, 2003). Descriptive analysis was conducted on all collected data. Means and standard deviations were calculated for continuous variables and proportions for categorical data. Student's t-test and one-way analysis of variance (ANOVA) were used to assess mean differences in dietary intakes of the women. Fischer's Exact was calculated for categorical variables because of the

small cell count of some variables. Multiple linear regression analysis was used to determine the predictors of energy and nutrient intake. Significance was set at $P < 0.05$ for all statistics computed.

Assumptions underlining dietary analysis

- The methodological difficulties (using household measures to estimate portion sizes) were assumed to be similar for all three groups of women in the study.
- Portion sizes as estimated by women in this study may not have reflect true intakes as studies have shown that some individuals tend to either over-estimate or under-estimate portion sizes for various reasons e.g. to impress investigators (Litchtman, 1992).
- The food composition database used to determine the energy and nutrient composition of foods eaten had been previously validated as an appropriate database to be used in assessing nutrient composition of Ghanaian foods (Dewey and Lartey, 1994).

CHAPTER 4. ENERGY AND NUTRIENT INTAKES OF GHANAIAN PREGNANT AND LACTATING WOMEN WHO ARE HIV INFECTED, UNINFECTED, OR OF UNKNOWN STATUS

Paper prepared for submission to the journal of maternal and child health

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ABSTRACT

Maternal energy and nutrient deficiencies in pregnancy increase the risk of poor pregnancy outcomes and hastens the progression of disease among pregnant and lactating women with HIV. We examined potential predictors of energy and nutrient intakes of Ghanaian women based on an *a priori* conceptual framework. Information on diet, anthropometry, and dietary recommendations received was collected from 92 pregnant and lactating women (23 HIV-infected, 33 HIV-uninfected, and 36 of unknown HIV status), who were participants in an on-going infant health study. Most women (88%) reported receiving nutrition recommendations from the Ghana Health Services. Energy intake did not differ by HIV status (2780 ± 800; 2980 ± 1140; and 2880 ± 1020 kcal for infected, uninfected, and unknown, respectively) or by physiological status (2670 ± 570 and 2960 ± 1100 kcal for pregnancy and lactation, respectively). Protein and micronutrient intakes (vitamins A, B_1, B_2, B_3, C, and E, calcium and iron) were also similar by HIV and physiological status. After controlling for health, economic, and dietary recommendation indicators, being unmarried was

negatively associated with intake of energy, protein, thiamin, and niacin ($P < 0.04$), while stress was associated with decreased intake of energy, fat, iron, vitamins A, B_1, B_2, B_3, and C ($P < 0.03$) and tended to be associated with protein intake ($P < 0.06$). Absence of gastro-intestinal discomfort was also associated with energy intake ($P < 0.02$) and tended to be associated with fat intake ($P < 0.06$). More tailored nutrition education may be required for Ghanaian HIV-infected pregnant and lactating women to ensure that they meet their increased energy requirements.

Keywords: Pregnancy, lactation, energy intake, nutrient intake, HIV infection, Ghana

INTRODUCTION

Energy and nutrient requirements should be increased during pregnancy and lactation to meet the additional requirements of each physiological state (Hytten an Leitch, 1971; Hytten and Chamberlain, 1991). The increased requirement will depend in part on whether the body adapts to the increased energy demands by lowering metabolic rate as well as if the woman reduces the level of physical activity (Durnin, 1987; Prentice et al., 1996). Women who are underweight or do not gain enough weight during pregnancy have an increased risk of having babies that are intrauterine-growth retarded (IUGR) or are of low birth weight (LBW) (Norton, 1994; McGanity et al., 1994; Lechtig and Shrimpton, 1997). These LBW babies are in turn more likely to experience impaired growth and cognitive development compared to babies that were born healthy (Kramer, 1987; Ghassemi, 1990; Norton, 1994). Moller and Lindmark, 1997, have also demonstrated that malnourished women are

more likely to have difficulties during labor as compared to their healthy counterparts.

Dietary inadequacy in pregnancy and lactation is a public health concern which is exacerbated by Human Immunodeficiency Virus (HIV) infection. This is because HIV infection compromises the immune system and can result in malabsorption and excess nutrient loss, which can further increase the dietary intake needed to meet nutrient requirements (Singhal and Austin, 2002). Maternal nutrient deficiencies can also exacerbate the progression of HIV and increase the risk for mother-to-child transmission (MTCT) of HIV (Semba, 1997; Semba et al., 1994). Global estimates show that at the end of 2005, about 17 million women worldwide were infected with HIV. Of this, 13.5 million reside in sub-Saharan Africa (UNAIDS/WHO, 2002). In addition, over 2 million HIV-positive women become pregnant each year with approximately 90% residing in developing countries (UNAIDS/WHO, 2002). In Ghana, the 2003 adult HIV prevalence rate was 3.1% with about 180,000 women living with HIV/AIDS (Ghana Demographic and Health Survey, 2003). Currently, there are limited data available on the energy and nutrient intakes of pregnant and lactating women living in sub-Saharan Africa. In Ghana, although the Demographic and Health Survey report gives some data on prevalence of anemia among pregnant and lactating women as well as reported incidence of night blindness in pregnant women, there are no studies that have examined dietary intakes of these women. Also, no data exist on potential predictors of energy and nutrient intake among Ghanaian women. The objective of this study was to examine, for the first time,

energy and nutrient intakes of Ghanaian pregnant and lactating women who are HIV infected, HIV uninfected, or of unknown HIV status. Micronutrients focused on in this research included vitamins A, B_1, B_2, and C, and iron. These micronutrients were selected because of their known relationship with immune function and disease progression in HIV-infected individuals (Baeten et al., 2002; Semba et al., 2002; Dreyfuss and Fawzi, 2002; Baum et al., 1997; Semba, 1997). We also assessed calcium adequacy because of the potential adverse effect on mother and fetal bone development if maternal calcium stores are depleted and also because calcium is an essential component of breast milk (Thomas and Weisman, 2006; Dewey et al., 1996).

SUBJECTS AND METHODS

A priori framework

Figure 3. describes a working model of the inter-relationship between HIV infection, dietary intake, and health outcomes. Maternal dietary intake can be influenced by numerous factors, including physiological state (i.e., pregnancy, lactation, neither), nutritional knowledge, food security and stress. HIV infection weakens the immune system, reducing an individual's ability to fight other infections. Thus, an important determinant of dietary intake is health status; and poor health (e.g. loss of appetite and/or mouth sores) experienced by HIV-infected individuals can decrease food intake and consequently nutrient intake (National Institute of dental and craniofacial

research, 2005; South African national guidelines on nutrition for people living with TB, HIV/AIDS and other chronic debilitating conditions, 2001).

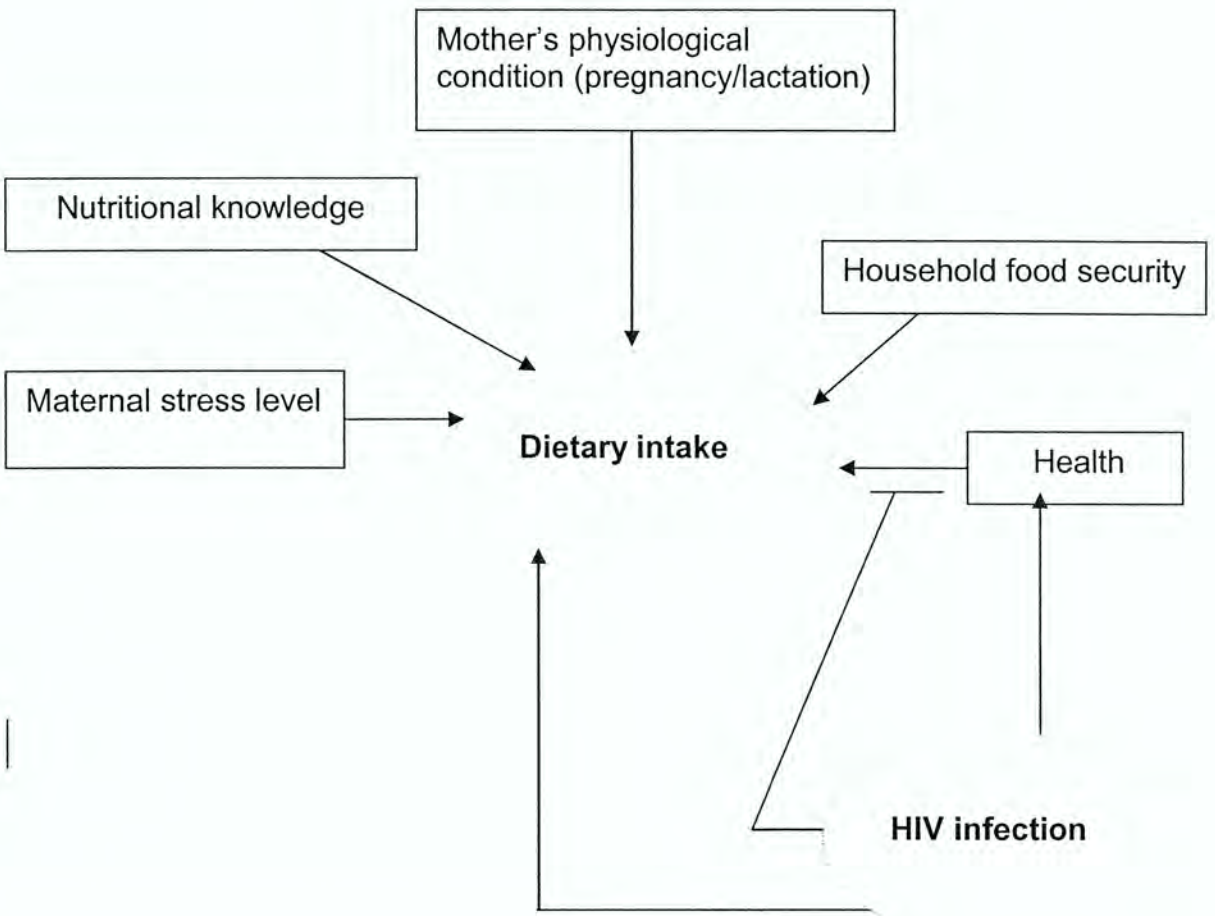


Figure 3. Conceptual framework describing the interaction between HIV infection, other predictors, and dietary intake

Study area

This research was conducted in Manya Krobo, a peri-urban district located in the Eastern Region of Ghana. Manya Krobo is approximately 60 Km east of Accra, the

capital of Ghana, and has a population of 154,226 (MOH/DCU: HIV/AIDS Sentinel Surveilance Data, 2004). This district has the highest HIV prevalence in Ghana (7.4%) (Ghana Demographic and Health Survey, 2003).

Study design

This was a cross-sectional study using a mixed-methods approach (quantitative and qualitative), that is embedded in an on-going infant health cohort study, entitled "Research to Improve Infant Nutrition and Growth" (RIING). RIING examines factors that alter households' ability to provide optimal feeding and care-giving for infants. The inclusion criteria for mothers in the RIING project are 1) pregnant at the time of enrollment; 2) known HIV status if completed voluntary counseling and testing (VCT); and 3) agreed to have HIV results released to the project. Enrollment was completed by a VCT nurse who was not part of the study staff and was stratified by VCT and HIV status: HIV-infected, HIV-uninfected, and women of unknown status (refused VCT). A total of 92 women (21 pregnant and 71 lactating) had been enrolled in RIING by the time of this cross-sectional study and were invited to participate. The sample included 23 HIV-infected, 33 HIV-uninfected, and 36 women of unknown HIV status. There were no drop-outs. The project was approved by the Institutional Review Boards at Iowa State University, University of Connecticut and the Nogouchi Memorial Institute of Research, University of Ghana, Legon.

Data Collection

Data collection took place between May and August 2005. Information on maternal background characteristics and reproductive history (e.g. age, ethnicity, education, live births, and marital status), maternal anthropometry and stress, and household food security were extracted from RIING records. Additional information was collected during face-to-face interviews using a physical and health status questionnaire, and a 24-hr food recall questionnaire.

Questions in the food security questionnaire included whether the women were satisfied with the quality of their diets, if she purchased food on credit, relied on friends or relatives' assistance for food, or consumed seed-stock held for planting the next season. There were also additional questions on whether the women ate less because there was not enough food in the house, whether they were hungry but did not eat because there was not enough food available, and lastly, if they lost weight because there was not enough food to eat. These questions were adapted from the United States Department of Agriculture (USDA) Household Food Security Survey Module, 1999.

To evaluate maternal perceived stress level, participants were asked a series of questions based on the Perceived Stress Scale (PSS) (Cohen and Williamson, 1998). Questions asked included how often the woman felt confident about her ability to handle personal problems, how often she felt that things were going her way, how often she felt difficulties were piling up so high that she could not

overcome them, and how often she felt unable to control the important things in her life.

Maternal anthropometric data (height, weight, mid-upper arm circumference (MUAC), and calf circumference) was extracted from the RIING data. Only data for the lactating women is presented in this study because the RIING project did not have anthropometric data for pregnant women. Body weight and height measurements were taken to the nearest 0.1 kg and 0.1 cm respectively, using a Tanita BWB 800S scale and an adult stadiometer while MUAC and calf circumference was measured to the nearest 0.1 mm using a non-stretchable tape. Body mass index (BMI in kg / m^2) was calculated using weight and height measurements. Adult BMI classification guidelines were used to categorize weight status. Participants with BMI < 18.5 were classified as underweight, BMI ≥18.5 and < 24.9 were classified as normal weight, BMI ≥25 and < 29.9 were classified as overweight, and obesity was described as BMI of 30 or greater (Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults, National Institutes of Health, 1998).

In-depth interviews

Face-to-face interviews with the women were conducted in a private corner of their homes, in their preferred local dialect (Krobo or Twi). A pre-tested semi-structured questionnaire was used to obtain information on maternal physical and perceived stress; dietary intake was collected using a 24-hr food recall questionnaire.

Maternal perception of health

These data were collected once during the first home visit. The questionnaire captured information on self reported illness (e.g. diarrhea, malaria, parasitic infections, and gastrointestinal diseases) experienced by the women within the two weeks preceding the day of interview.

24-hr dietary recall

Participants were asked to recall all foods eaten 24 hours prior to the time of interview. Three non-consecutive recalls (1 week day, 1 market day and 1 weekend day) were administered and each participant completed all three recalls within 1 – 3 weeks. Recalls obtained on Tuesdays and Fridays were considered as weekday recalls; while those obtained on Mondays were considered weekend recalls. Recalls obtained on Wednesdays and Thursdays were considered market day recalls. Visits were not pre-announced and food intakes were not measured on festive days when special foods are taken. Portion sizes were estimated using common household measures such as drinking cups, ladles, teaspoons, and tablespoons. In instances where the food eaten was available, it was weighed directly. Samples of foods purchased from street vendors were purchased and weighed. Common recipes were developed by several participants to estimate ingredients for traditional foods that were not prepared in the participant's home.

Statistical analysis

In the data analysis, composite variables were developed for food insecurity and maternal stress. Questions that were indirect indicators of food insecurity (e.g. being happy with the quality of diet, purchasing food on credit, relying on friend or relatives assistance for food, and consuming seed stock held for planting) were assigned 1 point for a positive response and zero point if answered in the negative. Questions directly reflecting a state of food insecurity (e.g. being hungry but not eating because there wasn't enough food and eating less because they wasn't enough food) were assigned two points for an affirmative answer and zero points for a negative response. Finally, questions indicating extreme cases of food insecurity (e.g. losing weight because there wasn't enough food) were assigned three points for a positive response. Points for all six questions were summed and a modified scale (Table 5) (based on the USDA household food security module) were used to categorize the food security/insecurity level of the participants.

Table 5. Summary score chart for assessing food security

0 points	1-3 points	4-7 points	8-11 points
Food secure	**At risk of food insecurity**	**Moderately food insecure** With moderate hunger	**Food insecure** With severe hunger

Mean stress level was assessed using the perceived stress scale (PSS) which has a range of responses from never to almost daily to the four questions previously

described. In the PSS, a response of never is assigned one point, a response of only once or twice is assigned two points , a response of at least once a week is assigned three points, a response of more than once a week is assigned four points, and a response of almost daily is assigned five points. When all the points are summed for each individual, a minimum of four and a maximum of twenty points are possible with four points representing a least stressed individual and twenty points being a very stressed. Kruskal-Wallis test was used to estimate mean differences in maternal stress level between groups.

Statistical softwares used included SPSS version 11.5 (SPSS, Inc; 2002), SAS (version 9.1, SAS Institute Inc., Cary, NC), and Epi-Info version 6.0 (Center for Disease Control and Prevention, 2003). In the analysis of demographic characteristics, means and standard deviations were calculated for continuous variables and proportions for categorical data. Energy and nutrient composition of foods was calculated using Ghanaian Food Composition Databases (Dewey and Lartey, 1994). Student's t-test and one-way analysis of variance (ANOVA) with Bonferonni post-hoc tests for significant ANOVAs were used to evaluate mean differences in dietary intakes of pregnant and lactating women while Fischer's Exact test was calculated for percentages. Since energy and nutrient intakes were normally distributed, all individuals were included in the statistical analysis. Results of women's energy and nutrient intakes are reported as means ± standard deviation and the last two digits of all values have been rounded off to the nearest tenth value. This is based on Kelly's "rounding off rule" which suggests that because the

precision of the mean is largely influenced by the weight of the standard error, the standard error of the mean should be divided by three and then one reports the mean to that leading digit (Kelly, 1924). Multiple linear regression analysis was used to determine the predictors of energy and nutrient intakes using the variables in our *a priori* conceptual framework (see Figure 3). Significance was set at $P < 0.05$ for all statistics calculated.

RESULTS

Demographic and reproductive characteristics of study participants

Ninety-two women aged 18 – 45 years old and in various stages of pregnancy (n=21) and lactation (n=71) were included in this study. There were 7 HIV-infected, 5 HIV-uninfected, and 9 of unknown HIV status for the pregnant women and 16 HIV-infected, 28 HIV-uninfected, and 27 of unknown HIV status for the lactating women. The demographic and reproductive characteristics of the study participants by HIV and physiological status are shown in Tables 6 and 7. Among the pregnant women, maternal age did not differ significantly between the three groups. However the lactating women showed significant differences in age by HIV status, with the HIV-uninfected women being older than and the HIV-infected and women with unknown status. Although the HIV-infected women were younger than the HIV-uninfected women, the mean number of live births for both groups was not significantly different.

About 4% of the women surveyed were illiterate, close to 23% had completed primary school, slightly more than one-half (54%) had started or completed junior secondary school and 11% had began or completed senior secondary school. Only 5% of the women had a vocational or technical school certificate while 2% had a professional diploma. In both pregnant and lactating women, mean educational years completed did not differ by HIV status. The predominant ethnic group was Ga / Adangbe (64%) followed by Ewe (24%) and then Akan (12%). It was therefore not surprising that 50% of the women preferred speaking the Ga / Adangbe dialect during interviews. For both pregnant and lactating women, ethnicity and preferred dialect spoken did not differ by HIV status. Most (77%) of the women surveyed were married or living with their partners. Marital status did not differ by HIV status for pregnant women; however, HIV-uninfected lactating women were more likely to be married as compared to their counterparts who were HIV-infected or of unknown status. A large proportion of the women (89%) were self-employed, engaging in professions such as trading, catering, dressmaking, and hairdressing. Only 5% were salaried workers with office jobs. Among the pregnant women, while a little more than half (60%) of the HIV-uninfected women were self employed, all the HIV-infected and women of unknown HIV status were self employed. Amongst the lactating women, maternal primary occupation did not differ by HIV status.

Maternal perception of health

While the majority (68%) of the women perceived they were in good health at the time of interview, a few (7%) reported poor health due to headaches, body pains,

gastrointestinal disease, malaria, and general malaise (Tables 8 and 9). One-fourth of the women said although they were not feeling ill, their health was not the very best either. Overall, self-reported malaria was low in the HIV-infected women with about 13% of lactating women and none of the pregnant women experiencing an episode within the last two weeks prior to the day of interview. Among the pregnant women, none of the HIV-infected women reported malarial infection while about 42% of the HIV-uninfected and women with unknown HIV status had malaria. Lactating women reporting malaria was 14% for HIV-uninfected women and 19% among women with unknown HIV status. For those participants who had malaria, two-thirds of the pregnant women sought treatment from health centers and 60% of lactating women visited drug stores. Some women (18%) also used both forms of treatment concurrently. One-half of the pregnant women and 82% of the lactating reported decreased appetites as a result of the malarial infection.

About 14% of the women reported experiencing gastro-intestinal (GIT) discomfort within two weeks prior to the day of interview (Tables 8 and 9). Ailments classified as GIT discomfort included stomach aches or pains, diarrhea, and vomiting. While slightly more than one-fourth (29%) of the HIV-infected pregnant women reported having GIT discomfort, only 6% of HIV-infected lactating women had a GIT distress. Among the pregnant women who had GIT discomfort, 57% sought treatment from health centers while 43% used he services of traditional herbalists. Of the lactating women that had GIT discomfort, (75%) sought treatment from traditional herbalists. None of the women reporting GIT discomfort consulted a health personal and a

traditional herbalist simultaneously. About one-half of the pregnant women and 20% of the lactating women believed that the GIT discomfort they experienced decreased their appetites. In both pregnant and lactating women, there were no significant differences in self-reported illnesses, treatment type, or effect of illness on appetite by HIV status.

The mean perceived stress level of the study participants did not differ by HIV or physiological status (Tables 8 and 9). Nearly one-third (32%) of the women felt they were never in a position whereby they could not cope with important changes in their lives. About 65% of the women also said that difficulties never piled on them to an extent such that they could not overcome it.

Maternal anthropometry

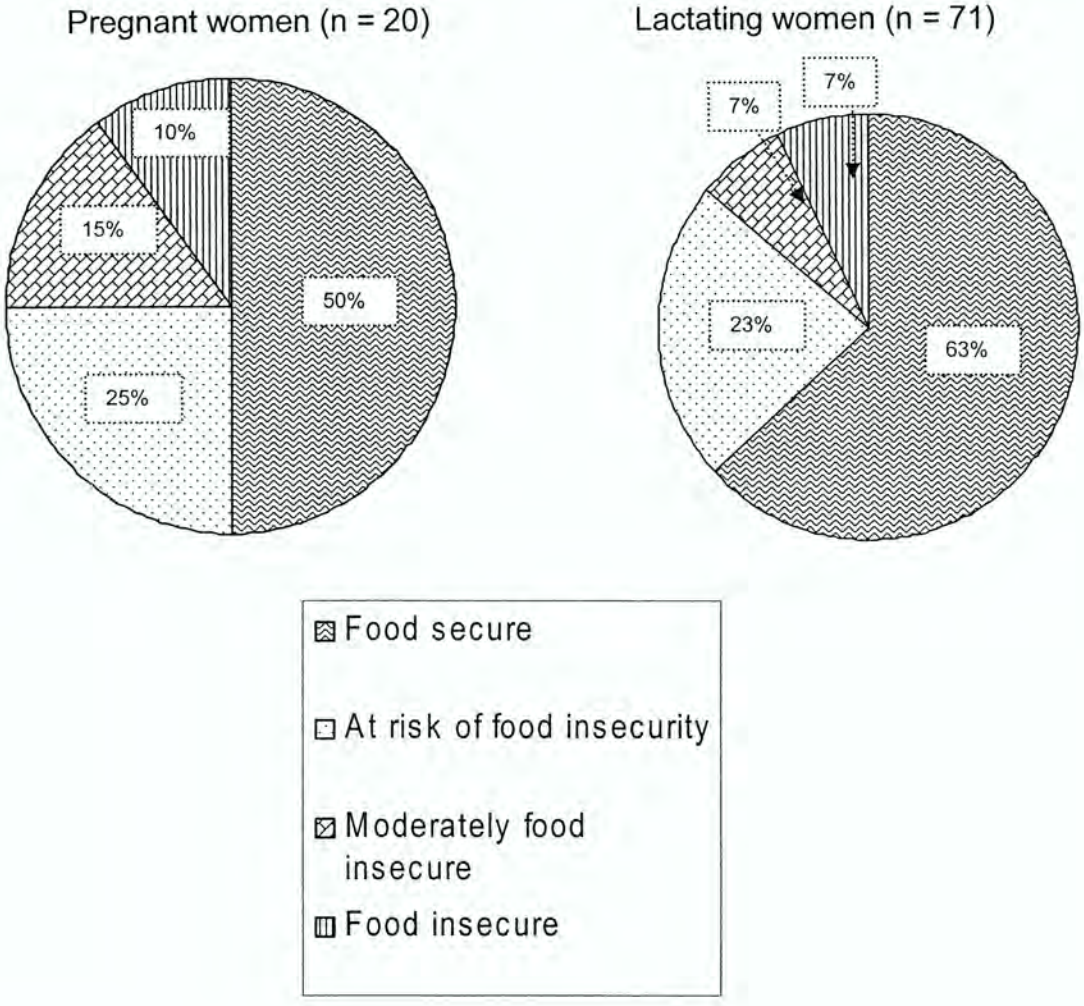
Maternal height ranged from 149 – 172 cm and did not differ by HIV status within each physiological group (Table 12). Maternal weight varied immensely (40 – 104 kg) with the HIV-uninfected women and women of unknown status having significantly higher body weights than the HIV-infected women (P = 0.001). Women's body mass index (BMI) ranged from 16.9 - 37.9 m/kg^2. Mean BMI differed by HIV status, with the HIV-infected and women of unknown status falling within the normal range and the HIV-uninfected women in the overweight region. Mid upper arm circumference (MUAC) also varied significantly (range of 22 – 42 cm) with the HIV-infected women having the least measurement compared to their HIV-uninfected and unknown status counterparts. Maternal calf circumference followed a

similar pattern as MUAC with the HIV-infected women having the lowest measurements compared to the HIV-uninfected and women with unknown HIV status.

Maternal food security

About 57% of the study participants reported being satisfied with the quality of their diet (Tables 13 and 14). Three-quarters of the women also believed that having more money would alter the quality of their diets. When asked exactly what they would buy, some of the commonest foods mentioned were meat, fish, milk, vegetables, and rice. Analysis of household food security data showed that nearly a quarter (23%) of the women purchased food on credit within the previous month while 9% relied on a relatives' assistance for food. Very few women (5%) reported consuming seed stock held for planting the next season. About 15% of the women mentioned being hungry but did not eat because there was not enough food available while 28% said they ate less because they was not enough food at home. An appreciable 12% of the women also reported losing weight because there was not enough food to eat. Overall, a little more than half (57%) of the women in the study were food secure (Figure 4). About one-fourth of both pregnant and lactating women were at risk of food insecurity while 11.0% were food insecure with moderate hunger. In addition, 9% of the participants were food insecure with severe hunger. In both pregnant and lactating women, household food security was not influenced by HIV status.

Figure 4. Food security distribution of Ghanaian pregnant and lactating women



Maternal energy and nutrient intake

The majority (86%) of the women surveyed reported receiving dietary recommendations from personnel at the Ghana Health services. Intakes of energy and some selected nutrients are presented in Tables 15 and 16. Energy intake was normally distributed with few extreme values. The women's average energy intake was 2890 ± 1010 kcal which was not significantly different than the Institute of

Medicine (IOM) recommendation for pregnant and lactating women (see foot-note under Tables 15 and 16). The average energy intake of the pregnant women was not different from that of the lactating women. Within each physiological stage, energy intake did not differ by day of week or HIV status. Protein intake ranged from 40 g – 480 g and was also not affected by physiological state, HIV status, or day of week. Average protein intakes for both physiological groups were significantly higher than the IOM recommendations. Generally, micronutrient intake did not differ by physiological state, HIV status, or day of week; however, reported intakes of vitamin A and iron were much higher than the IOM recommendations.

In the regression analysis (Tables 17, 18, 19 and 20) variables from the a *priori* framework were used to assess predictors of energy and nutrient intake. After controlling for health (physiological status, HIV-infection, absence of gastrointestinal discomfort, perceived stress) economic (unmarried, household food security), and dietary recommendation indicators, being unmarried was negatively associated with energy, protein, thiamin and niacin intake ($P < 0.04$) and tended to be associated with fat, vitamin A, and riboflavin intake ($P < 0.09$). Being stressed was associated with lower intakes of energy, fat, iron, vitamins A, B_1, B_2, B_3, and C and tended to be associated with protein intake ($P < 0.07$). Absence of GIT distress was positively associated with energy intake ($P < 0.02$), and tended to be associated with fat intake ($P < 0.06$).

Discussion

In this cross-sectional study, we assessed for the first time, the dietary intakes of Ghanaian pregnant and lactating women by HIV status and our results showed no significant differences in energy and nutrient intakes by physiological status and HIV status. The latter observation is opposite to what could be expected because the presence of HIV is known to reduce dietary intake (Kim et al., 2001), possibly via poor health (e.g. poor appetites and mouth/throat sores) (National Institute of dental and craniofacial research, 2005; South African National Guidelines on Nutrition for people living with TB, HIV/AIDS and other Chronic Debilitating Conditions, 2001). Although the energy intakes of the HIV-infected women in this study did not differ from the Institute of Medicine (IOM) recommendation for moderately active non-HIV-infected women, Ghanaian HIV-infected women may still need to increase their energy intakes to ensure that they meet the 10-30% additional increase recommended by the World Health Organization. This additional increase is necessary because of the increased energy expenditures related to HIV infection (e.g. increased activity of the immune system due to the presence of opportunistic infections) (Sheehan and Macallan, 2000; Grinspoon et al., 1998). The percent contribution of total fat to energy intake was about 27% in this study. This value falls within the 20 – 35% range recommended in the 2005 dietary guidelines for Americans (U.S Department of Health and Human Services and USDA, 2005). Comparison of women's total fat intake in this study to that of the American population indicates that the typical American diet contains more fat (about 33% contribution to total energy intake (Kennedy et al., 1999).

After controlling for indictors of health, socioeconomic status, and dietary recommendations received, maternal perceived stress was one of the most significant predictors of energy and nutrient intake (stress was negatively associated with intake of energy and all nutrients except calcium). Compared to most of the other predictors used in the regression model, maternal perceived stress was a continuum and had a wide range of responses (4 - 17 based on a scale of 4 – 20). Thus in comparison to a woman with no reported stress, a woman with a total stress score of 17 will have an energy intake difference of 1420 k cal assuming all other variables were similar. Based on this finding, health personnel may therefore need to provide counseling for women who report stress-related symptoms to ensure that their diets are not compromised. Another significant predictor of energy and nutrient intake in this study was a single mother status. Studies in the United States and Canada have shown that the odds of reporting food insecurity tend to increase with declining income and reliance on social assistance and this prevalence was greatest among unmarried women with children as compared to married women with children (Nord et al., 2001; Che and Chen, 2001). In this cross-sectional study, we observed no differences in maternal food insecurity level by HIV status. This observation is contrary to what is expected because HIV-infection has a direct impact on livelihoods (HIV reduces the available labor force owing to poor health) which can ultimately affect income levels and hence the ability to purchase food (Rutengwe, 2004). For households that rely on subsistence farming, HIV-infection can limit the amount of land that is cultivated, thus affecting household food security (FAO, 2001; Lemke, 2005).

Since the participants in the present study were mostly traders and many were physically active (walking long distances to sell their wares) we recommend that comparison of their energy intakes take into account their physical activity level (see foot note under tables 15 and 16). Comparison of our dietary results to what Kesa and Oldewage-Theron, (2005) observed among pregnant and lactating women in South Africa suggests that women in our study had higher energy, protein and iron intakes than their South African counterparts. The high energy and nutrient intakes observed in this study could be due to several factors such as errors associated using household measures to estimate portion sizes (Briefel et al., 1995; Harnack et al., 2004; Godwin et al., 2004) or deliberate changes in food intake on the part of HIV-infected individuals due to disease progression (Cohen et al., 2002), or deliberately reporting desirable behaviors e.g. consuming animal source foods (Horner et al., 2002).

However, there are several other factors that lend some support to these results. The observation that most of the HIV-uninfected women had body mass index (BMI) in the overweight region may also have influenced food intake of some of the participants. The high intakes of protein in this population may be attributed to the fact that data collection took place in the rainy season when fish was in abundance and quite affordable hence women may have increased their intakes. The high intakes of calcium could also be due to the consumption of a fish known as *matsowi* (smoked baby herrings) which was usually eaten whole by the women. Red palm oil which is an excellent source of β-carotene is a common household ingredient in this

region and is used in most Ghanaian traditional preparations (Radhika et al., 2003; Zagre et al., 2003; Benade, 2003). This may explain the high vitamin A intakes observed. Many women also reported using the leaves of the cocoyam plant popularly known *kontomire* in the making of stews. *Kontomire* is a dark green leafy vegetable and nutrient analysis of *kontomire* shows that it is rich in β-carotene as well (Nutrition and fitness software with cooking and preparation yields, by Dewey and Lartey, 1994). In contrast, the high iron intakes in this population are not as easily understood.

The results of this study also showed that the HIV-uninfected lactating women had better weights, mid upper arm circumference (MUAC) and calf measurements than their colleagues who were HIV-infected or had unknown status. These observations are consistent (Villamor et al., 2003; Ladner et al., 1998) and the same time opposite to what has been reported in some studies among HIV-infected pregnant and lactating women (Vorster et al., 2004). In the latter study, the researchers speculated that the reason why they did no observe significant differences in anthropometric indices of HIV-infected and uninfected individuals was probably because the HIV-infected individuals were in the early stages of infection. Future studies may therefore need to stratify their analysis by progression of disease in order to effectively compare anthropometric indices of HIV-infected and uninfected individuals. The results from our study also show that the HIV-uninfected lactating women were older and more likely to be married as compared to the HIV-infected and women with unknown HIV status. This suggests that maturity (age) and stability

(marriage) may have a role to play in determining who is likely to go through voluntary counseling and testing and who is more at risk of contracting HIV. Among the pregnant women, we did not observe any differences between the three groups of women in terms of maternal age and marital status. This may have been due to the relatively smaller sample size of pregnant women compared to lactating women (Frieman et al., 1978).

The practice of using both orthodox and traditional medicines simultaneously appeared to be quite common among this population and this raises some concern because the components of some herbal potions typically are not regulated and may present complications for both mother and infant.

In this study, we observed no differences in perceived stress level according to HIV status. This finding differs from what other studies have reported (Blaney et al., 2004; Grassi et al., 1998). In other studies that used a similar stress scale, HIV-infected women reported feeling more stressed (because of worries related to social stigma and anxiety over various issues such as whether or not they would transmit the virus to the infants) , and frustrations over health complications associated with HIV-infection (Hudson et al., 2003). However, among our study population, we did not find an association between HIV infection and perceived stress level. This could be because the sample size was too small to detect any differences. It could also be that because Manya Krobo has the highest HIV prevalence in Ghana (MOH/DCU: HIV/AIDS Sentinel Surveillance Data, 2004) it may also have more perceived

acceptance and more support systems for HIV-infected persons. Further research is needed to confirm these speculations.

Conclusions

This study showed that energy and nutrient intakes of Ghanaian pregnant and lactating women were not associated with HIV status. We also found that maternal perceived stress and marital status were important predictors of women's energy and nutrient intakes. Since this was the first study examining the dietary intakes of Ghanaian women, more research is needed to substantiate these findings and to validate them for other populations in Ghana. Future studies should consider using both weighed food intake and 24-hr recalls as methodologies for assessing food intakes. This will help to eliminate potential errors associated with use of household measures and also allow for methodological comparison of findings.

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Table 6: Demographic and reproductive characteristics of Ghanaian pregnant women by HIV status

Characteristic	All (n = 21)	HIV Status			P^1
		Infected (n = 7)	Uninfected (n = 5)	Unknown (n = 9)	
Age (y)	29.9 ± 7.0 [2]	30.6 ± 9.5	27.2 ± 6.9	30.9 ± 5.1	0.635
Education completed (y)	8.2 ± 3.6	7.7 ± 4.7	9.6 ± 3.9	7.9 ± 2.4	0.640
Live births (#)	1.6 ± 1.3	1.6 ± 1.9	1.2 ± 1.3	1.8 ± 0.8	0.756
Ethnicity					0.114
Ga/Adangbe	12 (57.1) [3]	3 (42.9)	2 (40.0)	7 (77.8)	
Ewe	6 (28.6)	4 (57.1)	1 (20.0)	1 (11.1)	
Akan	3 (14.3)	0 (0.0)	1 (20.0)	1 (11.1)	
Preferred Language					0.776
Ga/Adangbe	9 (45.0)	2 (28.6)	2 (40.0)	5 (55.6)	
Ewe	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
Akan	3 (15.0)	2 (28.6)	0 (0.0)	1 (11.1)	
Fulani	4 (20.0)	1 (14.3)	1 (20.0)	2 (22.2)	
Foreigner	5 (25.0)	2 (28.6)	2 (40.0)	1 (11.1)	
Primary occupation					**0.047**
Self employed	19 (90.5)	7 (100.0) [a]	3 (60.0) [ab]	9 (100.0) [a]	
Salaried worker	1 (4.8)	0 (0.0)	1 (20.0)	0 (0.0)	
Unemployed	1 (4.8)	0 (0.0)	1 (20.0)	0 (0.0)	
Marital status					0.119
Married	8 (38.1)	2 (28.6)	2 (40.0)	4 (44.4)	
Co-habitants	8 (38.1)	1 (14.3)	2 (40.0)	5 (55.6)	
Single	5 (23.8)	4 (57.1)	1 (20.0)	0 (0.0)	

[1] values compare groups by HIV status using Fisher's Exact for percentages and one-way ANOVA for means statistics computed using SPSS (version 11.5), SAS (version 9.1) and Epi-Info (version 6.0)

[a,b] values with same superscript are not significantly different from each other

[2] mean ± standard deviation

[3] n (%)

Table 7: Demographic and reproductive characteristics of Ghanaian lactating women by HIV status

Characteristic	All (n = 71)	HIV Status			P [2]
		Infected (n = 16)	Uninfected (n = 28)	Unknown (n = 27)[1]	
Age (y)	28.1 ± 5.6 [3]	25.8 ± 4.7[a]	30.8 ± 6.2[b]	26.7 ± 4.4[a]	**0.003**
Education completed (y)	8.3 ± 3.2	7.7 ± 0.2	8.8 ± 3.3	8.0 ± 3.1	0.506
Live births (#)	1.3 ± 1.5	1.3 ± 1.7[ab]	1.9 ± 1.5[a]	0.9 ± 1.1[b]	**0.037**
Ethnicity					0.920
Ga/Adangbe	50 (70.4) [4]	12 (75.0)	21 (75.0)	17 (63.0)	
Ewe	13 (18.3)	3 (18.8)	4 (14.3)	6 (22.20	
Akan	7 (9.9)	1 (6.3)	3 (10.7)	3 (11.1)	
Preferred Language					0.416
Ga/Adangbe	39 (55.7)	12 (75.0)	15 (53.6)	12 (46.2)	
Ewe	2 (2.8))	1 (6.3)	0 (0.0)	1 (3.8)	
Akan	9 (12.9))	1 (6.3)	3 (10.7)	5 (19.2)	
Fulani	15 (21.4)	1 (6.3)	7 (25.0)	7 (26.9)	
Other	5 (7.1)	1 (6.3)	3 (10.7)	1 (3.8)	
Primary occupation					0.675
Self employed	60 (87.0)	14 (87.5)	23 (85.2)	23 (88.5)	
Salaried worker	4 (5.8)	0 (0.0)	2 (7.4)	2 (7.7)	
Unemployed	5 (7.2)	2 (12.5)	2 (7.4)	1 (3.8)	
Marital status					**0.004**
Married	27 (38.0)	2 (12.5) [a]	18 (64.3) [b]	7 (25.9) [a]	
Co-habitants	28 (39.4)	8 (50.0)	6 (21.4)	14 (51.9)	
Single	16 (22.5)	6 (37.5)	4 (14.3)	6 (22.2)	

[1] n at least 26

[2] P values compares groups by HIV status using Fisher's Exact for percentages and one-way ANOVA for means with Bonferroni post-hoc tests for significant ANOVA. Statistics computed using SPSS (version 11.5), SAS (version 9.1) and Epi-Info (version 6.0)

[a,b] values with same superscript are not significantly different from each other

[3] mean ± standard deviation

[4] n (%)

Table 8: Physical health of Ghanaian pregnant women by HIV status

Characteristic	All (n = 21)	HIV Status		
		Infected (n = 7)	Uninfected (n = 5)	Unknown (n = 9)
Perception of health on day of interview				
Very good	13 (61.9) [1]	5 (71.4)	2 (40.0)	6 (66.7)
Not too good	7 (33.3)	1 (14.3)	3 (60.0)	3 (33.3)
Poor	1 (4.8)	1 (14.3)	0 (0.0)	0 (0.0)
Specific illness reported[2]				
Headache	2 (33.3)	1 (50.0)	1 (50.0)	0 (0.0)
Body pains	2 (33.3)	1 (50.0)	1 (50.0)	0 (0.0)
Gastro intestinal diseases	1 (16.7)	0 (0.0)	0 (0.0)	1 (50.0)
General malaise	1 (16.7)	0 (0.0)	0 (0.0)	1 (50.0)
Did illness affect her appetite				
Yes	2 (40.0)	1 (50.0)	1 (100.0)	0 (0.0)
No	3 (60.0)	1 (50.0)	0 (0.0)	2 (100.0)
Was illness treated				
Yes	4 (80.0)	2 (100.0)	1 (100.0)	1 (50.0)
No	1 (20.0)	0 (0.0)	0 (0.0)	1 (50.0)
Where was illness treated				
Health centre	4 (100.0)	2 (100.0)	1 (100.0)	1 (100.0)
Malaria within the last two weeks				
Yes	6 (28.6)	0 (0.0)	2 (40.0)	4 (44.4)
No	15 (71.4)	7 (100.0)	3 (60.0)	5 (55.6)

Did malaria affect her appetite				
No	3 (50.0)	0 (0.0)	1 (50.0)	2 (50.0)
Not sure	3 (50.0)	0 (0.0)	1 (50.0)	2 (50.0)
Was malaria treated				
Yes	4 (66.7)	0 (0.0)	1 (50.0)	3 (75.0)
No	2 (33.3)	0 (0.0)	1 (50.0)	1 (25.0)
Where was malaria treated				
Health centre	3 (75.0)	0 (0.0)	1 (100.0)	2 (66.7)
Health centre and herbalist	1 (25.0)	0 (0.0)	0 (0.0)	1 (33.3)
Gastrointestinal (GIT) distress				
Yes	8 (38.1)	2 (28.6)	2 (40.0)	4 (44.4)
No	13 (61.9)	5 (71.4)	3 (60.0)	5 (55.6)
Specific GIT infection				
Stomach ache/pain	5 (62.5)	2 (100.0)	2 (100.0)	1 (25.0)
Diarrhoea	2 (25.0)	0 (0.0)	0 (0.0)	2 (50.0)
Diarrhoea and vomiting	1 (12.5)	0 (0.0)	0 (0.0)	1 (25.0)
Did GIT distress affect her appetite				
No	3 (37.5)	0 (0.0)	2 (100.0)	1 (25.0)
Not sure	5 (62.5)	2 (100.0)	0 (0.0)	3 (75.0)
Was GIT distress treated				
Yes	7 (87.5)	2 (100.0)	1 (50.0)	4 (100.0)
No	1 (12.5)	0 (0.0)	1 (50.0)	0 (0.0)
Where was GIT distress treated				
Health centre	4 (57.1)	1 (50.0)	1 (100.0)	2 (50.0)
Herbalist	3 (42.9)	1 (50.0)	0 (0.0)	2 (50.0)

[1] n (%). Fisher's Exact were computed by HIV status but are not reported here because none was significant statistics computed using SPSS (version 11.5), SAS (version 9.1), Epi-Info (version 6.0)

[2] n (specific illness) = 6

Table 9: Physical health of Ghanaian lactating women by HIV status

Characteristic	All (n = 71)	HIV Status		
		Infected (n = 16)	Uninfected (n = 28)	Unknown (n = 27)
Perception of health on day of interview				
Very good	53 (74.6) [1]	11 (68.8)	21 (75.0)	21 (77.8)
Not too good	12 (16.9)	3 (18.8)	5 (17.9)	4 (14.8)
Poor	6 (8.5)	2 (12.5)	2 (7.1)	2 (7.4)
Specific illness				
Headache	4 (28.6) [2]	2 (14.3)	1 (7.1)	1 (7.1)
Body pains	2 (14.3)	0 (0.0)	1 (7.1)	0 (0.0)
Gastro intestinal diseases	4 (28.6)	1 (7.1)	0 (0.0)	2 (14.3)
General malaise	3 (21.4)	0 (0.0)	1 (7.1)	0 (0.0)
Malaria	1 (7.1)	0 (0.0)	0 (0.0)	0 (0.0)
Did illness affect her appetite				
Yes	1 (7.1)	0 (0.0)	0 (0.0)	1 (25.0)
No	7 (50.0)	2 (50.0)	3 (50.0)	2 (50.0)
Not sure	6 (42.9)	2 (50.0)	3 (50.0)	1 (25.0)
Was illness treated				
Yes	12 (85.7)	4 (100.0)	4 (66.7)	4 (100.0)
No	2 (14.3)	0 (0.0)	2 (33.3)	0 (0.0)
Where was illness treated				
Health centre	3 (25.0)	0 (0.0)	1 (25.0)	2 (50.0)
Health centre and herbalist	1 (8.3)	0 (0.0)	0 (0.0)	1 (25.0)
Drug store	8 (66.7)	4 (100.0)	3 (75.0)	1 (25.0)

Malaria within the last two weeks				
Yes	11 (15.5)	2 (12.5)	4 (14.3)	5 (18.5)
No	60 (84.5)	14 (87.5)	24 (85.7)	22 (81.5)
Did malaria affect her appetite				
No	9 (81.8)	1 (50.0)	4 (100.0)	4 (80.0)
Not sure	2 (18.2)	1 (50.0)	0 (0.0)	1 (20.0)
Was malaria treated				
Yes	10 (90.9)	2 (100.0)	3 (75.0)	5 (100.0)
No	1 (9.1)	0 (0.0)	1 (25.0)	0 (0.0)
Where was malaria treated				
Health centre	3 (30.0)	0 (0.0)	2 (66.7)	1 (20.0)
Health centre and herbalist	1 (10.0)	0 (0.0)	0 (0.0)	1 (20.0)
Drug store	6 (60.0)	2 (100.0	1 (33.3)	3 (60.0)
Gastrointestinal (GIT) distress				
Yes	5 (7.0)	1 (6.3)	3 (10.7)	1 (3.7)
No	66 (93.0)	15 (93.8)	25 (89.3)	26 (96.3)
Specific GIT infection				
Stomach ache/pain	4 (80.0)	0 (0.0)	3 (100.0)	1 (100.0)
Diarrhoea	1 (20.0)	1 (100.0)	0 (0.0)	0 (0.0)
Did GIT distress affect her appetite				
No	4 (80.0)	1 (100.0)	2 (66.7)	1 (100.0)
Not sure	1 (20.0)	0 (0.0)	1 (33.3)	0 (0.0)
Was GIT distress treated				
Yes	4 (60.0)	1 (100.0)	2 (33.3)	1 (100.0)
No	1 (20.0)	0 (0.0)	1 (33.3)	0 (0.0)
Where was GIT distress treated				
Health centre	1 (25.0)	0 (0.0)	1 (50.0)	0 (0.0)
Herbalist	3 (75.0)	1 (100.0)	1 (50.0)	1 (100.0)

[1] n (%). Fisher's Exact were computed by HIV status but are not reported here because none was significant statistics computed using SPSS (version 11.5), SAS (version 9.1) and Epi-Info (version 6.0)

[2] n (specific illness) = 14

Table 10: Perceived stress level of Ghanaian pregnant women by HIV status

Characteristic	All (n = 21)	HIV Status			P^1
		Infected (n = 7)	Uninfected (n = 5)	Unknown (n = 9)	
Inability to cope with important changes in her life					0.668
Never	6 (28.6) [2]	2 (28.6)	1 (20.0)	3 (33.3)	
Only once or twice	8 (38.1)	1 (14.30	3 (60.0)	4 (44.4)	
At least once a week	3 (14.3)	2 (28.6)	1 (20.0)	0 (0.0)	
More than once a week	4 (19.0)	2 (28.6)		2 (22.2)	
Inability to handle personal problems					0.364
Never	7 (33.3)	2 (28.6)	0 (0.0)	5 (55.6)	
Only once or twice	7 (33.3)	2 (28.6)	3 (60.0)	2 (22.2)	
At least once a week	3 (14.3)	1 (14.3)	2 (40.0)	0 (0.0)	
More than once a week	3 (14.3)	1 (14.3)	0 (0.0)	2 (22.2)	
Almost daily	1 (4.8)	1 (14.3)	0 (0.0)	0 (0.0)	
Unable to control the important things in her life					0.695
Never	8 (38.1)	3 (42.9)	1 (20.0)	4 (44.4)	
Only once or twice	9 (42.9)	1 (14.3)	4 (80.0)	4 (44.4)	
At least once a week	2 (9.5)	1 (14.3)	0 (0.0)	1 (11.1)	
More than once a week	1 (4.8)	1 (14.3)	0 (0.0)	0 (0.0)	
Almost daily	1 (4.8)	1 (14.3)	0 (0.0)	0 (0.0)	
Difficulties pile so high she could not overcome them					0.437
Never	14 (66.7)	4 (57.1)	3 (60.0)	7 (77.80	
Only once or twice	4 (19.0)	0 (0.0)	2 (40.0)	2 (22.2)	
At least once a week	1 (4.8)	1 (14.3)	0 (0.0)	0 (0.0)	
More than once a week	2 (9.5)	2 (28.6)	0 (0.0)	0 (0.0)	
Mean perceived stress score[3]	8.1 ± 3.5 [4]	9.7 ± 4.9	7.6 ± 1.8	6.9 ± 3	0.283

[1] Kruskal-Wallis test was conducted for percentages and one-way ANOVA for means by HIV status. Statistics computed using SPSS (version 11.5)

[2] n (%)

[3] Perceived stress responses [never = 1 (very stable), only once or twice = 2, at least once a week = 3, more than once a week = 4, almost daily = 5 (very stressed)]
PSS is the sum of responses to the four questions above [Least value = 4 (least stressed); Highest value = 20 (most stressed)]

[4] mean ± standard deviation

Table 11: Perceived stress level of Ghanaian lactating women by HIV status

Characteristic	All (n = 70)	HIV Status			P^1
		Infected (n = 16)	Uninfected (n = 28)	Unknown (n = 26)	
Inability to cope with important changes in her life					0.471
Never	25 (35.7) [2]	7 (43.8)	8 (28.6)	10 (38.5)	
Only once or twice	15 (21.4)	3 (18.8)	8 (28.6)	4 (15.4)	
At least once a week	17 (24.3)	6 (37.5)	7 (25.0)	4 (15.4)	
More than once a week	9 (12.9)	0 (0.0)	4 (14.3)	5 (19.2)	
Almost daily	4 (5.7)	0 (0.0)	1 (3.6)	3 (11.5)	
Inability to handle personal problems					0.816
Never	23 (32.9)	3 (18.8)	10 (35.7)	10 (38.5)	
Only once or twice	21 (30.0)	8 (50.0)	9 (32.10	4 (15.4)	
At least once a week	13 (18.6)	5 (31.3)	3 (10.7)	5 (19.2)	
More than once a week	9 (12.9)	0 (0.0)	6 (21.4)	3 (11.5)	
Almost daily	4 (5.7)	0 (0.0)	0 (0.0)	4 (15.4)	
Unable to control the important things in her life					0.630
Never	38 (54.3)	8 (50.0)	15 (53.6)	15 (57.70	
Only once or twice	20 (28.6)	4 (25.00	13 (46.4)	3 (11.5)	
At least once a week	7 (10.0)	3 (18.8)	0 (0.0)	4 (15.4)	0.486
More than once a week	4 (5.7)	0 (0.0)	0 (0.0)	4 (15.4)	
Almost daily	1 (1.4)	1 (6.3)	0 (0.0)	0 (0.0)	
Difficulties pile so high she could not overcome them					0.514
Never	44 (62.9)	12 (75.0)	16 (57.1)	16 (61.5)	
Only once or twice	16 (22.9)	2 (12.5)	11 (39.3)	3 (11.5)	
At least once a week	6 (8.6)	2 (12.5)	1 (3.6)	3 (11.5)	
More than once a week	2 (2.9)	0 (0.0)	0 (0.0)	2 (7.7)	
Almost daily	2 (2.9)	0 (0.0)	0 (0.0)	2 (7.7)	
Mean perceived stress score[3]	7.9 ± 3.3 [4]	7.3 ± 2.4	7.5 ± 2.7	8.8 ± 4.2	0.246

[1] Kruskal-Wallis test was conducted for percentages and one-way ANOVA for means by HIV status. Statistics computed using SPSS (version 11.5)

[2] n (%)

[3] Perceived stress respnses [never = 1 (very stable), only once or twice = 2, at least once a week = 3, more than once a week = 4, almost daily = 5 (very stressed)]
PSS is the sum of responses to the four questions above [Least value = 4 (least stressed); Highest value = 20 (most stressed)]

[4] mean ± standard deviation

Table 12: Anthropometric measurements of Ghanaian lactating women by HIV status (n = 70)

Characteristic	Mimimum	Maximum	Median	Mean	HIV Status: Infected (n = 16)[1]	HIV Status: Uninfected (n = 27)	HIV Status: Unknown (n = 27)[2]	P[3]
Weight (kg)	39.6	104.2	60.3	62.3 ± 13.6[4]	52.7 ± 8.8[a]	67.6 ± 15.6[b]	62.9 ± 10.0[b]	**0.001**
Height (cm)	149.3	171.7	159.6	159.6 ± 5.5	158.1 ± 5.3	159.6 ± 6.2	160.4 ± 4.8	0.478
BMI[5] (kg/m^2)	16.9	37.9	23.5	24.4 ± 4.7	21.1 ± 3.4[a]	26.4 ± 5.3[b]	24.1 ± 3.5[ab]	**0.002**
MUAC[6] (cm)	21.5	41.5	28.3	28.8 ± 4.2	25.6 ± 3.0[a]	30.7 ± 4.7[b]	28.8 ± 4.1[b]	**< 0.001**
Calf circumference (cm)	24.9	42.1	33.5	33.3 ± 3.3	31.1 ± 2.8[a]	34.5 ± 3.4[b]	33.5 ± 2.6[b]	**0.002**

[1] n at least 14

[2] n at least 24

[3] values compare groups by HIV status using one-way ANOVA for means with Bonferroni post-hoc tests for significant ANOVAs
Statistics computed using SPSS (version 11.5)

[4] mean ± standard deviation

[a,b] values with same superscript are not significantly different from each other

[5] BMI = Body Mass Index

[6] MUAC = Mid Upper Arm Circumference

Table 13: Food security of Ghanaian pregnant women by HIV status

	All (n = 20)	HIV Status			P^2
		Infected (n = 7)	Uninfected (n = 5)[1]	Unknown (n = 9)	
Happy with the quality of her diet now[3]					0.588
Yes	12 (57.1) [4,5]	3 (42.9)	3 (60.0)	6 (57.1)	
No	7 (33.3)	3 (42.9)	1 (20.0)	3 (33.3)	
Not sure	2 (9.5)	1 (14.3)	1 (20.0)	0 (0.0)	
Would having more money alter her diet					**0.011**
Yes	16 (76.2) [5]	7 (100.0) [a]	5 (100.0) [ab]	4 (44.4) [b]	
No	5 (23.8)	0 (0.0)	0 (0.0)	5 (55.6)	
Purchased food on credit[6]					0.792
Yes	4 (20.0)	2 (28.6)	1 (25.0)	1 (11.1)	
No	16 (80.0)	5 (71.4)	3 (75.0)	8 (88.9)	
Relied on friend/relatives assistance for food[7]					0.557
Yes	3 (15.0)	2 (28.6)	0 (0.0)	1 (11.1)	
No	17 (85.0)	5 (71.4)	4 (100.0)	8 (88.9)	
Consumed seed stock held for the next season[8]					1.000
Yes	1 (5.0)	0 (0.0)	0 (0.0)	1 (11.1)	
No	19 (95.0)	7 (100.0)	4 (100.0)	8 (88.9)	
Was hungry but didn't eat beacause there wasn't enough food[9]					0.442
Yes	5 (25.0)	3 (42.9)	1 (25.0)	1 (11.1)	
No	15 (75.0)	4 (57.1)	3 (75.0)	8 (88.9)	
Ate less because there wasn't enough food[10]					0.100
Yes	7 (35.0)	4 (57.1)	2 (50.0)	1 (11.1)	
No	13 (65.0)	3 (42.9)	2 (50.0)	8 (88.9)	
Lost weight because there wasn't enough food to eat[11]					0.142
Yes	2 (10.0)	2 (28.6)	0 (0.0)	0 (0.0)	
No	18 (90.0)	5 (71.4)	4 (100.0)	9 (100.0)	
Summary[12]					
Food secure	10 (50.0)	2 (28.6)	2 (50.0)	6 (66.7)	
At risk of food insecurity	5 (25.0)	2 (28.6)	1 (25.0)	2 (22.2)	
Moderately food insecure (with moderate hunger)	3 (15.0)	1 (14.3)	1 (25.0)	1 (11.1)	
Food insecure (with severe hunger)	2 (10.0)	2 (28.6)	0 (0.0)	0 (0.0)	

[1] n at least 4

[2] values compare groups by HIV status using Fisher's Exact. Statistics computed using SPSS (version 11.5), SAS (version 9.1) and Epi-Info (version 6.0)

[4] n (%). Values with same superscript are not significantly different from each other

[5] n = 21

[3,6,7,8] are less severe stage of food insecurity, [9, 10] are mildly severe stages of food insecurity, and [11] is a severe stage of food insecurity

[12] Assign 1 point in least severe stage questions[3,6-8], 2 points in mildly severe stage questions[9,10] and 3 points in severe stage question[11] and sum scores [0 = Food secure, 1-3 = At risk of food insecurity, 4-7 = Moderately food insecure with moderate hunger, 8-11 = Food insecure with severe hunger]

Table 14: Food security of Ghanaian lactating women by HIV status

	All (n = 70)	HIV Status			P^1
		Infected (n =16)	Uninfected (n = 28)	Unknown (n = 26)	
Happy with the quality of her diet now[2]					0.241
Yes	41 (57.7) [3]	11 (68.8)	13 (46.4)	17 (63.0)	
No	26 (36.6)	5 (31.3)	14 (50.0)	7 (25.9)	
Not sure	4 (5.6)	0 (0.0)	1 (3.6)	3 (11.1)	
Would having more money alter her diet					0.249
Yes	53 (74.6)	13 (81.3)	23 (82.1)	17 (63.0)	
No	18 (25.4)	3 (18.8)	5 (17.9)	10 (37.0)	
Purchased food on credit[4]					0.831
Yes	18 (25.7)	3 (18.7)	8 (28.6)	7 (26.9)	
No	52 (74.3)	13 (81.3)	20 (71.4)	19 (73.1)	
Relied on friend/relatives assistance for food[5]					1.000
Yes	2 (2.9)	0 (0.0)	1 (3.6)	1 (3.8)	
No	68 (97.1)	16 (100.0)	27 (96.4)	25 (96.2)	
Consumed seed stock held for the next season[6]					0.057
Yes	3 (4.3)	0 (0.0)	0 (0.0)	3 (11.5)	
No	67 (95.7)	16 (100.0)	28 (100.0)	23 (88.5)	
Was hungry but didn't eat beacause there wasn't enough food[7]					0.870
Yes	6 (8.6)	1 (6.3)	2 (7.1)	3 (11.5)	
No	64 (91.4)	15 (93.8)	26 (92.9)	23 (88.5)	
Ate less because there wasn't enough food[8]					0.241
Yes	14 (20.0)	2 (12.5)	4 (14.3)	8 (30.8)	
No	56 (80.0)	14 (87.5)	24 (85.7)	18 (69.2)	
Lost weight because there wasn't enough food to eat[9]					0.204
Yes	9 (12.9)	1 (6.3)	2 (7.1)	6 (23.1)	
No	61 (87.1)	15 (93.8)	26 (92.9)	20 (76.9)	
Summary[10]					
Food secure	44 (62.9)	13 (81.3)	16 (57.1)	15 (57.7)	
At risk of food insecurity	16 (22.9)	2 (12.5)	10 (35.7)	4 (15.4)	
Moderately food insecure (with moderate hunger)	5 (7.1)	0 (0.0)	1 (3.6)	4 (15.4)	
Food insecure (with severe hunger)	5 (7.1)	1 (6.2)	1 (3.6)	3 (11.5)	

[1] values compare groups by HIV status using Fisher's Exact. Statistics computed using SPSS (version 11.5), SAS (version 9.1) and Epi-Info (version 6.0)

[2] n for unknown status = 27

[3] n (%)

[4,5,6] question describes least severe stage of food insecurity

[7,8] question describes mildly severe stage of food insecurity

[9] question describes severe stage of food insecurity

[10] summary: assign 1 point in least severe stage questions[2,4-6], 2 points in mildly severe stage questions[7,8] and 3 points in severe stage question9 and sum scores [0 = Food secure, 1-3 = At risk of food insecurity, 4-7 = Moderately food insecure with moderate hunger, 8-11 = Food insecure with severe hunger]

Table 15: Energy and nutrient intake of Ghanaian pregnant women by HIV status (n = 21)

	Mean	HIV Status			P [2]	HIV Status		
		Infected (n = 7)	Uninfected (n = 5)	Unknown (n = 9) [1]		Infected	Uninfected	Unknown
Energy (kcal)								
Week-day	2600 ± 810 [3]	2320 ± 1010	2630 ± 710	2810 ± 700	0.525	0.890 [4]	0.500	0.991
Weekend-day	2640 ± 720	2270 ± 430	2500 ± 720	3040 ± 780	0.412	0.222 [5]	0.560	0.890
Market-day	2860 ± 1080	3040 ± 1100	2970 ± 1050	2630 ± 1180	0.758	0.049 [6]	0.309	0.326
Average	2680 ± 580	2550 ± 650	2700 ± 660	2790 ± 500	0.806			
Total Fat (g)								
Week-day	80 ± 40	90 ± 60	70 ± 20	70 ± 30	0.884	0.464	0.748	0.808
Weekend-day	80 ± 40	60 ± 30	80 ± 60	90 ± 40	0.635	0.786	0.426	0.692
Market-day	80 ± 50	80 ± 40	110 ± 80	70 ± 40	0.576	0.079	0.686	0.277
Average	80 ± 30	80 ± 30	90 ± 30	80 ± 20	0.752			
Protein (g)								
Week-day	110 ± 60	80 ± 50	130 ± 70	110 ± 40	0.188	0.146	0.265	0.571
Weekend-day	120 ± 60	100 ± 40	110 ± 60	150 ± 70	0.424	0.068	0.962	0.370
Market-day	110 ± 50	130 ± 50	130 ± 60	100 ± 50	0.448	0.100	0.409	0.062
Average	110 ± 40	100 ± 40	120 ± 60	120 ± 40	0.600			
Total Vitamin A (RE)								
Week-day	2460 ± 1480	2170 ± 1180	3150 ± 1180	2270 ± 1870	0.637	0.878	0.658	0.647
Weekend-day	2380 ± 1520	2070 ± 1410	2540 ± 2080	2540 ± 1400	0.890	0.962	0.091	0.721
Market-day	2210 ± 2020	2200 ± 1630	1520 ± 990	2650 ± 2780	0.642	0.908	0.245	0.937
Average	2350 ± 870	2150 ± 720	2400 ± 840	2490 ± 1060	0.610			
Calcium (mg)								
Week-day	1170 ± 850	800 ± 790	1390 ± 1110	1360 ± 710	0.407	0.105	0.730	0.285
Weekend-day	1500 ± 1200	1100 ± 730	1290 ± 990	1980 ± 1600	0.509	0.076	0.881	0.128
Market-day	1170 ± 890	1300 ± 1130	1470 ± 990	870 ± 570	0.461	0.444	0.696	0.880
Average	1280 ± 780	1070 ± 840	1380 ± 830	1400 ± 750	0.765			
Iron (mg)								
Week-day	30 ± 10	30 ± 10	30 ± 10	40 ± 10	0.182	0.846	0.363	0.871
Weekend-day	30 ± 20	30 ± 10	30 ± 20	40 ± 20	0.307	0.145	0.530	0.392
Market-day	30 ± 20	40 ± 20	40 ± 20	30 ± 10	0.527	0.034	0.292	0.106
Average	30 ± 10	30 ± 10	30 ± 20	40 ± 10	0.553			

Zinc (mg)									
Week-day	20 ±	10	10 ± 10	20 ± 10	20 ± 10	0.110	0.452	0.182	0.293
Weekend-day	20 ±	10	10 ± 10	20 ± 10	20 ± 10	0.261	0.018	0.222	0.306
Market-day	20 ±	10	20 ± 10	20 ± 10	10 ± 10	0.623	0.063	0.805	0.062
Average	20 ±	10	10 ± 10	20 ± 10	20 ± 10	0.591			
Thiamin (mg)									
Week-day	1 ±	1	1 ± 1	1 ± 1	1 ± 0	0.943	0.386	0.580	0.204
Weekend-day	1 ±	1	1 ± 0	2 ± 1	1 ± 0	0.119	0.869	0.688	0.916
Market-day	1 ±	1	1 ± 1	1 ± 1	1 ± 1	0.839	0.119	0.724	0.519
Average	1 ±	0	1 ± 1	1 ± 0	1 ± 0	0.469			
Riboflavin (mg)									
Week-day	1 ±	1	1 ± 1	1 ± 0	1 ± 0	0.831	0.981	0.655	0.870
Weekend-day	1 ±	1	1 ± 0	1 ± 1	2 ± 1	0.977	0.865	0.507	0.835
Market-day	1 ±	1	2 ± 1	2 ± 1	1 ± 1	0.766	0.758	0.839	0.331
Average	1 ±	0	1 ± 0	1 ± 0	1 ± 0	0.941			
Niacin (mg)									
Week-day	20 ±	10	20 ± 20	20 ± 10	20 ± 10	0.908	0.789	0.661	0.839
Weekend-day	20 ±	10	20 ± 10	20 ± 10	20 ± 10	0.837	0.711	0.628	0.454
Market-day	20 ±	10	30 ± 10	30 ± 20	20 ± 10	0.953	0.452	0.629	0.672
Average	20 ±	10	20 ± 10	20 ± 10	20 ± 10	0.917			
Vitamin C (mg)									
Week-day	140 ±	80	140 ± 90	150 ± 70	140 ± 80	0.996	0.603	0.300	0.625
Weekend-day	130 ±	70	120 ± 80	120 ± 40	140 ± 90	0.945	0.794	0.737	0.751
Market-day	140 ±	70	140 ± 70	130 ± 20	160 ± 100	0.762	0.712	0.532	0.642
Average	140 ±	50	130 ± 60	130 ± 30	150 ± 60	0.870			

[1] n = 8 for market-day

[2] values are one-way ANOVAs comparing means by HIV Status with Bonferroni post-hocs for significant ANOVAs. Statistics computed using SPSS (version 11.5)

[3] mean ± standard deviation

[4,5,6] set of paired tests showing in order; comparison of week-day vs weekend-day intakes,
comparison of week-day vs market-day intakes, and comparison of weekend-day vs market-day intakes

[4,5,6] Bonferroni adjustment for three pairs of comparison is made. *P* values are therefore compared against a significance of 0.05/3 = 0.0167

Comparison of reported mean energy and nutrient intakes to Institute of Medicine recommendations. EAR for Energy = 2500 kcal/d; *P* = 0.197
AI for Calcium = 1000 mg/d; *P* = 0.011, and RDA for all other nutrients (Protein = 71 g/d; *P* < 0.0001
Vitamin A = 770 µg/d; P <0.0001; Iron = 27 mg/d; P = 0.029, Zinc = 11 mg/d; P = 0.002, Thiamin = 1.4 mg/d; P = 0.128
Riboflavin = 1.4 mg/d; *P* = 0.955, Niacin = 18 mg/d; *P* = 0.010, Vitamin C = 85 mg/d; *P*< 0.0001)

Table 16: Energy and nutrient intake of Ghanaian lactating women by HIV status (n =71)

	Mean		HIV Status				HIV Status		
			Infected (n = 16)	Uninfected (n = 28)[1]	Unknown (n = 27)	P[2]	Infected	Uninfected	Unknown
Energy (kcal)									
Week-day	2810 ±	1160[3]	2720 ± 920	2920 ± 1350	2750 ± 1100	0.816	0.245[4]	0.298	0.438
Weekend-day	3000 ±	1340	2980 ± 1080	3100 ± 1630	2920 ± 1200	0.890	0.430[5]	0.655	0.176
Market-day	3040 ±	1490	2940 ± 1090	3010 ± 1340	3120 ± 1850	0.922	0.899[6]	0.789	0.548
Average	2950 ±	1100	2880 ± 860	3000 ± 1220	2930 ± 1150	0.909			
Total Fat (g)									
Week-day	80 ±	50	90 ± 60	90 ± 60	80 ± 40	0.596	0.793	0.331	0.605
Weekend-day	90 ±	70	100 ± 80	100 ± 90	80 ± 40	0.528	0.194	0.640	0.452
Market-day	90 ±	50	70 ± 50	100 ± 50	90 ± 50	0.344	0.190	0.653	0.777
Average	90 ±	40	90 ± 50	100 ± 50	80 ± 30	0.443			
Protein (g)									
Week-day	110 ±	70	100 ± 40	120 ± 80	120 ± 70	0.396	0.365	0.566	0.480
Weekend-day	130 ±	80	110 ± 50	130 ± 90	130 ± 90	0.677	0.107	0.584	0.140
Market-day	140 ±	140	120 ± 60	140 ± 170	160 ± 160	0.687	0.624	0.799	0.416
Average	130 ±	80	110 ± 30	130 ± 80	140 ± 90	0.466			
Total Vitamin A (RE)									
Week-day	2870 ±	2270	2670 ± 1480	2850 ± 2480	3000 ± 2490	0.895	0.926	0.049	0.152
Weekend-day	2150 ±	1880	2280 ± 1940	1790 ± 1880	2170 ± 1840	0.302	0.989	0.727	0.520
Market-day	2620 ±	2320	2680 ± 2490	2650 ± 2080	2540 ± 2520	0.977	0.969	0.076	0.564
Average	2540 ±	1330	2690 ± 1170	2430 ± 1500	2570 ± 1270	0.794			
Calcium (mg)									
Week-day	1220 ±	1340	940 ± 710	1260 ± 1460	1330 ± 1510	0.610	0.292	0.878	0.373
Weekend-day	1360 ±	1420	1170 ± 850	1210 ± 1380	1620 ± 1710	0.487	0.189	0.903	0.415
Market-day	1370 ±	1740	1230 ± 940	1210 ± 1750	1620 ± 2090	0.644	0.875	0.994	0.996
Average	1320 ±	1090	1110 ± 590	1230 ± 1010	1520 ± 1360	0.481			
Iron (mg)									
Week-day	30 ±	20	30 ± 10	40 ± 20	30 ± 20	0.576	0.146	0.966	0.371
Weekend-day	40 ±	20	40 ± 10	40 ± 20	40 ± 20	0.997	0.276	0.836	0.126
Market-day	40 ±	30	40 ± 10	40 ± 30	40 ± 20	0.842	0.779	0.809	0.546
Average	40 ±	20	30 ± 10	40 ± 20	40 ± 20	0.856			

Zinc (mg)									
Week-day	20 ±	10	10 ± 10	20 ± 10	20 ± 10	0.482	0.148	0.660	0.322
Weekend-day	20 ±	20	20 ± 10	20 ± 20	20 ± 20	0.633	0.082	0.711	0.253
Market-day	20 ±	30	20 ± 10	20 ± 30	20 ± 30	0.829	0.602	0.896	0.806
Average	20 ±	10	20 ± 10	20 ± 10	20 ± 20	0.584			
Thiamin (mg)									
Week-day	1 ±	1	1 ± 0	2 ± 1	1 ± 0	0.173	0.694	0.883	0.310
Weekend-day	1 ±	1	1 ± 0	2 ± 1	1 ± 1	0.423	0.284	0.172	0.055
Market-day	1 ±	1	1 ± 1	1 ± 1	1 ± 1	0.914	0.390	0.303	0.629
Average	1 ±	1	1 ± 0	1 ± 1	1 ± 1	0.412			
Riboflavin (mg)									
Week-day	1 ±	1	1 ± 1	1 ± 1	1 ± 1	0.861	0.471	0.757	0.131
Weekend-day	1 ±	1	1 ± 1	1 ± 1	1 ± 1	0.519	0.621	0.630	0.475
Market-day	1 ±	1	1 ± 1	1 ± 1	2 ± 1	0.508	0.849	0.792	0.105
Average	1 ±	1	1 ± 0	1 ± 1	1 ± 1	0.689			
Niacin (mg)									
Week-day	20 ±	10	20 ± 10	20 ± 20	20 ± 10	0.996	0.828	0.818	0.112
Weekend-day	20 ±	10	20 ± 10	20 ± 10	20 ± 10	0.676	0.954	0.892	0.578
Market-day	20 ±	20	20 ± 20	20 ± 10	30 ± 20	0.661	0.782	0.626	0.168
Average	20 ±	10	20 ± 10	20 ± 10	20 ± 10	0.989			
Vitamin C (mg)									
Week-day	150 ±	100	160 ± 90	130 ± 80	160 ± 130	0.358	0.216	0.471	0.196
Weekend-day	120 ±	70	130 ± 70	110 ± 80	130 ± 80	0.781	0.469	0.723	0.330
Market-day	130 ±	100	140 ± 110	120 ± 100	140 ± 100	0.700	0.727	0.875	0.522
Average	130 ±	70	150 ± 70	120 ± 60	140 ± 70	0.323			

[1] n = 27 for weekend-day

[2] values are one-way ANOVA comparing means by HIV Status with Bonferroni post-hocs for significant ANOVAs. Statistics computed using SPSS (version 11.5)

[3] mean ± standard deviation

[4,5,6] set of paired tests showing in order; comparison of week-day vs weekend-day intakes,comparison of week-day vs market-day intakes, and comparison of weekend-day vs market-day intakes

[4,5,6] Bonferroni adjustment for three pairs of comparison is made. *P* values are therefore compared against a significance of 0.05/3 = 0.0167

Comparison of reported average energy and nutrient intakes to Institute of Medicine recommendations. NOTE: EAR for Energy = 2700 kcal/d; *P* = 0.054
AI for Calcium = 1000 mg/d; *P* = 0.011, RDA for all other nutrients (Protein = 71 g/d; *P* < 0.0001
Vitamin A = 1300 µg/d; P < 0.0001, Iron = 9 mg/d; *P* < 0.0001, Zinc = 12 mg/d; *P* < 0.0001,Thiamin = 1.4 mg/d: *P* = 0.171
Riboflavin = 1.6 mg/d; *P* < 0.0001, Niacin = 17 mg/d; *P* < 0.0001, Vitamin C = 120 mg/d; *P* = 0.930

Table 17: Predictors of energy, protein and fat intake in Ghanaian women (n = 92)

	Energy (kcal); R^2 = 0.189			Protein (g); R^2 = 0.124			Fat (g); R^2 = 0.190		
Variable	***β***	**Std. Error**	***P***	***β***	**Std. Error**	***P***	***β***	**Std. Error**	***P***
HIV-infected	-332.7	293.5	0.260	-32.9	20.6	0.113	-12.6	11.5	0.278
Unknown status	-185.9	251.8	0.463	-6.1	17.6	0.730	-14.2	9.9	0.156
Pregnant	-34.2	267.3	0.899	0.6	18.7	0.977	0.9	10.5	0.931
Unmarried	-582.7	243.5	**0.019**	-37.7	17.1	**0.030**	-16.5	9.6	0.089
Food secure	33.3	42.0	0.431	1.0	2.9	0.727	0.4	1.7	0.808
Perceived stress[1]	-109.4	34.1	**0.002**	-4.4	2.4	0.067	-4.5	1.3	**0.001**
Absence of gastro-intestinal disease	816.4	333.6	**0.017**	32.3	23.4	0.170	24.6	13.1	0.064
Not receiving nutrition recommendation	-393.4	302.2	0.197	-20.4	21.2	0.338	-16.2	11.9	0.177

[1] Perceived stress: range of 4-20; 4 = least stressed, 20 = most stressed

NOTE: Data for pregnant and lactating women are combined for this analysis because we are interested in predictors of energy and nutrient intake for all women

Table 18: Predictors of iron and calcium intake in Ghanaian women (n = 92)

	Iron (mg); R^2 = 0.115			Calcium (mg); R^2 = 0.077		
Variable	***β***	**Std. Error**	***P***	***β***	**Std. Error**	***P***
HIV-infected	-4.6	4.6	0.321	-240.9	297.2	0.420
Unknown status	-1.5	3.9	0.704	9.4	254.9	0.971
Pregnant	-2.0	4.2	0.638	64.1	270.6	0.814
Unmarried	-7.2	3.9	0.066	-354.0	246.6	0.155
Food secure	0.1	0.7	0.924	-6.3	42.5	0.883
Perceived stress[1]	-1.2	0.5	**0.034**	-52.4	34.6	0.133
Absence of gastro-intestinal disease	6.6	5.3	0.219	326.5	337.8	0.337
Not receiving nutrition recommendation	-6.9	4.8	0.148	-451.1	306.0	0.144

[1] Perceived stress: range of 4-20; 4 = least stressed, 20 = most stressed

NOTE: Data for pregnant and lactating women are combined for this analysis because we areinterested in predictors of energy and nutrient intake for all women

Table 19: Predictors of vitamin A and vitamin C intake in Ghanaian women (n = 92)

	Vitamin A (RE); R^2 = 0.116			Vitamin C (mg); R^2 = 0.102		
Variable	***β***	**Std. Error**	***P***	***β***	**Std. Error**	***P***
HIV-infected	24.1	365.2	0.947	11.2	18.9	0.555
Unknown status	30.0	313.3	0.924	17.2	16.2	0.240
Pregnant	78.6	332.6	0.814	11.2	17.2	0.517
Unmarried	-522.2	302.9	0.089	-17.2	15.7	0.275
Food secure	-14.3	52.3	0.786	2.3	2.7	0.391
Perceived stress[1]	-107.6	42.5	**0.013**	-4.8	2.2	**0.030**
Absence of gastro-intestinal disease	525.8	415.0	0.209	35.9	21.5	0.098
Not receiving nutrition recommendation	-474.3	376.0	0.211	-6.0	19.4	0.757

[1] Perceived stress: range of 4-20; 4 = least stressed, 20 = most stressed

NOTE: Data for pregnant and lactating women are combined for this analysis because we are interested in predictors of energy and nutrient intake for all women

Table 20: Predictors of thiamin, riboflavin, and niacin intake in Ghanaian women (n = 92)

	Thiamin (mg); R^2 = 0.143			Riboflavin (mg); R^2 = 0.118			Niacin (mg); R^2 = 0.141		
Variable	***β***	**Std. Error**	***P***	***β***	**Std. Error**	***P***	***β***	**Std. Error**	***P***
HIV-infected	-0.4	0.2	0.073	-0.2	0.2	0.221	-2.6	2.7	0.335
Unknown status	-0.3	0.2	0.141	-0.1	0.1	0.540	-0.9	2.3	0.703
Pregnant	0.1	0.2	0.494	0.2	0.1	0.278	0.7	2.5	0.770
Unmarried	-0.4	0.2	**0.043**	-0.2	0.1	0.062	-5.7	2.2	**0.013**
Food secure	0.0	0.3	0.576	0.0	0.0	0.981	-0.1	0.4	0.877
Perceived stress[1]	-0.1	0.2	**0.007**	0.0	0.0	**0.008**	-0.8	0.3	**0.009**
Absence of gastro-intestinal disease	0.4	0.2	0.145	0.2	0.2	0.334	4.6	3.1	0.138
Not receiving nutrition recommendation	-0.2	0.2	0.314	-0.1	0.2	0.614	-0.1	2.8	0.982

[1] Perceived stress: range of 4-20; 4 = least stressed, 20 = most stressed

NOTE: Data for pregnant and lactating women are combined for this analysis because we are interested in predictors of energy and nutrient intake for all women

CHAPTER 5. FOOD BELIEFS AND DIETARY HABITS AMONG GHANAIAN PREGNANT AND LACTATING WOMEN WHO ARE HIV INFECTED, UNINFECTED, OR OF UNKNOWN STATUS

Paper prepared for submission to the journal of maternal and child health

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Abstract

Ante- and post-natal health clinics provide nutrition education to improve maternal and infant health outcomes. We assessed women's food beliefs, dietary habits and compliance with nutrition recommendations received from the Ghana Health Services (GHS). The study enrolled 92 pregnant and lactating women (23 HIV-infected, 33 HIV-uninfected, and 36 of unknown status) who were participants of a longitudinal study on HIV and child health. About 86% of the women had received nutrition recommendations from the GHS. Dietary recommendations from the GHS included: 1) encouragement to eat more snacks, 2) eat more carbohydrate-rich foods for energy, 3) consume more soups and stews, 4) add more protein-rich foods to the diet, and 5) consume more vegetables and fruits. The most common recommendations mothers complied with was to consume more soups - especially palm soup, and use *kontomire* (a green leafy vegetable) for stews. The latter two foods are rich in ß-carotene, a precursor of vitamin A. HIV status did not affect compliance. It was more common to seek out specific foods for good health and

breast milk production than to avoid foods. Foods like palm soup with *fufu* (a cassava and plantain dish) and peanut butter soup with *banku* (a maize dish) were most sought ,while starchy foods, black-eyed peas and foods made with coconut oil were avoided. Nearly one-half (49%) of the women believed there were specific foods that HIV infected individuals should eat. Food suggested included palm soup, *light soup* (tomato soup), and fruits like pineapple. The results from this study indicate that nutrition education programs are essential during the pre- and postnatal periods. Nutrition education programs need to address food beliefs that limit women's compliance with dietary recommendations and should also include information on the potential implications of pica on maternal and child health.

Key words: Food beliefs, dietary habits, food preferences, food aversions, pica, pregnancy, lactation, HIV, Ghana

INTRODUCTION

Maternal nutritional status is an important predictor of maternal health status and birth outcome (Van den Broek, 2001; Stephensen et al., 2000; Lechtig and Shrimpton, 1997; Norton, 1994). HIV infection compromises the immune system; and among HIV-infected pregnant or lactating women with dietary inadequacies, increases the risk of mother to child transfer of the virus (Dreyfuss and Fawzi, 2002; Semba, 1997; Semba et al., 1994). Globally, more than two million HIV positive women become pregnant every year with about 90% residing in developing countries (UNAIDS/WHO, 2002). Estimates for Ghana show that in 2003, the mean adult HIV prevalence was 3.1% with 110,000 – 300,000 women living with HIV/AIDS

(Ghana Demographic and Health Survey, 2003). The World Health Organization's recent strategic plan for people living with HIV/AIDS includes nutrition education programs that recommend increased energy intakes by 10-30% depending on the stage of infection and assurance of meeting normal protein and micronutrient requirements (WHO, 2003). Although adequate nutrition cannot cure HIV infection, it is essential to maintain a person's immune system, sustain healthy levels of physical activity, and assure optimal quality of life.

Food cravings and aversions are recognized all over the world; however, their causes and implications on maternal nutrition are not clearly defined (Tierson et al., 1985; Coloronois-vargas et al., 1991). Studies have shown that women usually crave foods that are lacking in their diets; for instance, in the United States, 47% of pregnant women surveyed craved fruits, while 34% craved dairy products (Hook, 1978). Among Ethiopian pregnant women, Tsegaye and colleagues also observed that livestock products were craved by 55% of women surveyed (Tsegaye et al., 1998). Studies on maternal food aversion have shown that women usually avoid staples or commonly ingested foods (Coloronois-vargas et al., 1991; Tsegaye et al., 1998). In their study, Tsegaye et al., 1998, found that 60% of pregnant Ethiopians avoided cereal foods. While some investigators have reported findings suggesting that food aversions may have negative effects on maternal dietary intake because they reduce the mothers' food options (Tierson et al., 1985), others have suggested that food aversions are consequences of physiological adaptations that seek to

protect the fetus from toxic substances present in foods (Coloronois-vargas et al., 1991).

Another dietary practice of significance in maternal nutrition is pica: the eating of nonfood items such as ice, freezer frost, laundry starch, cornstarch, earth, and clay (Corbett et al., 2003; Parry-Jones and Parry Jones, 2003). Although pica during pregnancy is a worldwide phenomenon, its etiology is not very well established (Coloronois-vargas et al., 1991; Homer et al., 1991; Lacey, 1990). Pica has been associated with dental injury (Edwards et al., 1994), constipation, blockage of the large intestines (Ukaonu et al., 2003), interference with the absorption of minerals (Talkington et al., 1970), parasitic infection, and hyperkalemia (Geissler et al.,1998), phosphorous intoxication, and lead poisoning (Minnich et al, 1968; Rothenberg et al., 1999). Several studies have also linked the practice of pica with anemia (Geissler et al., 1998; Rainville, 1998; Horner et al., 1991; Federman et al., 1997); however, the mechanism for this phenomenon is unknown. Studies examining the relationship between pica and birth outcomes have associated pica with premature birth, increased risk of peri-natal mortality, low birth weight, and decreased fetal head circumference (Al-Kanhal and Bani, 1995; Vermeer and Farrell, 1985). Studies on pica have been cross-sectional and observational, hence causal relationship of pica with any of the above conditions has yet to be established.

In many regions of Africa, maternal and child nutrition education programs have targeted ante-natal and post-natal clinics as the major platform for reaching pregnant

and lactating women respectively. This approach of incorporating services within an existing ante-natal clinic system increases the likelihood of reaching the target audience, since a high proportion of pregnant women (approximately 70%) attend an antenatal clinic at least once in most sub-Saharan countries (Demographic and Health Survey data for sub Saharan Africa, 1995-2002). In Ghana, 94% of pregnant women receive ante-natal care from a health care professional (Ghana Demographic and Health Survey, 2003). About 48% of lactating women also attend post-natal clinics. The objectives of this study were to assess the perceptions of Ghanaian women who are HIV-infected, HIV-uninfected or of unknown HIV status about the role of nutrition in maternal health and also to assess women's compliance with nutrition recommendations received from the Ghana Health Services.

SUBJECTS AND METHODS

Study area

The study area and design for this research is describes elsewhere (see chapter 4 of this thesis).

Data collection

We collected data from May to August 2005. Information on maternal background characteristics and reproductive history (e.g. age, ethnicity, education, live births, and marital status) were extracted from RIING records.

Focus group discussions

To help guide the development questionnaires for assessing women's compliance with nutrition recommendations, in-person interviews were held with midwifes and at the Ghana Health Services (GHS) to learn more about nutrition information available for mothers. Nurses at the Ghana Health Services were also observed at ante-natal and post-natal clinics as they delivered nutrition education to women. We summarized the GHS dietary recommendations as follows: 1). eat more carbohydrate-rich foods for energy, 2). consume more soups and stews, 3). add more protein-rich foods to diet, 4). eat more vegetables and fruits, and 5). eat snacks more often.

In-depth interviews

This was done through face-to-face interviews with the women in a private corner of their homes in the preferred local language (Krobo or Twi). Semi-structured questionnaires on maternal dietary habits and nutrition knowledge were pre-tested and modified accordingly before being used. The Maternal dietary habits questionnaire covered maternal eating patterns before pregnancy, and during pregnancy and lactation. Participants were asked to recount the number of times they ate per day and compare portion sizes of foods eaten to their pre-pregnant/pregnant states. Participants were also asked about current maternal food preferences, avoidances, and intake of non-food items. In addition to the above questions, participants were asked if they had received any dietary recommendations during pregnancy or lactation, the source of the information, and

whether or not they carried out the recommendation. The women were also asked whether they believed there were specific dietary needs for individuals with diarrhea, malaria, or HIV.

Statistical analysis

Data entry and statistical analyses were done using SPSS version 11.5 (SPSS, Inc; 2002), SAS (version 9.1, SAS Institute Inc., Cary, NC), and Epi-Info version 6.0 (Center for Disease Control and Prevention, 2003). In the analysis of food preferences and aversions, foods were placed into 12 categories: starchy foods (including roots and tubers), cereals, soups, stews, fruits and vegetables, legumes, animal flesh proteins, milk and milk products, porridge and beverages, and snacks. Foods that did not directly fit into any of the above categories were classified as miscellaneous foods. Means and standard deviations were calculated for continuous variables and percentages used for categorical data. Fischer's Exact tests and one-way analysis of variance (ANOVA) with Bonferonni post hoc tests for significant ANOVAs were used to evaluate mean differences between groups. Significance was set at $P < 0.05$ for all statistics computed.

Results

The demographic and reproductive characteristics of the study participants are reported else where (see chapter 4 of this thesis).

Maternal dietary habits

More than half (53%) of the women surveyed reported that their eating habits were not influenced by their physiological state. Among the pregnant women, the majority (67%) reported eating more in their current state compared to their pre-pregnant state (Table 21). On the other hand, a few lactating women (14%) reported eating more compared to when they were pregnant (Table 22). Almost three-quarters (74%) of the women reported eating only at meal times. Most women (65%) ate three meals per day. In both pregnant and lactating women, dietary habits did not differ by HIV status. Among the women surveyed, intake of vitamins and supplements during pregnancy and lactation was quite high (85%). While almost all (95%) of the pregnant women in this study reported taking vitamins and supplements at the time of the study, only one-fourth of the lactating women were taking vitamins and supplements. Nearly all (95%) of the women surveyed also said that the vitamins and supplements they were taking were recommended by a health personnel. With each physiological group, intake of vitamins and supplements did not differ by HIV status

Dietary recommendations received and compliance level

About 86% of the women reported receiving dietary recommendations from the Ghana Health Services (GHS) (Tables 21 and 22). About 12% of the women complied with all of the five GHS dietary recommendations. About 17% complied with at least two while 22% complied with at least three of the five dietary recommendations received from the GHS. Among the women who received dietary

recommendations, the recommendation most complied with was to increase the intake of soups and stews (90%). About 62% of the women also reported increasing their carbohydrate intake while a little more than one-third (44%) of the women reported increasing their protein intake. About 63% of the women also reported increasing their fruits and vegetables intake. In both pregnant and lactating women, the recommendation least complied with was to snack more often (23%). Among the participants, reported compliance with nutrition recommendations received from the GHS did not differ by HIV status.

Maternal food beliefs related to illness

The majority (71%) of the participants believed there were specific foods that were beneficial for individuals affected with malaria (Table 23). The most common foods mentioned were light tomato soup/broth, rice or maize porridge, mashed *kenkey* (*kenkey* is a maize dish made from fermented maize dough), and *agidi* (a soft type of *kenkey* made from white maize flour). To reduce or cure diarrhea, about 59% of the women suggested drinking coconut milk, rice porridge, or eating bread and solid foods like *kenkey* and *banku* (another type maize dish made from fermented maize dough). Almost one-half (47%) of the women believed some foods were most appropriate for HIV affected persons. Women who believed certain foods were more beneficial for HIV infected individuals suggested beta carotene rich foods like palm soup, and *kontomire* (a green leafy vegetable) stew, and animal proteins such as meat, fish, eggs, and milk. Among both pregnant and lactating women, response to questions regarding food beliefs did not differ by HIV status.

Prevalence of pica, food preferences and aversions

Few women (9%) reported eating non-food items such as white clay and ice. About 20% of the pregnant women ate clay while 10% ate ice (Table 24). Very few lactating women ate either clay or ice (1% respectively). Among the women surveyed, the eating of clay was practiced only by the HIV infected women. Reasons given for eating these non-food items included cravings and the desire to reduce nausea. Almost a quarter (24%) of the women avoided some type of foods during pregnancy and lactation (Tables 25 and 26). Among the pregnant women that avoided some foods, specific foods avoided included dishes prepared with palm and coconut oils (40%), some types of *kenkey* (20%), legumes such as black-eyed peas (20%), and okra (20%). The lactating women tended to avoid cereals like rice (19%), starchy foods like cassava (15%), yams (8%) and some maize dishes such as *banku* and roasted corn (12%). Other foods avoided during lactation included fruits like orange and mango (12%), peanut butter soup (8%), okra stew (4%), and animal source foods such as cow meat , goat meat, and eggs (4% respectively). Reasons given for avoiding the above mentioned foods included personal dislike (36%), fear that the food will induce gastrointestinal discomfort in the mother (41%), and fear that the food will induce gastrointestinal discomfort in the baby (23%). When asked about the source (s) of advice to avoided specific foods, all the pregnant women responded that the no one advised them on the issue. To them it was a personal decision. On the other hand, almost a quarter (24%) of the lactating women with food aversions said they obtained the information to avoid some foods from health personnel at the Ghana Health Services. About 59% of the participants sought

specific foods like palm soup, *kontomire* stew, and smoked fish during pregnancy or lactation. Among the pregnant women, more than half (54%) believed that the foods sought were nutritious and would promote healthy growth of them and their unborn baby. Among the lactating women, the most common reason for seeking specific foods was that the foods would enhance breast milk production (54%). Craving was another common reason (20%) for seeking specific foods. Most of the participants mentioned obtaining the advice to seek specific foods from multiple sources such as the Ghana Health Services, family members, neighbors, and the media.

Discussion

In this study, majority of the women reported receiving nutrition education from the Ghana Health Services (GHS). Compliance with GHS dietary recommendations was highest for soups and stews. A majority of the women in this study reported eating only at meal times (breakfast, lunch, and dinner) which supported the observation that snacking was the GHS recommendation with which women least complied. Factors preventing women from snacking could be cultural, financial, personal choices, or a combination of factors. More research is needed to better understand this behavior. The pattern observed in dietary habits also showed that most women increased their food intake during pregnancy as compared to their pre-pregnant state. However, once they begun lactating, very few women further increased their food intake. This finding was consistent with women's self-reported dietary intakes (estimated using 24 hr-dietary recalls) which showed no significant differences by physiological status (see chapter 4 of this thesis).

We also observed that almost half (42%) of the women were taking vitamins and supplements at the time of study. Supplementation appeared to be part of a routine multivitamin supplementation since almost all (95%) the mothers who were taking supplements reported similar multivitamins and iron products which they had received from heath centers. Use of vitamins and supplements in this study was positively associated with gastrointestinal discomfort. Women taking supplements containing iron have been known to complain of gastrointestinal related problems such as heartburn, nausea, vomiting, diarrhea, or constipation (Hyder et al., 2004; Ortega et al., 1998; Liu and Liu, 1996). More research is needed in to help understand the mechanism behind this phenomenon.

In the present study, majority of the women purposively sought some foods during pregnancy and lactation. Specific foods sought during pregnancy and lactation matched with the GHS dietary recommendations that the mothers complied with the most (i.e. intake of soups and stews). Specific soups sought included palm soup, peanut butter soup and tomato soup (popularly known as *light soup*); while *kontomire* stew (a green leafy vegetable stew) was the most popular stew sought after. While the pregnant women believed these foods to be nutritious and best for optimal growth of the fetus, the lactating mothers sought these foods mainly because they had been educated that these foods would enhanced breast milk production. This suggests that nutrition education in the clinics can be useful in

improving women's dietary behaviors (Kramer, 2000; Lanerolle and Atukorala, 2006).

Participants in this study also reported several food aversions, including avoidance of staples such as rice, cassava, and maize-based foods. This observation is consistent with findings from Ethiopia which showed that among 295 pregnant women surveyed, 41% avoided staple foods like cereals (Tsegaye et al., 1998). In addition to avoiding staples, some women in our study also reported excluding foods prepared with palm and coconut oils from their diets. This finding may be problematic in extreme cases as fats and oils are needed for optimal absorption of fat soluble vitamins. Some women in this study also reported avoiding fruits like oranges and mangoes and animal proteins such as beef, mutton, and eggs. Fruits are good sources of vitamin C, calcium and folate while animal flesh proteins provide protein, iron and zinc. Nutrition education programs meant for pregnant and lactating women may need to include information of the importance of these foods to ensure that women do not exclude nutritious foods from their diets. Our assessment of food-related beliefs showed that almost half of the women surveyed believed that HIV-infected individuals have specific dietary needs. Foods suggested included beta carotene rich foods like palm soup and *kontomire* (a green leafy vegetable) stew. These traditional soups and stews usually include proteins (such as meat and fish), and vegetables (like tomatoes, peppers and onions) thus making them good sources of vitamins and minerals. Some women also suggested that HIV-infected individuals eat more fruits like pineapples, mangoes, and oranges. If added to the diet, fruits

could provide vitamins such as vitamins A and C, which are micronutrients that are commonly deficient in the diet of HIV-infected individuals (Fawzi et al., 1998; Semba et al., 2002; Dreyfuss and Fawzi., 2002)

About 28% of pregnant women in this study reported eating clay or ice. This figure is similar to what was found in another population of Ghanaian women (Tayie and Lartey, 1999). We did not assess women's knowledge regarding the health implications of pica; however, we did ask the women their reasons for eating clay or ice. In both pregnant and lactating women, craving was the most important reason for practicing pica. Cravings and desire to reduce nausea have been cited women in similar studies as common reasons for practicing pica (Walker et al., 1985; Mcloughlin, 1987; Hunter, 1993; Tayie and Lartey, 1999). Pica has been implicated in several adverse birth outcomes and health effects and pregnant and lactating women should be made aware of the potential health risks associated with practicing pica.

Conclusions and implications

In conclusion, our study showed that the Ghana Health Services (GHS) are providing nutrition education through clinic services for Ghanaian pregnant and lactating women and women reported complying with many of the recommendations. In this study population, women reported food aversions during pregnancy and lactation. Given the nutritional value of many of these foods, health

personnel should use these findings to provide appropriate nutrition counseling and education for Ghanaian women to ensure optimal maternal and infant health.

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Table 21: Dietary habits and nutrition recommendation received among Ghanaian pregnant women by HIV status

		HIV Status		
	All (n = 21)	Infected (n = 7)	Uninfected (n = 5)	Unknown (n = 9)
Characteristic				
How well she eats now compared to when not pregnant				
Eats more when pregnant	14 (66.7) [1]	5 (71.4)	4 (80.0)	5 (55.6)
Same	6 (28.6)	2 (28.6)	1 (20.0)	3 (33.3)
Eats more when not pregnant	1 (4.8)	0 (0.0)	0 (0.0)	1 (11.1)
Average number of meals she eats per day				
1 meal	1 (4.8)	1(14.3)	0 (0.0)	0 (0.0)
2 meals	3 (14.3)	2 (28.6)	1 (20.0)	0 (0.0)
3 meals	13 (61.9)	4 (57.1)	4 (80.0)	5 (55.6)
4 meals	3 (14.3)	0 (0.0)	0 (0.0)	3 (33.3)
5 meals	1 (4.8)	0 (0.0)	0 (0.0)	1 (11.1)
Pattern of eating				
Eats onlyat meal times	16 (76.2)	6 (85.7)	4 (80.0)	6 (66.7)
Eats intermitently	5 (23.8)	1 (14.3)	1 (20.0)	3 (33.3)
Has received some nutrition recommendations				
Yes	19 (90.5)	6 (85.7)	5 (100.0)	8 (88.9)
No	2 (9.5)	1 (14.3)	0 (0.0)	1 (11.1)
Carried out recommendation				
Yes	19 (100.0)	6 (100.0)	5 (100.0)	8 (100.0)
Specific recommendation(s) carried out				
Ate more carbohydrate foods				
Yes	11 (52.4)	3 (42.9)	4 (80.0)	4 (44.4)
No	10 (47.6)	4 (57.1)	1 (20.0)	5 (55.6)
Ate more soups/stews				
Yes	18 (85.7)	5 (71.4)	5 (100.0)	8 (88.9)
No	3 (14.3)	2 (28.6)	0 (0.0)	1 (11.1)

Ate more protein foods				
Yes	16 (76.2)	4 (57.1)	5 (100.0)	7 (77.8)
No	5 (23.8)	3 (42.9)	0 (0.0)	2 (22.2)
Ate more fruit/vegetables				
Yes	16 (76.2)	4 (57.1)	4 (80.0)	8 (88.9)
No	5 (23.8)	3 (42.9)	1 (20.0)	1 (11.1)
Snacked more often				
Yes	6 (28.6)	2 (28.6)	1 (20.0)	3 (33.3)
No	15 (71.4)	5 (71.4)	4 (80.0)	6 (66.7)
Do you take vitamins/supplements during pregnancy	21 (100.0)	7 (100.0)	5 (100.0)	9 (100.0)
Yes				
Are you taking any vitamins/supplements now	20 (95.2)	6 (85.7)	5 (100.0)	9 (100.0)
Yes	1 (4.8)	1 (14.3)	0 (0.0)	0 (0.0)
No				
Specify vitamin/supplement	20 (100.0)	6 (100.0)	5 (100.0)	9 (100.0)
Folic acid, vitamin C, B-complex, and multivitamin				
Who recommended the vitamin/supplement	20 (100.0)	6 (100.0)	5 (100.0)	9 (100.0)
Health personnel				

[1] n (%). Fisher's Exact were computed by HIV status but are not reported here because none was significant statistics computed using SPSS (version 11.5), SAS (version 9.1) and Epi-Info (version 6.0)

[2] family members mentioned included mother and sister

Table 22: Dietary habits and nutrition recommendation received among Ghanaian lactating women by HIV status

Characteristic	All (n = 71)	HIV Status		
		Infected (n = 16)	Uninfected (n = 28)	Unknown (n = 27)
How well she eats now compared to when pregnant				
Eats more when pregnant	18 (25.4) [1]	6 (37.5)	6 (21.4)	6 (22.2)
Same	43 (60.6)	8 (50.0)	19 (67.9)	16 (59.3)
Eats more when lactating	10 (14.1)	2 (12.5)	3 (10.7)	5 (18.5)
Average number of meals she eats per day				
2 meals	15 (21.1)	3 (18.8)	6 (21.4)	6 (22.2)
3 meals	47 (66.2)	11 (68.8)	17 (60.7)	19 (70.4)
4 meals	8 (11.3)	2 (12.5)	4 (14.3)	2 (7.4)
5 meals	1 (1.4)	0 (0.0)	1 (3.6)	0 (0.0)
Pattern of eating				
Eats only at meal times	52 (73.2)	9 (56.3)	21 (75.0)	22 (81.5)
Eats intermitently	17 (23.9)	6 (37.5)	6 (21.4)	5 (18.5)
Cannot specify	2 (2.8)	1 (6.3)	1 (3.6)	0 (0.0)
Has received some nutrition recommendations				
Yes	60 (84.5)	11 (68.8)	26 (92.9)	23 (85.2)
No	11 (15.5)	5 (31.3)	2 (7.1)	4 (14.8)
Carried out recommendation				
Yes	60 (100.0)	11 (100.0)	26 (100.0)	23 (100.0)
Specific recommendation(s) carried out[2]				
Ate more carbohydrate foods				
Yes	38 (53.5)	6 (37.5)	17 (60.7)	15 (55.6)
No	33 (46.5)	10 (62.5)	11 (39.3)	12 (44.4)
Ate more soups/stews				
Yes	53 (74.6)	9 (56.3)	23 (82.1)	21 (77.8)
No	18 (25.4)	7 (43.8)	5 (17.9)	6 (22.2)

Ate more protein				
Yes	19 (26.8)	2 (12.5)	11 (39.3)	6 (22.2)
No	52 (73.2)	14 (87.5)	17 (60.7)	21 (77.8)
Ate more fruit/vegetables				
Yes	34 (47.9)	8 (50.0)	15 (53.6)	11 (40.7)
No	37 (52.1)	8 (50.0)	13 (46.4)	16 (59.3)
Snacked more often				
Yes	12 (16.9)	1 (6.3)	5 (17.9)	6 (22.2)
No	59 (83.1)	15 (93.8)	23 (82.1)	21 (77.8)
Do you take vitamins/supplements during lactation				
Yes	57 (80.3)	12 (75.0)	24 (85.7)	21 (77.8)
No	14 (19.7)	4 (25.0)	4 (14.3)	6 (22.2)
Are you taking any vitamins or supplements now				
Yes	18 (25.7)	5 (31.3)	5 (18.5)	8 (29.6)
No	52 (74.3)	11 (68.8)	22 (81.5)	19 (70.4)
Specify vitamin/supplement				
Folic acid, vitamin C, B-complex, and multivitamin	17 (94.4)	5 (100.0)	5 (100.0)	7 (87.5)
B complex + multivitamin	1 (5.6)	0 (0.0)		1 (12.5)
Who recommended the vitamin/supplement				
Health personnel	17 (89.4)	4 (80.0)	6 (100.0)	7 (87.5)
Self	1 (5.3)	1 (20.0)	0 (0.0)	0 (0.0)

[1] n (%). Fisher's Exact were computed by HIV status but are not reported here because none was significant statistics computed using SPSS (version 11.5), SAS (version 9.1) and Epi-Info (version 6.0)

[2] subjects may have carried out more than recommendation

Table 23: Food beliefs of Ghanaian pregnant and lactating women by HIV status

	Pregnant women	HIV Status		
	All (n = 21) [1]	Infected (n = 7)	Uninfected (n = 5)	Unknown (n = 9)
Belief that some foods are "good" for people with malaria				
Yes	11 (52.4)	2 (28.60	3 (60.0)	6 (66.7)
No	3 (14.3)	2 (28.60		1 (11.1)
Not sure	7 (33.3)	3 (42.9)	2 (40.0)	2 (22.2)
Belief that some foods are "good" for people with diarrhoea				
Yes	11 (52.4)	3 (42.9)	2 (40.0)	6 (66.7)
No	3 (14.3)	1 (14.3)	1 (20.0)	1 (11.1)
Not sure	7 (33.3)	3 (42.9)	2 (40.0)	2 (22.2)
Belief that some foods are "good" for people with HIV				
Yes	11 (52.4)	4 (57.1)	3 (60.0)	4 (44.4)
No	1 (4.8)	0 (0.0)	0 (0.0)	1 (11.1)
Not sure	9 (42.9)	3 (42.9)	2 (40.0)	4 (44.4)

	Lactating women	HIV Status		
	All (n = 71)	Infected (n = 16)	Uninfected (n = 28)	Unknown (n = 27)
Belief that some foods are "good" for people with malaria				
Yes	54 (76.1)	11 (68.8)	23 (82.1)	20 (74.1)
No	6 (8.5)	1 (6.3)	3 (10.7)	2 (7.4)
Not sure	11 (15.5)	4 (25.0)	2 (7.1)	5 (18.5)
Belief that some foods are "good" for people with diarrhoea				
Yes	43 (60.6)	8 (50.0)	18 (64.3)	17 (63.0)
No	4 (5.6)	0 (0.0)	2 (7.1)	2 (7.4)
Not sure	24 (33.8)	8 (50.0)	8 (28.6)	8 (29.6)
Belief that some foods are "good" for people with HIV				
Yes	32 (45.1)	7 (43.8)	14 (50.0)	11 (40.7)
No	10 (14.1)	1 (6.3)	5 (17.9)	4 (14.8)
Not sure	29 (40.8)	8 (50.0)	9 (32.1)	12 (44.4)

[1] n (%). Fisher's Exact were computed by HIV status but are not reported here because none was significant

Table 24. Intake of non-food items among Ghanaian pregnant and lactating women

		Pregnant women			
Characteristic	**All (n = 21)**	**Infected (n = 7)**	**Uninfected (n = 5)**	**Unknown (n = 9)**	**p [1]**
Intake of non-food item					**0.031**
Yes	6 (28.6) [2]	4 (57.1) [a]	2 (40.0) [ab]	0 (0.0) [b]	
No	15 (71.4)	3 (42.9)	3 (60.0)	9 (100.0)	
Type of non-food					0.067
White clay	4 (66.7)	4 (100.0)	0 (0.0)	0 (0.0)	
Ice	2 (33.3)	0 (0.0)	2 (100.0)	0 (0.0)	
Estimated amount eaten per day					0.067
Clay (6g)	4 (66.6)	4 (100.0)	0 (0.0)	0 (0.0)	
Ice (≤250g)	2 (32.4)	0 (0.0)	2 (100.0)	0 (0.0)	
Reasons for eating non-food item					0.467
Craving	5 (83.3)	3 (75.0)	2 (100.0)	0 (0.0)	
To reduce nausea	1 (16.7)	1 (25.0)	0 (0.0)	0 (0.0)	
		Lactating women			
Characteristic	**All (n = 71)**	**Infected (n = 16)**	**Uninfected (n = 28)**	**Unknown (n = 27)**	
Intake of non-food item					0.696
Yes	2 (2.8)	1 (6.3)	1 (3.6)	0 (0.0)	
No	69 (97.2)	15 (93.8)	27 (96.4)	27 (100.0)	
Type of non-food					1.000
White clay	1 (50.0)	1 (100.)	0 (0.0)	0 (0.0)	
Ice	1 (50.0)	0 (0.0)	1 (100.0)	0 (0.0)	
Estimated amount eaten per day					1.000
Clay (30g)	1 (50.0)	1 (100.0)	0 (0.0)	0 (0.0)	
Ice (250g)	1 (50.0)	0 (0.0)	1 (100.0)	0 (0.0)	
Reasons for eating non-food item					1.000
Craving	2 (100.0)	1 (100.0)	1 (100.0)	0 (0.0)	

[1] values compare groups by HIV status using Fisher's Exact. Statistics computed using SAS (version 9.1) and Epi-Info (version 6.0)

[a,b] values with same superscript are not significantly different from each other

[2] n (%)

Table 25: Food preferences and aversions of Ghanaian pregnant women by HIV status

		HIV Status		
	All (n = 21)	**Infected (n = 7)**	**Uninfected (n = 5)**	**Unknown (n = 9)**
Do you avoid some food(s) when pregnant				
Yes	5 (23.8) [1]	1 (14.3)	1 (20.0)	3 (33.3)
No	16 (76.2)	6 (85.7)	4 (80.0)	6 (66.7)
Type of food(s) avoided during pregnancy[2]				
Starchy foods	1 (20.0)	0 (0.0)	0 (0.0)	1 (33.3)
Legumes	1 (20.0)	0 (0.0)	1 (100.0)	0 (0.0)
Vegetables	1 (20.0)	0 (0.0)	0 (0.0)	1 (33.3)
Miscellaneous	2 (40.0)	1 (100.0)	0 (0.0)	1 (33.3)
Reasons for avoiding specific food(s)				
Personal dislike	2 (40.0)	1 (100.0)	0 (0.0)	1 (33.3)
Causes gastrointestinal distress in mother	3 (60.0)	0 (0.0)	1 (100.0)	2 (66.7)
Source of above information				
Self	5 (100.0)	1 (100.0)	1 (100.0)	3 (100.0)
Do you seek out specific food(s) when pregnant				
Yes	13 (61.9)	3 (42.9)	4 (80.0)	6 (66.7)
No	8 (38.1)	4 (57.1)	1 (20.0)	3 (33.3)
Type of food(s) sought during pregnancy[3]				
Starchy foods	8 (50.0)	2 (50.0)	2 (50.0)	4 (57.1)
Fruits	4 (25.0)	1 (25.0)	1 (25.0)	2 (28.6)
Vegetables	4 (25.0)	1 (25.0)	1 (25.0)	1 (14.3)
Reasons for seeking above food(s)				
Craving	5 (38.5)	1 (33.3)	1 (25.0)	3 (50.0)
Nutritious / healthy	7 (53.8)	2 (66.7)	3 (75.0)	2 (33.3)
Enhances breastmilk production	1 (7.7)	0 (0.0)	0 (0.0)	1 (16.7)

Source of above information				
MOH	8 (30.8)	2 (50.0)	2 (28.6)	4 (26.7)
Family member[4]	4 (15.4)	0 (0.0)	2 (28.6)	2 (13.3)
Neighbors	4 (15.4)	0 (0.0)	1 (14.2)	3 (20.0)
TV, Radio, Newspaper, Pamphlet	10 (38.4)	2 (50.0)	2 (28.6)	6 (40.0)

[1] n (%). Fisher's Exact were computed by HIV status but are not reported here because none was significant
Statistics computed using SPSS (version 11.5), SAS (version 9.1) and Epi-Info (version 6.0)

[2] includes only women who avoided some foods (n = 5)

[3] women may have given ≥1 food

[4] family members mentioned included mother and aunt

Table 26: Food preferences and aversions of Ghanaian lactating women by HIV status

		HIV Status		
	All (n =71)	**Infected (n = 16)**	**Uninfected (n = 28)**	**Unknown (n = 27)**
Do you avoid some food(s) when lactating				
Yes	17 (23.9) [1]	2 (12.5)	5 (17.9)	10 (37.0)
No	54 (76.1)	14 (87.5)	23 (82.1)	17 (63.0)
Type of food(s) avoided during lactation[2]				
Starchy foods	11 (64.7)	2 (100.0)	4 (80.0)	5 (50.0)
Fruits	3 (17.6)	0 (0.0)	1(20.0)	2 (20.0)
Stews	1 (5.9)	0 (0.0)	0 (0.0)	1 (10.0)
Animal source protein	2 (11.8)	0 (0.0)	0 (0.0)	2 (20.0)
Reason for avoiding specific food(s)				
Personal dislike	6 (35.3)	2 (100.0)	3 (60.0)	1 (10.0)
Causes gastro-intestinal distress in mother	6 (35.3)	0 (0.0)	1 (20.0)	5 (50.0)
Causes gastro-intestinal distress in baby	5 (29.4)	0 (0.0)	1 (20.0)	4 (40.0)
Source of above information				
MOH	4 (19.0)	0 (0.0)	0 (0.0)	4 (26.7)
Family member[3]	6 (28.6)	0 (0.0)	1 (20.0)	5 (33.3)
Neighbors	2 (9.5)	0 (0.0)	0 (0.0)	2 (13.3)
TV, Radio, Newspaper	9 (42.9)	1 (100.0)	4 (80.0)	4 (26.7)
Do you seek out specific food(s) when lactating				
Yes	41 (57.7)	8 (50.0)	19 (67.9)	14 (51.9)
No	30 (42.3)	8 (50.0)	9 (32.1)	13 (48.1)
Type of food(s) sought during lactation[4]				
Starchy foods	29 (34.1)	7 (43.8)	14 (34.1)	8 (28.6)
Cereal/grains	3 (3.5)	0 (0.0)	3 (7.3)	0 (0.0)
Animal source proetins	4 (4.7)	1 (6.3)	1 (2.4)	2 (7.1)
Vegetables	6 (7.1)	0 (0.0)	3 (7.3)	3 (10.7)
Beverage/porridge	4 (4.7)	0 (0.0)	2 (4.9)	2 (7.1)
Soups	24 (28.2)	5 (31.3)	9 (21.9)	10 (35.7)
Stews	10 (11.8)	2 (12.5)	6 (14.6)	2 (7.1)
Reasons for seeking specific food(s)				
Craving	6 (14.6)	2 (25.0)	2 (10.5)	2 (14.3)
Nutritious / healthy	13 (31.7)	0 (0.0)	9 (47.4)	4 (28.6)
Enhances breastmilk production	22 (53.7)	6 (75.0)	8 (42.1)	8 (57.1)

Reasons for seeking specific food(s)				
Craving	6 (14.6)	2 (25.0)	2 (10.5)	2 (14.3)
Nutritious / healthy	13 (31.7)	0 (0.0)	9 (47.4)	4 (28.6)
Enhances breastmilk production	22 (53.7)	6 (75.0)	8 (42.1)	8 (57.1)
Source of information				
MOH	17 (23.6)	2 (20.0)	9 (25.0)	6 (24.0)
Family member	23 (31.9)	3 (30.0)	10 (27.8)	10 (40.0)
Neighbors	12 (16.7)	0 (0.0)	7 (19.4)	5 (20.0)
TV, Radio, Newspaper	20 (27.8)	5 (50.0)	10 (27.8)	4 (16.0)

[1] n (%). Fisher's Exact were computed by HIV status but are not reported here because none was significant statistics computed using SPSS (version 11.5), SAS (version 9.1) and Epi-Info (version 6.0)

[2] includes only women who avoided some foods (n = 17)

[3] family members mentioned included mother and aunt

[4] women may have given ≥1 food

CHAPTER 6. GENERAL CONCLUSIONS

Summary

Adequate dietary intake during pregnancy and lactation women is fundamental in ensuring optimal birth outcomes and infant growth (Hytten and Leitch, 1971, Kramer, 2000, Kramer, 2003). If a pregnant or lactating woman becomes infected with HIV, her energy and nutrient requirements may become higher as requirements for HIV are superimposed on that for pregnancy and lactation (WHO, 2003; Singhal and Austin, 2002). In most African countries, the high attendance at ante-natal and post natal clinics has made these places suitable platforms for educating women on nutrition issues. In Ghana, there is scarcity of data on maternal energy and nutrient intakes. Information on womens compliance with nutrition recommendations received from the Ghana Health Services is also lacking. Given that nutrient deficiencies during HIV infection are closely tied with disease progression and duration of survival, it is important to examine the dietary intakes and habits of Ghanaian pregnant and lactating women who may also be HIV-infected or uninfected.

The results of this study showed that energy and nutrient intakes of Ghanaian pregnant and lactating women did not differ by physiological or HIV status. Assessment of energy and nutrient intake by day of week (i.e. weekday, weekend, or market day) also showed no significant differences. After controlling for indicators of health, socioeconomic status, and dietary recommendations, being unmarried was negatively associated with energy, protein, thiamin and niacin intake ($P < 0.04$)

and tended to be associated with fat, vitamin A, and riboflavin intake ($P < 0.09$). Being stressed was associated with lower intakes of energy, fat, iron, vitamins A, B_1, B_2, B_3, and C and tended to be associated with protein intake ($P < 0.07$). Absence of GIT distress was positively associated with energy intake ($P < 0.02$), and tended to be associated with fat intake ($P < 0.06$).

The results of this study also indicated that about 86% of Ghanaian women receive dietary recommendation from the Ghana Health Services (GHS). Dietary recommendations from the GHS focused on eating more carbohydrate-rich foods for energy, consuming more soups and stews, adding more protein-rich foods to diet, eating more vegetables and fruits, and snacking more often. Only 12% of the women in this study reported complying with all five of the GHS dietary recommendations while 22% complied with at least three. The recommendation most complied with was intake of soups and soups (90%). Compliance was least for snacking (22%). Most of the women surveyed (59%) also reported seeking specific foods like soups and stews during pregnancy and lactation. Food aversions were present in 24% of the participants with women mostly avoiding starchy foods like yams, cassava, rice, and some maize dishes. Some women also avoided foods prepared with palm and coconut oil, legumes such as black-eyed peas and animal proteins such as meat and eggs during pregnancy and lactation. Almost half (47%) of the women believed some foods were beneficial for HIV affected persons. Foods mentioned included palm soup, *kontomire* (a green leafy vegetable) stew, and animal proteins such as meat, fish, eggs, and milk. Among the women surveyed, the practice of pica was

very low in the lactating women (3%). About 29% of pregnant women however reported eating clay or ice because of craving or to prevent nausea.

Limitations and future studies

Participants in this study were recruited through the RIING project. While this recruitment method facilitated the inclusion of women who were HIV-infected, uninfected, of unknown HIV status, it also restricted the potential number of women who could have been recruited since all the women had to be participants of the RIING project. Also, due to the limited time available for data collection (3 months), we were unable to recruit more women.

The main tool used to assess dietary intake in this study was the 24-hr dietary recall which relies on the women's ability to accurately estimate portion sizes using household measures. This method is subjective and studies have shown that some individuals tend to over-estimate or underestimate portion sizes (Lichtman, 1992) The observation that the mean BMI for the HIV-uninfected women was in the overweight region makes their reported energy and nutrient intakes more credible. However, given that about 45% of Ghanaian women are anemic and 8% report night blindness (Ghana Demographic and Health Survey, 2003), more research is needed to confirm these results and to ensure that energy and nutrient intakes of this population can be extrapolated to the country as a whole.

To minimize the problems associated with the 24-hr dietary recall, only local and familiar household measures were used in this study. An alternative methodology that could have been used was the weighed food intake in which all foods are weighed before eating. This latter method is thought to be the gold standard of dietary assessment because of its probable greater accuracy (Cameron and Van Staveron, 1988). Weighed food intake is also associated with some limitations e.g. habitual food intake may be altered owing to the presence of the investigator in the home. In addition, snacks and drinks may be under-recorded as these are inconvenient to weigh or measure each time they are consumed. Lastly, weighed food records are time consuming for both participant and investigator (Cameron and Van Staveron, 1988). Future studies should therefore aim at using both 24-hr recalls and weighed food intake as the methodologies for assessing dietary intakes. This approach will help to compare both outcomes in a Ghanaian setting and also produce more effective results.

Recommendations

In this cross-sectional study, we observed that even though there was about 10 -15 kg difference in weight between the HIV-infected and uninfected women or women with unknown status, the energy and nutrient intakes of the three groups did not differ. This inability to detect differences between groups may have been due to the small sample size of this study. But, if the results in this study are accurate, then there is concern that Ghanaian women who are HIV-infected may not be meeting the energy requirement associated with HIV-infection. The Ghana Health Services

may therefore need to provide separate nutrition counseling for HIV-infected women to ensure that they eat energy sufficient diets.

CHAPTER 7. GENERAL REFERENCES

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Title of Study: **Optimal child nutrition**

Investigators: **Grace S. Marquis, Ph.D. (ISU), Robert E. Mazur, Ph.D., (ISU), Rafael Perez-Escamilla, Ph.D. (U Conn), Anna Lartey, Ph.D. (U Ghana)**

This is a research study. Please take your time in deciding if you would like to participate. Please feel free to ask questions at any time.

INTRODUCTION

The purpose of this study is to understand how the individual health, household, and community characteristics affect child-feeding practices and to develop new feeding recommendations that are feasible to carry out safely and will meet the nutritional needs of young children who live in communities similar to yours. You are being invited to participate in this study because you are pregnant, have been offered by the health personnel voluntary testing and counseling for HIV, and have expressed interest to the clinic staff in hearing about the study.

DESCRIPTION OF PROCEDURES

If you agree to participate in this study, your participation will last through the remaining months of your pregnancy and then for 12 months after you give birth. During the study you may expect the following study procedures to be followed. At enrollment, study staff will conduct an interview at the clinic about characteristics of yourself and your household, your health, obstetric history, and previous breastfeeding and child-feeding practices. When you are interviewed, you may skip any question that you do not wish to answer or that makes you feel uncomfortable. The staff also will take your body measurements, such as weight, height, arm and calf circumferences, and skinfolds. During the third trimester, you will be visited at home to collect additional information about your health and pregnancy. Medical information about your pregnancy, the birth, and the postnatal period, including your and your baby's HIV status (if you have been tested), will be extracted from your and your baby's clinic and the testing site records. After you give birth, study staff will visit you at your home to collect information about infant feeding, your and your baby's health, and characteristics about your household. Twice weekly, study staff will ask you about your and your baby's health and diet; this will take about 10 minutes. Once a month, study staff will weigh and measure the length of your baby. This will take about 15 minutes. About one-third of the participants (chosen by lottery) will be asked to permit a study staff to stay with them in their house for 24 hours when their baby is one, three, and six months old. The purpose of this visit is to measure the amount of breast milk and other foods and liquids that their

baby drinks. If you are chosen, for these studies, your baby will be weighed before and after each breastfeed, and any food or drink that is given will be weighed before and after it is offered. If you participated in the Health Perceptions survey during an antenatal visit, the information from that survey will be used in this study.

RISKS

While participating in this study you may experience inconvenience and privacy issues because of the 24-hour in-home visit. This study involves women who have gone through voluntary counselling and testing (VCT) and those who have not been through VCT and therefore some will know their HIV status and some will not know. There may be a risk that some people in your community might think that you are HIV if you are participating in the study; however, a number of measures have been taken to minimize this risk. These measures are described below under the Confidentiality section.

BENEFITS

To coordinate with a hospital delivery, the study staff will encourage you to use the associated prenatal services to monitor your pregnancy. By giving birth at the hospital, you and your baby will have access to emergency services during the delivery and post-natal preventive care that will protect your and your baby's health. It is hoped that the

information gained in this study will benefit society by providing valuable information about new options for infant feeding that will improve the lives of Ghanaian children. At the end of the study, the study staff will also provide you with nutrition education information about how to best meet the dietary needs of your growing child.

COSTS AND COMPENSATION

You will not have any costs from participating in this study. If you decide to participate in this study and agree to give birth at the hospital, the study will pay for part of the medical expenses related to the delivery of your baby. If you have a normal (vaginal) delivery, the study will pay the equivalent of $20. If a caesarean delivery is medically necessary, the study will pay the equivalent of $40 because of the additional cost related to this procedure. These payments will be made directly to your account at the hospital. Any travel expenses your need to make to participate fully in the study will be covered by the study.

PARTICIPANT RIGHTS

Your participation in this study is completely voluntary and you may refuse to participate or leave the study at any time. If you decide to not participate in the study or leave the study early, it will not result in any penalty or loss of benefits to which you are otherwise entitled.

CONFIDENTIALITY

Records identifying participants will be kept confidential to the extent permitted by applicable laws and regulations and will not be made publicly available. However, federal government regulatory agencies, NIH, and the Institutional Review Board (a committee that reviews and approves human subject research studies) may inspect and/or copy your records for quality assurance and data analysis. These records may contain private information. To ensure confidentiality to the extent permitted by law, the following measures will be taken. Participantss will be assigned a unique code and that code will be used on forms instead of their name. Only Project Investigators and the program supervisor will have access to records linking womens' name and codes. Other study staff will not have access to information about the HIV status of participants. Records will be kept in a locked filing cabinet; digital information will be kept in password-protected computer files. Files linking womens' name with a unique code will be destroyed at the end of the project. If the results are published, your identity will remain confidential. To help us keep your HIV status confidential, we encourage you to not talk about whether you used the HIV testing center or your test results with the field worker who visits your home. Also, we encourage you to not discuss your participation in the study with others.

QUESTIONS OR PROBLEMS

You are encouraged to ask questions at any time during this study. For further information about the study contact Dr. Anna Lartey at 513293; aalartey@hotmail.com (Legon, Ghana) or Dr. Grace Marquis at (515) 294-9231; gmarquis@iastate.edu (USA). If you have any questions about the rights of research subjects or research-related injury, please contact the Human Subjects Research Office, 2810 Beardshear Hall, (515) 294-4566; austingr@iastate.edu or the Research Compliance Officer, Office of Research Compliance, 2810 Beardshear Hall, (515) 294-3115; dament@iastate.edu

****

SUBJECT SIGNATURE

Your signature indicates that you voluntarily agree to participate in this study, that the study has been explained to you, that you have been given the time to read the document and that your questions have been satisfactorily answered. You will receive a copy of the signed and dated written informed consent prior to your participation in the study.

Subject's Name (printed) _____

_____ _____

(Subject's Signature/thumbprint) (Date)

Your signature below indicates that you voluntarily agree to allow your infant also to participate in this study.

Infant's Name (printed) _____

_____ _____

(Signature/thumbprint of Parent/Guardian or Legally Authorized Representative) (Date)

INVESTIGATOR STATEMENT

I certify that the participant has been given adequate time to read and learn about the study and all of their questions have been answered. It is my opinion that the participant understands the purpose, risks, benefits and the procedures that will be followed in this study and has voluntarily agreed to participate.

_____ _____

(Signature of Person Obtaining Informed Consent) (Date)

APPENDIX 2-A. MATERNAL DEMOGRAPHIC CHARACTERISTICS

Household Identifier ___ ___ ___

Date Completed (dd/mm/yy) ___ / ___ / ___

Interviewer Identifier ___ ___ ___

1. Age (y) _____

2. Education (y) _____

(Circle one)

None = 0
Class 1–6 (Primary) = 1-6
Junior Secondary School JSS 1 = 7,
JSS 2 = 8, JSS 3/Middle school completed = 9
Senior Secondary School
SSS 1 = 10, SSS 2 = 11, SSS 3 = 12

Post-Secondary
Voc/Tech – started = 13
Voc/Tech – completed = 14
Prof. Diploma – started = 15
Prof. Diploma – completed = 16
University – started = 17
University – completed = 18
Other/informal =19

3. Ethnicity *(Circle one)*

1. Ga/Adangbe 2. Ewe 3. Akan 4. Northerners
5. Other_____

4. Primary occupation _____

1. Trader 2. Seamstress 3. Caterer 4. Secretary 5. Hairdresser
6. Teacher 7. Unemployed 8. Baker 9. Farmer

5. Marital status *(Circle one)*

1. Married 2. Cohabitants 3. Single 4. Separated 5. Divorced

6. Preferred language spoken *(Circle only one)*
   1. Krobo 2. Ga/Adangbe 3. Ewe 4. Akan 4. Fulani 5. Other_____

7. Gestational characteristics (Live births ___ ___)

APPENDIX 2-B. ANTHROPOMETRIC MEASUREMENT FORM

Household Identifier ___ ___ ___ Interviewer Identifier ___ ___

Collection Time ___ ___ Date (dd/mm/yy) ___ ___/___ ___/___ ___

Index Mother	**1st**	**2nd**
Weight (kg)	___ ___ ___ . ___	___ ___ ___ . ___
Height (cm)	___ ___ ___ . ___	___ ___ ___ . ___
Arm circumference (cm)	___ ___ ___ . ___	___ ___ ___ . ___
Calf circumference (cm)	___ ___ . ___	___ ___ . ___

Maternal height to be taken only once at 6 months post- partum

APPENDIX 2-C. FOOD-SECURITY/HUNGER CORE MODULE

Household identifier __ __ __Date Completed (dd/mm/yy) __ / __ / __ Interviewer Identifier __ __ __

<u>Transition into Module</u> *(administered to all index mothers): These next questions are about the food eaten in your household in the last month, and whether you were able to afford the food you need.*

Now I'm going to read you several statements that people have made about their food situation. For these statements, please tell me whether the statement was <u>often</u> true, <u>sometimes</u> true, or <u>never</u> true for (you/your household) in the last month.

In the last month, did you ever eat less because there wasn't enough food?	1= Yes 2= No 8= Don't know 5= Refused
2. In the last month, were you ever hungry but didn't eat because there wasn't enough food?	1= Yes 2= No 8= Don't know 5= Refused
3. In the last month, did you lose weight because you didn't have enough food to eat?	1= Yes 2= No 8= Don't know 5= Refused
4. In the last month, did you purchase food on credit?	1= Yes 2= No 8= Don't know 5= Refused
5. In the last month, did you consume seed stock held for the next season?	1= Yes 2= No 8= Don't know 5= Refused
In the last month, did you rely on assistance from a friend or relative outside the household for food?	1= Yes 2= No 8= Don't know 5= Refused

Household Identifier ___ ___ ___

Date Completed (dd/mm/yy) ___/___/___

Interviewer Identifier ___ ___ ___

Collection Time __ __

PERCEIVED STRESS SCALE

Never 1	Only once or twice 2	At least once a week 3	More than once a week 4	Almost daily 5

a. In the last month, how often have you felt that you were effectively coping with important changes that were occurring in your life?	
b. In the last month, how often have you felt confident about your ability to handle your personal problems?	
c. In the last month, how often have you felt that you were unable to control the important things in your life?	
d. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?	

[PARTID] Participant ID #

[INTCODE] Interviewer Code

[DATECOMP] Date Completed (mm/dd/yy)

[MOTHERIS] Mother is: (1 = pregnant, 2 = lactating, 3 = neither)

[MSTATUS] Participant's status: (A = HIV+ B = HIV- C = Unknown)

1. **[HEALTHY]** How was your health yesterday? 1. Very good 2. Not too good 3. Poor

[SYMPTOM] If poor to Q1, specify the illness / symptoms _____

[SYMLAST] How many days did the illness / symptoms last?

Write in number of days of days, or 99 = if illness still exists

[SYMTREAT] Did you receive any treatment? 1. Yes 2. No 3. Don't Know

[WHSYMTR] If yes to (iii), where did you get the treatment?

1 = health center

2 = herbs / traditional medicine

3 = other (specify)

0 = health centre and herbs

[SYMAPPE] How did your illness affect your appetite?

1. Increased appetite 2. Decreased appetite 3. No effect

2. **[MALARIA]** Within the last two weeks, have you had malaria? 1.Yes 2. No 3. Don't Know

[MALLAST] If yes to Q2, How many days did the malaria last?

[MALTREAT] Did you receive any treatment? 1.Yes 2. No 3. Don't Know

[WHMALTR] If yes to (iii), where did you obtain the treatment?

1 = health center

2 = herbs / traditional medicine

3 = other (specify) (1=myself 2.drug store)

0 = health centre and herbs

[MALAPPE] How did the malaria affect your appetite?

1. Increased appetite 2. Decreased appetite 3.No effect

3. **[FEVAPPE]** Within the last two weeks, have you had a fever? 1. Yes 2. No 3. Don't Know

[FEVLAST] If yes to Q3, How many days did the fever last?

[FEVTREAT] Did you receive any treatment? 1. Yes 2. No 3. Don't Know

[WHFEVTR] If yes to (iii), where did you obtain the treatment?

1 = health center

2 = herbs / traditional medicine

3 = other (specify)

(1 = myself 2. drugstore)

0 = health centre and herbs

[FEVAPPE] How did the fever affect your appetite?

1. Increased appetite 2. Decreased appetite 3.No effect

4. **[GASTRO]** Within the last two weeks, have you had diarrhoea or any gastrointestinal infection?

1. Yes 2. No 3. Don't Know

[SPECGAS] If yes to Q4, specify illness _____

[GASTREAT] How many days did the illness last?

[WHGASTR] Did you receive any treatment? 1. Yes 2. No 3. Don't Know

If yes to (iii), where did you obtain the treatment?

1 = health center

2 = herbs / traditional medicine

3 = other (specify)

(1=myself 2. drugstore)

0 = health centre and herbs

[GASAPPE] How did the illness affect your appetite?

1. Increased appetite 2. Decreased appetite 3.No effect

5. [NONFOOD] Do you eat clay or any other non-food substance? 1. Yes 2. No 3. Don't Know

[SPECNFD] If yes to Q5, specify item (s) _____

[QUANTNFD] Roughly how much of the item mentioned in (i) do you eat per day?_____

[WHYNFD] Could you share with me what eating the item mentioned in (i) does for you _____

[PARTID] Participant ID #

[INTCODE] Interviewer Code

[DATECOMP] Date Completed (mm/dd/yy):_ _ / _ _ / _ _

[MOTHERIS] Mother is: 1 = pregnant, 2 = lactating, 3 = neither

[MSTATUS] Mother's status: A = HIV+ B = HIV- C = UNKNOWN

1. **[EATPAT]** Some women change their dietary habits during pregnancy/lactation compared to when they were not pregnant /lactating. Could you share with me how your diet has changed?

[NTIMES] Number of times per day 1._____P, _____ L, _____ Same

[REGULAR] How often does subject eat e.g. little bits or fixed times

1. Eats around the same time all the time (fixed meal times).

2. Irregular eating pattern. Prefers to eat in little quantities

[QUANTITY] Does she eat more/less now compared to previous physiological state? (1 = Eats more when preg, 2. Eats more when lactating, 3. Same, 4. Eats more when not preg, 5. Eats more when lactating)

2. **[RECOMM]** What recommendations about eating (foods to be eaten during pregnancy / lactation) have you received?

[RECSCORE] Score points as related to MOH recommendations (0 – 5 point)

[DONEREC] Have you done any of these things you were told? 1. Yes 2. No 3. Don't Know

[YESREC] If yes to (ii), could you specify which ones?

[YESRECSC] Score points as related to MOH recommendations (0 – 5 point)

[NOREC] If no to (ii), could you share with me what is preventing you from doing the things you were told _____

[SOURCERE] From whom did you receive this information?

[MOHREC] Ministry of Health 1. Yes 2. No 3. Don't Know

If yes, specify (1. Doctor 2. Nurse)

[FAMREC] Family 1. Yes 2. No 3. Don't Know / Not Sure

If yes specify (1. Mother 2. Sister 3. Aunt 4. In-laws 5. Grandmother 6. Father 7. Others)

[NEIGHREC] Neighbours 1. Yes 2. No 3. Don't Know

[OTHRREC] Others (specify)(0 = TV, Radio, Newspaper 1. TV 2. Radio 3. Newspaper

4. TV & Radio 5. Book/Pamphlet 6. TV & Book)

3. **[FDAVOID]** Are there specific foods you avoid when you are pregnant / lactating?

1. Yes 2. No 3. Don't Know / Not Sure

[FDAVNAME] If yes, could you name some of these foods?

[WHYAVOID] Could you share with me why you feel the need to avoid the above mentioned foods?

[SOURCE] From whom did you receive this information to avoid the above mentioned foods?

[MOHREC] Ministry of Health 1. Yes 2. No 3. Don't Know

If yes, specify (1. Doctor 2. Nurse)

[FAMREC] Family 1. Yes 2. No 3. Don't Know / Not Sure

If yes specify (1. Mother 2. Sister 3. Aunt 4. In-laws 5. Grandmother

6. Father 7. Others)

[NEIGHREC] Neighbours 1. Yes 2. No 3. Don't Know

[OTHRREC] Others (specify)(0 = TV, Radio, Newspaper 1. TV 2. Radio 3. Newspaper

4. TV & Radio 5. Book/Pamphlet 6. TV & Book)

4. **[FDSEEK]** Are there specific foods you purposively seek out when you are pregnant / lactating?

1. Yes 2. No 3. Don't Know / Not Sure

[FDSENAME] If yes, could you name some of these foods

[WHYSEEK] Could you share with me why you feel the need to purposively

seek out the above mentioned foods _____

[SOURCESE] From whom did you receive this information?

[MOHREC] Ministry of Health 1. Yes 2. No 3. Don't Know

If yes, specify (1. Doctor 2. Nurse)

[FAMREC] Family 1. Yes 2. No 3. Don't Know / Not Sure

If yes specify (1. Mother 2. Sister 3. Aunt 4. In-laws 5. Grandmother

6. Father 7. Others)

[NEIGHREC] Neighbours 1. Yes 2. No 3. Don't Know

[OTHRREC] Others (specify)(0 = TV, Radio, Newspaper 1. TV 2. Radio 3. Newspaper

4. TV & Radio 5. Book/Pamphlet 6. TV & Book)

[FDMALA] Do you believe there are specific dietary needs for someone with Malaria

1. Yes 2. No 3. Don't Know

[MALAFDSP] If yes, could you specify the need (s)

[FDDIARR] Diarrhea 1. Yes 2. No 3. Don't Know

[FDDIARRSP] If yes, could you specify the need (s)

[FDHIV] Do you believe there are specific dietary needs for someone with HIV?

1. Yes 2. No 3. Don't Know

[FDHIVSP] If yes, could you specify the need (s)

6. **[VITSUPP]** Do you take any vitamins/ supplements during pregnancy?

1. Yes 2. No 3. Don't Know

[SUPPSPE] If yes, specify vitamin/supplement

(0. Given at hospital 1. Vitamin C 2. Bcomplex 3. Iron 4. Fesolate

5. Multivitamin capsules/tablet/tonic 6. Bcomplex & multivitamin)

[SUPPREC] Who recommended the vitamins/supplement to you?

(1. Doctor 2. Nurse 3. Pharmacist/Drug store 4. Family member (not specified)

5. Neighbour 6. Myself 7. Mother 8. Sister)

7. **[NOWVITS]** Are you taking any vitamins/ supplements now? 1. Yes 2. No 3. Don't Know

[VITSSPE] If yes, specify vitamin/supplement

(0. Given at hospital 1. Vitamin C 2. Bcomplex 3. Iron 4. Fesolate

5. Multivitamin capsules/tablet/tonic 6. Bcomplex & multivitamin)

[VITSREC] Who recommended the vitamin/supplement to you?

(1. Doctor 2. Nurse 3. Pharmacist/Drug store 4. Family member (not specified)

5. Neighbour 6. Myself 7. Mother 8. Sister)

8. **[FDQUALIT]** Are you satisfied with the quality of your diet now? 1. Yes 2. No 3. Don't Know

[QUALDIFF] Would having more money make your diet be different? 1. Yes 2. No 3. Don't Know

[HOWDIFF] If yes, could you share with me how having more money would

make your diet different? _____

APPENDIX 3-C. 24-HOUR DIETARY RECALL SHEET

Page: _ _of _ _

Participant ID # _ _ _ Time of data collection_____ Date (mm/dd/yy): / / _____

Type of meal
1= Breakfast
2 = Mid-morning snack
3 = Lunch
4 = Mid-afternoon snack
5 = Dinner
6 = Evening snack

Where consumed
1 = Home
2 = Family
3 = Friends/neighbours
4 = On street
5 = Restaurant
6 = At work

Source of food
1 = Prepared at home
2 = Purchased
3 = Gift
4 = Other; specify (_____)

Meal #	Meal	Type	Where

Meal #	Food #	Food item	Source	HH measure	Grams

RECIPES

[Meal # _ _ food # _ _]
[Serving size = _____ Total number of servings = _____]

Recipes # _ _

Ingredient	Code	HH measure	Quantity	Grams