

**DIETARY INTAKES AND BODY MASS INDICES OF NON-PREGNANT,  
NON-LACTATING (NPNL) WOMEN FROM THE COASTAL AND GUINEA  
SAVANNAH ZONES OF GHANA**

**Kobati GY<sup>1</sup>, Lartey A\*<sup>1</sup>, Marquis GS<sup>2</sup>, Colecraft EK<sup>1</sup> and LM Butler<sup>3</sup>**



**Gloria Yvonne Kobati**

\*Corresponding author email: [aalartey@ug.edu.gh](mailto:aalartey@ug.edu.gh)

<sup>1</sup>Department of Nutrition and Food Science, University of Ghana, Legon, Ghana

<sup>2</sup>School of Dietetics and Human Nutrition, CINE Bldg., Macdonald Campus, McGill University, 21, 111 Lakeshore Rd., Ste. Anne-de-Bellevue, Quebec, Canada H9X 3V9

<sup>3</sup> Global Agriculture and Life Sciences Fellow, Professor Emeritus (Iowa State University), 1215 Readings Drive, North Saanich, BC V8L5L2 Canada

## ABSTRACT

Adequate maternal nutrition prior to pregnancy is important for maternal health and favourable pregnancy outcomes. However, information on the dietary intakes of Non-Pregnant, Non-Lactating (NPNL) women in Ghana is lacking. A cross-sectional survey was undertaken to compare the dietary intakes of NPNL women of children aged 2 to 5 years who are either living in the Coastal (n=79) or Guinea Savannah (n=89) zones. Data were collected using various methods namely interviewer-administered socio-demographic questionnaire, 24hr dietary recall records, with data collected on one working and one non-working day within a week, and a 1-week food frequency questionnaire. Body mass index was derived from height and weight measurements. Women in the Coastal Savannah zone had significantly ( $p=0.05$ ) more formal education ( $3.9 \pm 2.5$  years) and earned a higher ( $p<0.001$ ) weekly income (Gh¢  $6.8 \pm 2.7$ ) than women in the Guinea Savannah zone with educational level and incomes of  $2.2 \pm 1.6$  years and Gh¢  $3.9 \pm 2.4$  respectively. More women in the Coastal zone had significantly ( $p<0.05$ ) fewer births and were heads of their households. Cereal-based foods were consumed daily by all women during the two-day observation period. Fish was the predominant animal source food in the diet in both zones. Significantly ( $p<0.05$ ) more women in the Guinea Savannah zone did not meet their Estimated Average Requirements (EAR) for protein (81%), vitamin A (94.4%), and vitamin C (72%) compared to women in the Coastal zone (44%, 22%, and 31% respectively). The diets of both groups of women were low in calcium. Generally, women in the Coastal zone had a significantly ( $p<0.001$ ) higher BMI ( $24.2 \pm 4.6$  kg/m<sup>2</sup>) than their counterparts in the Guinea Savannah zone ( $21.3 \pm 2.4$  kg/m<sup>2</sup>). The overall quality of dietary intakes and nutritional status of women in the Guinea Savannah zone was poorer than that of Coastal women. Dietary deficiencies are also present in NPNL women in Ghana. Efforts are needed to improve diet quality and to increase access to resources especially for women in the Guinea Savannah zone of Ghana.

**Key words:** Dietary intakes, Non-pregnant non-lactating women

## INTRODUCTION

An estimated 120 million women in low-income countries are regarded as underweight on the basis of Body Mass Index, (BMI) being less than 18.5 kg/m<sup>2</sup> [1]. Micronutrient deficiencies are common. More than 50% of pregnant and 40% of Non-Pregnant Non-Lactating (NPNL) women are anaemic partly due to iron deficiency [2]. Poor nutrition among women has devastating consequences on the women alongside their children. It undermines their productivity and income-generating capacity, increases the risk of adverse birth outcomes, and translates into higher maternal and infant mortality [3]. Factors that contribute to poor nutrition among women in Africa include heavy workloads, short inter-pregnancy intervals, frequent infections [4], inadequate food intake and limited diet diversity [5, 6]. Most African diets are dependent on root, tuber, and cereal staples, with minimal animal products and fruits and vegetables, hence generally tend to be deficient in micronutrients [7]. Within the household, food distribution patterns may also contribute to low food diversity and micronutrient intakes for women.

Traditionally, interventions aimed at improving women's nutritional status have targeted those either pregnant or lactating, with less attention given to NPNL women. Consequently, majority of studies on dietary intakes of women in low-income countries, including Ghana, have focused mainly on pregnant and lactating women. The nutrition of NPNL women is important given that it represents the pre-pregnancy status, and malnutrition during this period has been shown to negatively affect birth outcomes, leading to pre-term and low birth weight deliveries [8, 9]. It is therefore important to address nutrition of women before conception. This study assessed the dietary intakes and nutritional status (BMI) of NPNL women living in two district areas of Ghana, the Coastal zone with moderate (3.4%) maternal underweight rate and the Guinea Savannah zone with high maternal underweight rate (6.3%) [10].

## MATERIALS AND METHODS

The study was a cross-sectional survey with non-pregnant non-lactating women having children aged between 2– 5years. The target population were women who were living in four communities (Warabebe, Nsuekyire, Kwaekrom, and Akosua Village) in the Coastal zone (Winneba area) and four communities (Wuru, Gia, Bonia, and Biu) in the Guinea Savannah zone (Navrongo area). These eight communities were participating in the concurrent child nutrition study, Enhancing Child Nutrition through Animal Source Food Management (ENAM) project implemented during the period 2004-2009. From an existing community census, households with 2-5years old children were randomly selected. Trained fieldworkers visited the selected homes and identified eligible participants (women who were not pregnant or lactating). Pregnancy status was based on the woman's verbal confirmation but not on clinical diagnosis. Data collection took place between April and May, 2007.

The estimated total sample size (n=168) was based on a 12% prevalence of underweight (BMI <18.5 kg/m<sup>2</sup>) among women of child-bearing age in rural Ghana [10], a confidence level of 95%, and a 5% margin of error. Consequently, 79 women

from the Coastal and 89 from the Guinea Savannah zones were enrolled proportional to community size.

### ***Ethical clearance***

Ethical approval was sought from Institutional Review Boards of Noguchi Memorial Institute for Medical Research (University of Ghana, Legon) and Iowa State University (USA). Informed consent was confirmed by either signature or thumb print.

### ***Data collection***

Face-to-face personal interviews were conducted by trained field workers, who spoke the preferred local dialects (Akan, Kasem, and Buli).

Semi-structured, pre-tested questionnaires were used to obtain socio-demographic information (age, income, education, reproductive history) for all respondents. A food frequency questionnaire was used to record the type and frequency of Animal Source Foods (ASF) consumed by the women over the previous week. The types of ASF included livestock flesh meat (beef, mutton), organ meat, bush meat, whole fish, fish powder, poultry (chicken and guinea fowl), eggs, milk and milk products, and snails. Additionally, the 24-hour dietary recall methodology [11] was used to obtain the foods consumed over the 24-hours preceding the interview. Common household measures such as cups, ladles, and empty cans were used to aid women to estimate the amounts of foods they had consumed.

Weighed food intake data were collected over a 12-hour period with a randomly-selected sub-sample of women (n=72: Coastal =36; Guinea Savannah = 36) on two non-consecutive days; one day was economically active (fishing or marketing) and one day was not economically active. Using standard weighed food intake methodology [12] all foods consumed between 6 a.m. and 6 p.m. were measured to the nearest gram using compact food scales (Ohaus CS2000; Pine Brook, New Jersey). For the few cases where mixed dishes were consumed but nutrient data were not available in the local food composition table, participants provided recipe and the ingredients were weighed as the dish was prepared. The average energy and nutrient values from the two visits was used to derive the typical daytime nutrient intake of a participant. Evening dietary intakes (6p.m. to 6 a.m.) were estimated through corresponding data from the dietary recall. From the information obtained from the weighed food measurements, dietary diversity was computed based on eleven food groups: (i) cereals, (ii) legumes and nuts, (iii) starchy roots and tubers, (iv) fats and oils, (v) meat or poultry, (vi) eggs, (vii) fish and sea food, (viii) milk and milk products, (ix) green leafy vegetables, (x) other vegetables, and (xi) fruits [15].

### ***Anthropometry***

The weight of the women respondents were measured to the nearest 0.1 kg using an electronic digital scale (Tanita Electronic scale BWB-800; Illinois, USA). Prior to weighing, they were advised to wear light clothing and remove any footwear. Height measurements were taken to the nearest 0.1 cm using a stadiometer with a movable headpiece (Shorr Olney; MD, USA). All measurements were taken and recorded in



duplicate and the averages reported. The BMI for each respondent was calculated from the respective weight and height measurements ( $\text{kg/m}^2$ ).

### **Statistical analysis**

The energy and nutrient contents of foods consumed during the 12-hr weighed food record and in the 24-hr recall were estimated using the Ghanaian food composition database [13]. The average of the 2-day food intakes was used in the analysis. The mean daily intakes of protein, vitamin A, vitamin C, niacin, thiamin, riboflavin, iron, and zinc were compared with Estimated Average Requirements (EAR) for NPNL women [14] to estimate the percentage of requirement met by the women's intakes over the study period. Energy intake was compared to the Estimated Energy Requirement (EER) and calcium, which does not have an EAR value, was compared to the Adequate Intake (AI) value. A score of one (1) was assigned if a respondent consumed food from a group and zero (0) if the food group was not consumed. The Dietary Diversity Score (DDS) was calculated as the sum of individual food groups consumed. The diversity score did not take into account the number of times or quantity of a food group that was consumed. The maximum score was 11. This DDS is a modified version adopted from Torheim *et al.* [15]. A categorical variable was also developed to represent low diversity ( $\text{DDS} \leq 5$  foods) and high diversity ( $>5$  foods).

Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS version 11.5). Means and standard deviations were computed for continuous variables, while proportions were obtained for categorical data. Differences in characteristics among women in the two zones were tested using Pearson chi-square (for categorical variables) and Student's t-test (for continuous variables). Women's formal education, weekly income, parity, place of work, household headship, type of family system (nuclear or extended), ecological zone of residence, and dietary diversity score were simultaneously entered into a multiple linear regression model as predictors of women's BMI. Statistical significance was set at  $p < 0.05$ .

## **RESULTS**

### **Background characteristics of study population**

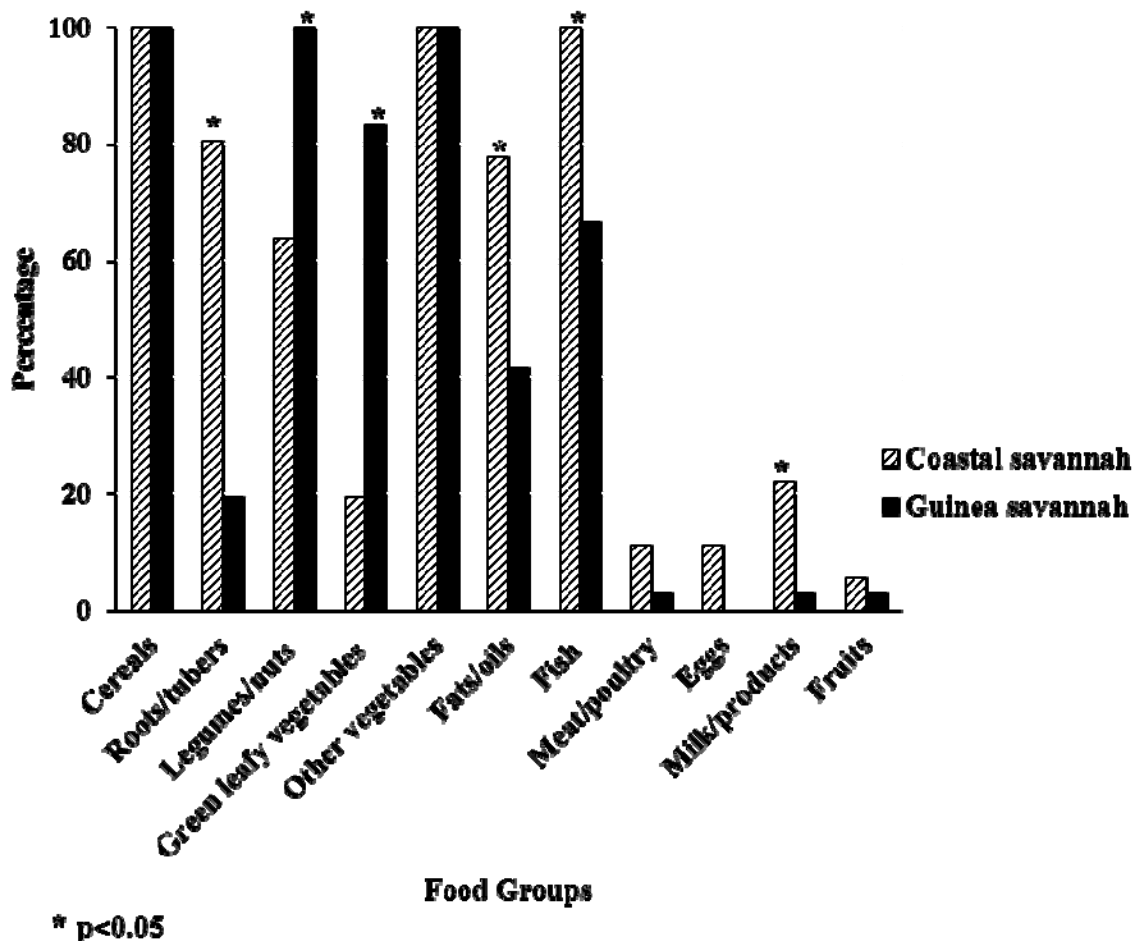
The mean ages of women in the Coastal and Guinea Savannah zones were  $34.3 \pm 7.9$  and  $34.2 \pm 7.4$  respectively (Table 1). Significantly ( $p < 0.05$ ) more women in the Guinea Savannah zone (62%) had never been to school compared to 43% of the women in the Coastal zone. There were however no significant differences among the two groups of women beyond primary school level. Women from the Coastal zone had significantly ( $p = 0.013$ ) fewer children ( $3.5 \pm 1.4$ ) compared to women from the Guinea Savannah zone ( $4.2 \pm 2.2$ ). Significantly ( $p < 0.05$ ) more women in the Coastal zone were also independent heads of households (53%) and worked at home (49%) compared to women in the Guinea Savannah zone (7% and 29% respectively). Weekly income levels were significantly higher among women in the Coastal zone ( $6.8 \pm 2.7$ ) than the Guinea Savannah zone ( $3.9 \pm 2.4$ ). Trading was the primary occupation for both groups of women, however, significantly more women from the

Guinea Savannah zone (44%;  $p < 0.05$ ) were engaged in farming compared to women in the Coastal zone (15.2%). Fish-related activities were common among women in the Coastal zone (24%;  $p < 0.001$ ) compared to women in the Guinea Savannah zone (8%).

### *Dietary intakes*

Distribution of food groups consumed by the women during the two weighed food observation days is shown in Figure 1. All the women consumed cereal-based foods on the two observation days. Significantly ( $p < 0.05$ ) more women from the Guinea Savannah zone consumed legumes/nuts (100%) and green leafy vegetables (83%) than those from the Coastal zone (64% and 19% respectively). However, the consumption of foods from the starchy roots/tubers and fats/oils food groups was high among women from the Coastal zone (81% and 78% respectively;  $p < 0.05$ ), compared to consumption of these same food groups among women in the Guinea Savannah zone (19% and 42%).

Fish was predominantly consumed by both groups of women, whereas meat, poultry, eggs, milk and milk products were consumed much less when compared to fish. All the women from both groups consumed tomatoes, pepper or onions, which were recorded under “other vegetable” category. These are typically incorporated into the soups and sauces eaten with starchy staples.



**Figure 1: Food groups consumed by NPNL women from the Coastal and Guinea Savannah zones**

***Dietary diversity***

The mean dietary diversity score was significantly higher among women from the Coastal zone compared to those from the Guinea Savannah zone ( $6.3 \pm 0.9$  vs.  $5.1 \pm 1.7$ , respectively;  $p = 0.002$ ). Using a dietary diversity score (DDS) of  $\leq 5$  as an indicator of low diet diversity, majority of women in the Guinea Savannah zone (68%) had significantly lower dietary diversity compared to women in the Coastal zone (22%;  $p < 0.001$ ) on the two observation days.

***Energy and nutrient intakes***

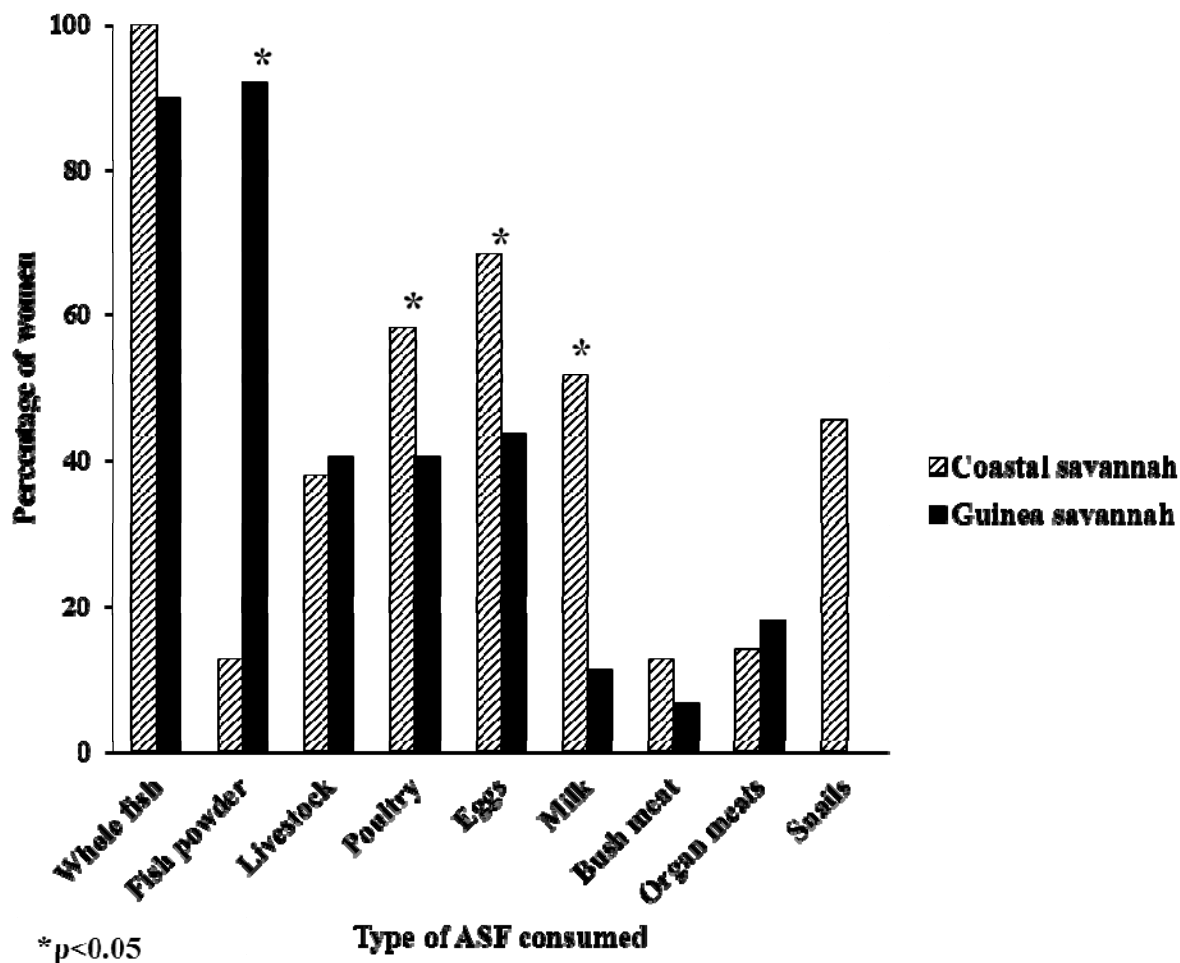
Mean energy intakes were similar for both women in the Coastal and Guinea Savannah zones at  $1926.2 \pm 906.8$  and  $1735.1 \pm 408.6$  kcal, respectively,  $p = 0.271$  (Table 2). There were also no significant group differences in intakes of calcium, thiamine, and zinc. However, women from the Coastal zone had significantly

( $p < 0.05$ ) higher intakes of protein ( $57.1 \pm 34.5\text{g}$ ), vitamin A ( $1291 \pm 1041.9\mu\text{RE}$ ), riboflavin ( $0.8 \pm 0.6\text{ mg}$ ), niacin ( $15.9 \pm 11.2\text{ mg}$ ) and vitamin C ( $61.1 \pm 33.9\text{ mg}$ ) compared to women from the Guinea Savannah zone ( $35.2 \pm 8.9\text{ g}$ ,  $153.5 \pm 150.9\mu\text{RE}$ ,  $0.4 \pm 0.2\text{ mg}$ ,  $7.4 \pm 3.2\text{ mg}$ , and  $35.6 \pm 23.4\text{ mg}$  respectively). Over 70% of all the women from both zones did not meet the estimated average requirement for energy. Significantly ( $p < 0.05$ ) more women from the Guinea Savannah zone did not meet their requirements for protein (81%;  $p = 0.002$ ), vitamin A (94%;  $p < 0.001$ ), niacin (81;  $p < 0.001$ ), and vitamin C (72;  $p < 0.001$ ) compared to women in the Coastal zone (44%, 22%, 39%, and 31%, respectively). Additionally, none of the women in the Guinea Savannah zone met their requirements for riboflavin and calcium on the two observation days and less than 10% of women living in the Coastal zone met the requirement for calcium. The EAR for iron was satisfied by almost all the women from both groups.

#### ***Women's consumption of different types of Animal Source Foods (ASF)***

Fish, mainly in the form of whole fish was consumed by 100% and more than 80% of women from the Coastal and Guinea Savannah zones, respectively (Figure 2). Whereas consumption of fish as fish powder was uncommon among women in the Coastal zone, at least 90% of women in the Guinea Savannah zone had consumed fish powder in the past week during the data collection period. Significantly more women ( $p < 0.05$ ) from the coastal zone than from the Guinea Savannah zone consumed poultry (58%), eggs (68%) and milk (52%). Few women from the Coastal (14%) and Guinea Savannah zones (18%) consumed organ meats. Snails were not consumed by women in the Guinea Savannah zone. The data obtained from the weighed foods showed that ASF contributed about 2.6% and 6.9% of the total energy intakes of women from the Guinea Savannah and Coastal zones, respectively.





**Figure 2: Animal source food intake of non-pregnant/non-lactating Ghanaian women in past 7 days, by ecological zone**

**Anthropometric indicators (Body mass index)**

Women in the guinea Savannah zone were significantly ( $p=0.009$ ) taller than their counterparts in the Coastal zone (Table 3). Compared to the women from the Guinea Savannah zone, the mean BMI for women in the Coastal zone was significantly higher ( $24.2 \pm 4.6$ ;  $p<0.001$ ). More women in the Guinea Savannah zone (15%) were significantly ( $p<0.001$ ) underweight compared to women from the Coastal zone (5%). Significantly ( $P<0.001$ ) more women in the Coastal zone were overweight (33%) compared to women in the guinea Savannah zone (6%).

### ***Factors affecting women's BMI***

The multiple linear regression analysis showed that living in the Coastal zone, and working at home were positively associated ( $p < 0.05$ ) with BMI. Though having five or more live births was significantly associated with BMI in the bivariate analysis, it was not a significant determinant of women nutritional status (BMI) (Table 4).

## **DISCUSSION**

### ***Dietary intakes***

Tubers or cereal staples are the predominant component of diets of most African women [6], hence the diets of these Ghanaian NPNL women were mainly based on rice, maize, and cassava. The majority of women from both zones did not meet the EAR for energy. The low energy intakes of women in this study may reflect seasonal food shortages in the two regions. The data collection took place during the pre-harvest season (April– May), a period during which there is low availability and accessibility to food in most regions in the country, especially in the guinea Savannah zone [16]. Seasonality is often an important factor in determining food consumption. In the African rural setting, especially where the population depends on rain-fed agricultural production for food, intakes can vary from season to season [16]. The effects of seasonality on nutrient intakes have been reported in other studies in northern Ghana [17]. Amar-Klemesu *et al.* [17] reported decreased mean intakes of vitamins A and C during the pre-harvest season compared to the post-harvest season. Most households in the guinea Savannah zone depended on their farms (rain-fed agriculture) for staple foods, which were the main source of energy for the women. It is possible that during the time of this study, most of the households had nearly exhausted their stocks and families were rationing food. In contrast to the study by Amar-Klemesu *et al.* [17], where lower quality but not quantity of the diet suggests that households were able to obtain adequate staple foods in the lean season, our study showed that both dietary quality and quantity were compromised amongst the study participants in the Guinea Savannah zone.

The dependence on cereal-based diets sets the stage for micronutrient deficiencies among these women. Plant-based foods contain micronutrients with low bioavailability due to the high phytate content which inhibits absorption of essential micronutrients (iron and zinc) [18]. Iron deficiency is the most common cause of anaemia in the developing world [2]. Interestingly, the diets of our study women in both study sites appeared adequate in iron. Only one woman (from the Coastal zone) did not meet her requirement for iron. The WHO committee estimated that the total iron bioavailability is 10% for most African diets [19]. A low bioavailable diet (mainly cereals with less than 3% of the meal (in grams) composed of animal source foods) has an iron bioavailability of about 5% [20]. Although iron intake was quite high among women in our present study, most of the iron was from plant sources and its bioavailability would have been as high as 10%. The absorption of iron from plant sources can however be enhanced when there is adequate vitamin C in the diet.

Calcium intakes were exceptionally low among all women in the two zones and intakes of almost all the women in both zones fell below the EAR for NPNL women.

In countries where the consumption of milk and dairy products is low, inadequate dietary intake of calcium is common [21]. In Ghana, milk is consumed in small quantities as part of beverages or porridges, however, women in the two zones rarely consumed these food items. Milk consumption was low, and this contributed to the low dietary calcium intake. Fish bones were another potential source of calcium for the women in our study. Fish with bones were pounded into a powder and added to soups. However, the quantity of fish powder in these soups was small (as suggested by the intake of fish powder from ASF consumption) and therefore contributed little to meeting calcium requirements. Low calcium intakes among women in the reproductive age group is critical as this reduces bone accretion rates and increases the risk of osteoporosis in later years [22].

Only a few women in the Coastal zone did not meet their recommended intakes for vitamin A. The majority of these women consumed palm oil, added to beans, dark green leafy vegetable stews and palm soup. Similar findings have been reported among pregnant women in other communities in Ghana [23]. Data on dietary intakes for NPNL Ghanaian women are lacking. Women in the Guinea Savannah zone consumed green leafy vegetables soups which were consumed with the main staple, *tuo-zaafi* (a thick maize porridge). Soups usually constituted a small portion of the meal (15-20% of soup; 60-75% staple; less than 10% ASF), providing insufficient beta-carotene rich vegetables for women to meet their requirements for vitamin A.

### ***Nutritional Status***

Women in the Coastal zone generally had a higher BMI (indication of a better nutritional status) than their Guinea Savannah counterparts. Majority of women in the Coastal zone lived in female-headed households (or were heads of their households). In female-headed households, income and resources are controlled by women themselves and their nutritional status tends to be better since their expenditures will be more related to food [24]. Higher BMI of women in female-headed households than male-headed households have also been reported by Kennedy *et al.* [25].

Majority of women in the Coastal zone were fish mongers, traders or food vendors. These occupations do not require them to leave their communities because they obtain most of their resources (fish) from within their communities, and they sell their fish mainly in their community. On the other hand, the major occupation for women in the Guinea Savannah zone was farming, which requires them to move away from their homes and working all day long. Research has shown that farm work has negative effects on women's nutritional status [26]. In the Bleiberg *et al.* [26] study, female farmers skipped their meals, especially lunch, during the rainy season (farming season) indicating that they were too busy working in their farms and had no time to eat.

Additionally, women in the Coastal zone had less births compared to their Guinea Savannah counterparts. In this study, regression analysis showed that the number of live births was a significant negative determinant of women's BMI. Women with five or more live births were more likely to have lower BMIs compared to women who had less than five children. Maternal depletion has been associated with closely

spaced births [27]. In this situation, women have not regained any lost weight before the next pregnancy and enter into next pregnancy with inadequate body nutrient stores [28]. Formal education has been shown to be associated with lower fertility rates among women [29]. The majority of women in the Guinea Savannah zone had never been to school and, therefore, it was not surprising that they had a higher number of live births compared to their counterparts in the Coastal zone.

### ***Dietary diversity and nutritional status***

The higher diversity score that was seen among women in the Coastal zone may reflect the market dependence of these women for their food. Many of the women in the Coastal zone do not cultivate their own food. Markets that include foodstuffs from different areas of the country expose households to a greater variety of foods. Though dietary diversity was higher among women in the Coastal zone, it was not a significant determinant of women's BMI in the regression analysis. In contrast, a study among women in Burkina Faso showed dietary diversity to be a significantly associated with women's anthropometric indices measured [30].

### **CONCLUSION**

This study assessed the dietary intakes and body mass indices of non-pregnant, non-lactating (NPNL) women from the Coastal and Guinea Savannah zones of Ghana. The results showed that most of the women did not meet the EAR for energy. The study also showed a low nutrient intake and BMI (poor nutritional status) among women in the Guinea Savannah zone compared to the Coastal zone. These findings could be a reflection of the deprived socioeconomic conditions in the north of the country. This study also shows that the dietary intakes of NPNL Ghanaian women, especially those living in the Guinea Savannah zone, is not optimal and as women who fall within the reproductive age group there is need to pay attention to their nutrition. Efforts to improve access to food, including the support of women's income-generating activities to increase their purchasing power, are important interventions to improve women's nutrition.

### **ACKNOWLEDGEMENTS**

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**Table 1: Socio-demographic characteristics of non pregnant non-lactating women from Coastal and Guinea Savannah zones<sup>1</sup>**

Characteristic	Ecological Zone		p-value <sup>2</sup>
	Coastal Savannah (n=79)	Guinea Savannah (n=89)	
Age (yrs)	34.3 ± 7.9	34.2 ± 7.4	0.901
Live births (#)	3.5 ± 1.4	4.2 ± 2.2	0.013
No formal education, n, (%)	34 (43.0)	55 (61.8)	0.020
Household head, n, (%)			
Female	42 (53.2)	6 (6.7)	<0.001
Male	37 (46.2)	83 (93.3)	<0.001
Main occupation, n (%)			
Trader	46 (58.2)	42 (47.2)	<0.001
Farmer	12 (15.2)	39 (43.8)	<0.001
Fish monger/seller	19 (24.1)	7 (7.9)	<0.001
Unemployed	2 (2.5)	1 (1.1)	
Work place, n (%)			
At home	39 (49.4)	26 (29.2)	0.017
Away from home	38 (48.1)	62 (69.7)	0.014
Mean weekly income (Gh¢) <sup>4</sup>			
Mean income	6.8 ± 2.7	3.9 ± 2.4	<0.001
Low income	3 (3.80)	8 (9.0)	
Medium income	42 (53.16)	38 (42.70)	
High income	30 (38.0)	13 (14.61)	<0.001
Unknown <sup>3</sup>	4 (5.06)	30 (33.71)	

<sup>1</sup> Values shown as mean ± standard deviation or n (%)

<sup>2</sup> Comparison between ecological zones using Chi-squared for categorical variables and Student's t-test for continuous variables

<sup>3</sup> Cannot specify weekly income; Low weekly income (Gh¢<2.00); Medium weekly income (Gh¢2.00 – 5.00); High weekly income (Gh¢> 5.00)

<sup>4</sup>Gh¢: Ghana Cedis :\$ 1 = Gh¢ 1.4



**Table 2: Energy and nutrient intakes by non pregnant non-lactating women from the Coastal and Guinea Savannah zones<sup>1</sup>**

Nutrient	Coastal Savannah (n=36)			Guinea Savannah (n=36)			p-value <sup>3</sup>	p-value <sup>4</sup>
	intake		% below EAR <sup>2</sup>	intake		% below EAR <sup>2</sup>		
Energy (kcal)	1926.2 ± 906.8		72.2	1735.1 ± 408.6		83.3	0.271	0.198
Protein (g)	57.1 ± 34.5		44.4	35.2 ± 8.9		80.6	< 0.001	0.002
Vitamin A (µgRE)	1291 ± 1041.9		22.2	153.5 ± 150.9		94.4	< 0.001	< 0.001
Thiamine (mg)	0.8 ± 0.4		63.9	0.8 ± 0.4		72.2	0.903	0.307
Riboflavin (mg)	0.8 ± 0.6		72.2	0.4 ± 0.19		100	0.005	< 0.001
Niacin (mg)	15.9 ± 11.2		38.9	7.4 ± 3.2		80.6	< 0.001	< 0.001
Vitamin C (mg)	61.1 ± 33.9		30.6	35.6 ± 23.4		72.2	< 0.001	< 0.001
Calcium (mg)	471.2 ± 323.9		94.4	395.0 ± 167.2		100	0.214	0.246
Iron (mg)	23.2 ± 12.7		2.8	28.7 ± 12.2		0	0.061	0.500
Zinc (mg)	8.9 ± 4.6		38.9	7.6 ± 2.7		44.4	0.160	0.406

<sup>1</sup> Intakes are reported as mean ± standard deviation

<sup>2</sup> Estimated Average Requirements. *Estimated Energy Requirement* was used for energy and *Adequate Intake* for calcium

<sup>3</sup> Comparison of intake between ecological zones by Student's t-test

<sup>4</sup> Comparison of intake below EAR between ecological zones by Chi-square test

**Table 3: Anthropometric characteristics of non pregnant non-lactating women from the Coastal and Guinea Savannah zones<sup>1</sup>**

Characteristic	Coastal Savannah zone (n=79)		Guinea Savannah zone (n=89)		p-value <sup>2</sup>
Height (m)	1.56 ± 0.05	(1.5-1.7) <sup>3</sup>	1.64 ± 0.05	(1.5-1.8)	0.009
Weight (kg)	61.5 ± 13.7	(41.9-106.8)	55.6 ± 7.4	(43.3-78.0)	0.001
BMI (kg/m <sup>2</sup> )	24.2 ± 4.6	(17.5-39.2)	21.3 ± 2.4	(16.2-31.3)	<0.001
Underweight (<18.5)	4	(5.1)	13	(14.6)	<0.001
Normal (18.5 – 24.9)	49	(62.0)	71	(79.8)	<0.001
Overweight (≥25.0)	26	(33.3)	5	(5.6)	<0.001

<sup>1</sup> Values are shown as mean ± SD (range) or n (%)

<sup>2</sup> Student's t- and Chi-square goodness of fit tests were used to test for group differences

<sup>3</sup> Range

**Table 4: Multiple linear regression model for body mass index of non pregnant non-lactating women from the Coastal and Guinea Savannah zones**

Variables	Beta	SE	p-value	R <sup>2</sup>
				5.86
(Constant)	23.003	0.931		
Living in the Coastal zone	2.164	0.655	0.001	
Woman working at home	1.497	0.590	0.012	
Parity ≥ 5 live births	-1.174	0.622	0.060	
Low Dietary diversity score	-1.754	0.707	0.731	

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