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Time in Ghana and Dietary Patterns in Liberian Refugees

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ABSTRACT

Previous research suggests acculturation (i.e. exposure and assimilation to local culture) is associated with changes in dietary patterns among immigrants. This study investigates this association in a refugee population using time in refugee settlement as a proxy for acculturation. A cross-sectional survey was conducted among a convenience sample to: (i) identify dietary patterns in Liberian refugees and Ghanaians living in or near a refugee settlement; (ii) compare adherence to these dietary patterns between groups; and (iii) investigate the association between acculturation and dietary patterns in Liberian refugees. Time in refugee settlement was assessed by self-report; food consumption was assessed by food frequency questionnaire (FFQ). Principal component analysis was used to identify dietary patterns; generalized linear model was used to test the association of interest. Participants were Liberian and Ghanaian women with young children living in Buduburam Refugee Settlement or Awutu in Ghana (n=480; 50% Liberian; mean age 28.0, SD=6.3, range=16-48, years). Three distinct dietary patterns emerged: Healthy, Sweets, and Fats. Ghanaians were more adherent to the Healthy pattern than Liberians ($p<0.05$). Liberians were more adherent to the Sweets and Fats patterns than Ghanaians ($p<0.05$). There were no significant differences in dietary pattern adherence among the Liberians based on time in settlement. Ghanaians living in Awutu were more adherent to the Healthy pattern than Ghanaians who lived in settlement ($p<0.05$). Differences in dietary patterns were observed between Liberian refugees and Ghanaians. These differences were not associated with acculturation. The reasons for these differences warrant further investigation.

Keywords: Acculturation, Dietary Patterns, Refugees, West Africa

ACKNOWLEDGEMENTS

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INTRODUCTION

As defined by the 1951 Refugee Convention, a United Nations treaty, a refugee is an individual who "owing to a well-founded fear of being persecuted for reasons of race, religion, nationality, membership of a particular social group or political opinion, is outside the country of his nationality, and is unable to, or owing to such fear, is unwilling to avail himself of the protection of that country" (Assembly, 1951). At mid-2015, there were an estimated 15.1 million refugees of concern to the United Nations High Commissioner on Refugees (UNHCR), a two-decade high (UNHCR, 2016). As the number of refugees around the world remains high due to various complex humanitarian emergencies, it becomes increasingly important to understand the health-related lifestyles of refugees, including dietary practices.

A civil war began in Liberia in 1989 and lasted until 2003. Approximately 200,000 Liberians were killed during the conflict, and close to a million Liberians became refugees (Dick, 2003). Buduburam Refugee Settlement was established in 1990 to accommodate the influx of Liberian refugees into Ghana. For years, the Liberian refugees living in Ghana have faced a protracted refugee situation. While some stability has returned to Liberia, humanitarian aid in the settlement has dwindled, and refugee livelihoods have stagnated, many refugees have elected to remain in Ghana, rather than returning to Liberia (Omata, 2012). The UNHCR suspended aid to the settlement in 1997 but resumed it again in 2002 (N'Tow, 2004). The UNHCR later launched two official repatriation efforts (2004-2007; 2008-2009), but not all Liberians repatriated. As late as early 2009, the UNCHR still provided a food ration to the refugees, and the World Food Program provided aid to certain vulnerable groups (e.g. the chronically ill).

However, virtually all aid ended by the summer of 2009. Despite these developments, as of 2011, there were still about 11,000 refugees living in Buduburam Refugee Settlement. On June 30, 2012, the UNHCR invoked the cessation clause, which provides for the termination of refugee status once stability and safety have returned to the refugees' home country. However, research has shown that many Liberians are against returning to Liberia, citing reasons ranging from a feeling of insecurity to lack of resources and support in Liberia (Omata, 2012).

Buduburam Refugee Settlement comprises about 140 acres and lies 32 kilometers west of Accra, the capital city of Ghana. The settlement is divided into 12 zones. Zones 1-10 are within the original boundaries of the settlement. Over time, many Liberian refugees settled in the village of Buduburam, which is adjacent to the settlement, and this area became part of the settlement, forming zones 11 and 12. Mainly Liberians live in zones 1-10, while Liberians and Ghanaians co-exist in zones 11 and 12.

The unique composition of the Buduburam Refugee Settlement, with refugees living both among and separate from the native population, provides an ideal setting to investigate the refugee experience. One important component of the refugee experience is diet, as this has a significant impact on overall health status. While research on the dietary patterns of refugees is lacking, a body of literature exists on the dietary patterns and changes of immigrants. It has been shown that upon settling in a new country, immigrants go through the process of acculturation. Acculturation has been defined as a complex, multidimensional, and dynamic process by which a racial/ethnic group is exposed to and adapts to the practices (e.g. language, beliefs) of

the majority group of the host country (Satia-Abouta et al., 2002). In particular, existing research shows that the acculturation of immigrants moving from less to more developed countries often involves the adoption of a "Western" diet high in fat and low in fruits and vegetables (Satia-Abouta et al., 2002). This is of public health concern given the association between a poor diet and poor health status. In a study looking at immigrants, defined as foreign-born individuals, in the United States (US), the age- and sex-adjusted prevalence of obesity was eight percent for immigrants who had lived in the US less than one year but reached 19% for immigrants who had lived in the US for at least 15 years (Goel et al., 2004). Greater duration of residence in the US was indeed associated with greater body mass index (BMI) among immigrants, reflecting acculturation and suggesting the adoption of suboptimal dietary practices (Goel et al., 2004).

Time in host country has been commonly used as a proxy for acculturation (Pérez-Escamilla and Putnik, 2007). It is expected that longer duration of residence in a foreign country allows for greater exposure and adaptation to the culture of the host country. The primary objectives of this study were to identify and compare adherence to diverse dietary patterns among Liberian refugees and Ghanaians living in and near the Buduburam Refugee Settlement in Ghana and to investigate the association between acculturation and dietary patterns in Liberian refugees. It was hypothesized that, as time living in the settlement increased, the dietary practices of the Liberian refugees would become more similar to the dietary practices of Ghanaians.

PARTICIPANTS AND METHODS

Interview Survey

A cross-sectional survey was conducted from July 2008 to August 2008. A convenience sample of 480 Liberian refugees and Ghanaians living in the Buduburam Refugee Settlement and the nearby urban village of Awutu (5km from Buduburam) was selected. Within Buduburam, a central location was chosen in each of zones 1-12, and four teams of interviewers (one Ghanaian and one Liberian per team) began at the central location. Standing in that central location, the team chose a random direction and visited the first household they encountered. Then the team visited every fifth house until reaching the desired sample size (120 Liberians in zones 1-10; 119 Liberians and 121 Ghanaians in zones 11 and 12; 120 Ghanaians in Awutu). If the mother was not present in the household at the time of the visit, the household was revisited at a more convenient time. If more than one mother meeting the inclusion criteria was living in the household, the interviewers randomly selected one mother to interview. The same surveying method was employed to obtain the sample in Awutu.

Women were included in the study if they were Liberian or Ghanaian, were 16 years of age or older, had a biological child between the ages of 6 and 59 months, were not currently pregnant, had no health problem or condition that caused a modification to their diet (e.g. diabetes, heart disease), and lived in either Buduburam Refugee Settlement or Awutu. The survey administered at each interview assessed the following: demographic/household characteristics, degree of acculturation, household food security, infant feeding practices, infant and maternal health status, and dietary intake. The following anthropometrics were also assessed in the respondent and the index

child: weight, height, mid-upper arm circumference, and head circumference (children only).

The survey was pre-tested among five Liberian and four Ghanaian women meeting the inclusion criteria, and the survey was modified as a result. Trained Liberian and Ghanaian interviewers from the target communities administered the survey. The interviewers underwent three days of training on conducting the interviews, interview techniques, and taking anthropometric measurements. The Liberian interviews were conducted in English (Liberian pigeon English). The Ghanaian interviews were conducted in English or the local Ghanaian dialect based on the interviewee's preference. Each interview lasted one-and-a-half to two hours. Interviews were reviewed daily for quality and standardization. Participants were revisited if data was missing or if responses were inconsistent to resolve any issues. All procedures were approved by the University of Connecticut, University of Ghana, and Yale University Institutional Review Boards. Verbal informed consent was obtained from all participants. Verbal consent was witnessed and formally recorded.

Food Frequency Questionnaire (FFQ)

Dietary intake was assessed using a culturally-appropriate detailed food frequency questionnaire (FFQ). The FFQ was adapted from the Block FFQ (Block et al., 1986) to include traditional Liberian and Ghanaian foods. Traditional Liberian and Ghanaian foods were included in the FFQ after conducting key informant interviews with Liberian refugees and Ghanaians living or working within the Buduburam Refugee Settlement or Awutu, visiting local markets, and consulting with Liberian refugees

employed by the Buduburam nutrition program. Participating women were asked about their consumption (yes/no) of 132 food/beverage items within the following 12 food/beverage categories: fruits; vegetables; beans and nuts; meats; fish and seafood; cereal and grains; milk and dairy products; snacks, sweets and desserts; drinks; tubers; other foods; traditional mixed dishes. Participants were shown pictures of various foods and beverages to ensure they clearly understood the food/beverage items in the list. They were then asked to report how many times they had eaten each food/beverage item, reported as either daily, weekly, monthly, or only occasionally. Participants were also able to provide the name and consumption frequency of any other foods within the 12 food/beverage categories. However, these responses were not included in the analysis because these questions were not asked of everyone. For analysis of the data, 34 specific food/beverage items were excluded: 1) 26 traditional mixed dishes were excluded because they were a mix of food groups (i.e. complex composition), and we could not be certain whether the constituents of these mixed dishes were included by participants in the reporting of individual food/beverage items (i.e. excluded mixed dishes to ensure food/beverage items were not double counted and consumption levels were not inflated), and 2) eight other food/beverage items were excluded because they were added to the survey after survey administration began and so not all participants were asked about these foods. This resulted in a final total of 98 food/beverage items included in the analysis.

Acculturation

Time in the Buduburam Refugee Settlement served as a proxy for acculturation. Time in the settlement was assessed in years and/or months during the interview through self-report.

Statistical Methods

Principal Component Analysis

Research suggests that it is preferable to study dietary patterns and quality (i.e. whole diet) rather than individual food components (Newby and Tucker, 2004). The original responses to the FFQ were standardized to reflect average weekly consumption. For example, a response of one time per day was represented by 1x7=7 times per week. The FFQ data were recoded into 32 food groups using the groupings classified in the Nutrient Data System for Research (NDSR) software from the University of Minnesota (University of Minnesota, Nutrition Coordinating Center, Minneapolis, MN) (Table 2). Average weekly frequency of consumption over a 6-month period was calculated for each individual for each food group.

Principal component analysis was used to identify distinct dietary patterns among all respondents. Principal component analysis grouped food groups based on inter-correlations and generated components (Newby and Tucker, 2004, Sofianou et al., 2011). Dietary patterns with eigenvalues greater than 1.5 were retained and were orthogonally rotated (varimax rotation). (Newby and Tucker, 2004, Sofianou et al., 2011). (Four dietary patterns were revealed explaining 33.3% of the variance. Three of the dietary patterns were retained. The fourth dietary pattern with an eigenvalue greater

than 1.5 was discarded because the association among the food groups with high factor loadings could not be identified.) The factor loading of each food group within the dietary patterns ranged from one to negative one, with values greater than 0.4 considered strong and negative values reflecting an inverse relationship with the corresponding dietary pattern (Sofianou et al., 2011, Newby and Tucker, 2004). Individual dietary pattern scores were generated by multiplying the factor loading for each food group by the frequency of consumption of each food group and then summing all products for each dietary pattern. An individual dietary pattern score was calculated for each individual for each dietary pattern. The scores for each pattern were approximately normally distributed. A high positive score indicated high adherence to a dietary pattern, and a low or negative score indicated little or no adherence to a dietary pattern (Newby and Tucker, 2004, Sofianou et al., 2011).

Multivariate Analyses

The Generalized Linear Model (GLM) was used to assess the association between time living in the Buduburam Refugee Settlement and dietary pattern scores. Three models were run with each dietary pattern score as an outcome. The dietary pattern score for each dietary pattern was included in the model as a continuous variable. Acculturation was included in the model as one combined exposure proxy variable with five population subgroups: Liberian refugees who had lived in the settlement less than eight years (the median for this group), Liberians who had lived in the settlement equal to or greater than eight years, Ghanaians who had lived in the settlement less than five years (the median for this group), Ghanaians who had lived in

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the settlement equal to or greater than five years, and Ghanaians who lived in Awutu (i.e. lived zero years in the settlement). Models were adjusted for age, marital status, level of education, employment status, income, household size, presence of electricity in the home, and whether or not money had been borrowed from or loaned to others in the past year. Marital status, level of education, employment status, income, presence of electricity in the home, and whether or not money had been borrowed from or loaned to others were included in the model as categorical variables. Age and household size were included in the model as continuous variables. All analyses were performed using SPSS (Version 22.0).

RESULTS

Characteristics of the Sample

Table 1 presents the characteristics of the sample (n=480) by population subgroup. Liberians overall were more likely to be single or to be living with or without a partner (i.e. living with partner but not married or having a partner/husband but not living together), be at least a high school graduate, be unemployed, be lower or middle income, have electricity at home, have borrowed or lent money in the past year, and to have eaten from cookshops or cook bars compared to Ghanaians overall (p<0.01). Liberians overall were less likely to have gardened or farmed in the past year compared to Ghanaians overall (p<0.001). Liberians who lived in the settlement less than eight years were more likely to be unemployed and were more likely to have lent money in the past year compared to Liberians who had lived in the settlement more than eight years (p=0.059 and p<0.05, respectively). Ghanaians who had lived in the settlement

less than five years were more likely to be unemployed compared to Ghanaians who had lived in the settlement more than five years (p<0.05). Ghanaians who lived in the settlement were less likely to have electricity at home compared to Ghanaians who lived in Awutu (p<0.05).

Dietary Patterns

Three dietary patterns were retained, and three dietary patterns were identified (Table 3). Based on our interpretation driven by factor loadings, these dietary patterns were labeled as "Healthy", "Sweets", and "Fats." The dietary patterns were named according to the food/beverage components that loaded into them and their strong similarity to similar patterns identified in the literature (Newby and Tucker, 2004). The Healthy pattern had high factor loadings for other non-starchy vegetables (including cucumbers, okra, and eggplant) (0.777), tomato/tomato based products (0.774), fish (dried, fresh, canned) (0.723), and nuts and seeds (0.480). The Sweets pattern had high factor loadings for candy (0.653), sweet baked goods (0.645), and sweetened fruit drinks (homemade/imported) (0.609). The Fats pattern had high factor loadings for salad dressing, (0.698), milk (0.607), oil (0.584), butter/margarine (0.514), cereal (0.495) and poultry (0.440).

Associations with Acculturation

There were significant differences in mean dietary pattern adherence scores between Liberian refugees and Ghanaians (Table 4). Ghanaians who lived in the camp as well as those outside of the camp in Awutu had significantly greater mean dietary

pattern scores than Liberian refugees for the Healthy pattern independent of the amount of time lived in the settlement (p<0.05). Consistent with this finding, Ghanaians who lived in the camp and outside of the camp in Awutu had significantly lower mean Sweet and Fats pattern scores than Liberian refugees independent of the amount of time lived in the settlement (both p<0.05).

Mean dietary pattern adherence scores were not significantly different for Liberian refugees who had lived in the camp less than eight years compared to Liberian refugees who had lived in the camp equal to or greater than eight years (p>0.05). Similarly, mean dietary pattern scores were not significantly different for Ghanaians who had lived in the camp less than five years compared to Ghanaians who had lived in the camp equal to or greater than five years (p>0.05).

The mean dietary pattern score for the Healthy pattern was significantly greater for Ghanaians who lived outside of the camp in Awutu compared to Ghanaians who lived within the camp (p<0.05). The mean dietary scores for the Sweets pattern and the Fats pattern were not significantly different for Ghanaians who lived outside of the camp compared to Ghanaians who lived within the camp (p>0.05)

DISCUSSION

Differences in dietary patterns were observed between Liberian refugees and Ghanaians living in and near the Buduburam Refugee Settlement. After adjusting for confounders, in general, Ghanaians had healthier dietary practices than Liberians. The strong adherence to the "Sweets" and "Fats" patterns among the Liberian refugees is interesting, as this propensity towards less healthy food is in agreement with previous

research on dietary changes experienced by immigrants in various settings. For example, Yang et al. found an increase in the consumption of fat and cholesterol and a decrease in the consumption of vegetables among Asian immigrants upon immigration to the US (Yang and Read, 1996). Similarly, Pan et al. found that Asian students who had immigrated to the US reported increased consumption of salty and sweet snacks and fats and sweets, as well as decreased consumption of vegetables (Pan et al., 1999). Specifically among Chinese immigrants in the US, Lv et al. found increased consumption of fats, sweets, and sugary beverages (Lv and Cason, 2004). Kruseman et al. found an increase in the consumption of sweetened beverages and a decrease in the consumption of vegetables among African refugees in Geneva (Kruseman et al., 2005). Renzaho et al. found an increased consumption of unhealthy foods, such as pizza, breakfast foods, and other fast foods, among sub-Saharan African migrants in Australia (Renzaho and Burns, 2006). Following a systematic review of the literature, Gilbert et al. found an increase in consumption of fat, sugar, and salt among ethnic groups in Europe (Gilbert and Khokhar, 2008). Holmboe-Ottensen et al. reported an increase in fat consumption and a decrease in vegetable consumption among South Asian immigrants in Europe (Holmboe-Ottesen and Wandel, 2012). To our knowledge however, ours is the first study documenting this shift towards unhealthy dietary patterns among immigrants coming from and moving to another country in West Africa.

In previous studies, the shift to an unhealthy dietary pattern among immigrant populations has been generally attributed to the effect of acculturation, which leads to the adoption of a more "Western" diet when immigrants move from lesser to more economically developed countries. More specifically, dietary changes among

immigrants are often found to be associated with duration of stay in the new country, a typical proxy for acculturation (Pan et al., 1999, Lv and Cason, 2004, Yang et al., 2007, Desilets et al., 2007, Franzen and Smith, 2009). However, among the Liberian refugee population in this study, dietary pattern adherence was not found to be associated with time in the settlement (i.e. Liberian diet did not approach the Ghanaian diet over time), suggesting that acculturation, at least as represented by time in the settlement, was not the driving force behind dietary practices in this population. This may be explained by the nature of the migration pattern in our study, as it involved immigrants moving from and to a country in the same world region.

A major strength of this study is that we were able to examine and compare dietary patterns of a group of long-term refugees and their local counterparts with whom they had been intermingling for several years under a protracted refugee situation. The collection of culturally-appropriate detailed food consumption data for both groups is another strength of this study as it allowed for documenting and comparing of dietary patterns as opposed to individual food/beverage items, allowing for a much better understanding of overall diet quality aspects.

Several limitations of this study should be acknowledged. One limitation was the use of time in the settlement as the only proxy for acculturation. While length of time in the settlement was not associated with dietary patterns among the Liberian refugees, it is possible that other unmeasured components of acculturation were at play in this population. Indeed, dietary research among immigrant populations has used other proxies for acculturation, including education, language preference (Lunes et al., 1997), proportion of lifetime spent in the new country (Desilets et al., 2007), and age at arrival

in the new country (Roshania et al., 2008, Franzen and Smith, 2009), which could reflect adaptive capability.

The psychological aspects of acculturation were also not included in this study. For example, research has shown that a desire to fit in can actually alter food preferences and food choices (Guendelman et al., 2011). The stress experienced by immigrants has also been linked to unhealthy dietary patterns (Tseng and Fang, 2011). Future research into the dietary patterns among refugees should perhaps take these other aspects of acculturation into account.

A third limitation of this study was that it was cross-sectional. Therefore, causal inferences cannot be made. Additionally, dietary changes cannot be assessed, as information on the pre-immigration diet was not collected. It is also possible that dietary patterns among the Liberian refugees were influenced by experiences that occurred *prior* to arrival in the camp. For example, among Hmong immigrants who had resettled in the US, parents and grandparents tended to overfeed their children once they were in the US in response to the threat of food deprivation that they had faced during their time in refugee camps (Franzen and Smith, 2009, Kasemsup and Reicks, 2006). Another study found that Cambodian households reported liberal consumption of high fat meat because it was a "highly deprived item in pre-migration" (Peterman et al., 2010). Other research has further suggested that the "episodic abundance of food supplies" is associated with disordered eating (Polivy et al., 1994). The pre-arrival experiences of the Liberians living in the Buduburam Refugee Settlement were highly complex and included varying degrees of exposure to marginalization, food insecurity, conflict and

violence. It is possible that these experiences contributed significantly to the dietary patterns among the Liberian refugees in a way that was not measured in this study.

The study was also limited by the use of an FFQ that did not collect data on portion sizes to quantitatively assess dietary intakes. FFQs do not always accurately capture food intake and the FFQ data were also limited by not including details on food preparation, such as cooking method, which might have allowed for a better resolution of dietary patterns. For example in one immigrant study, the increase in the consumption of fat among Asian immigrants was related to adding butter, margarine, and cheese to food (Yang and Read, 1996), and, in another, poor dietary quality was related to the addition of butter, salt, sugar, and oil to foods (Renzaho and Burns, 2006). The study also relied on self-report, which could be subject to bias. Lastly, this study only assessed the dietary patterns among female refugees. Research on the dietary patterns of immigrants have shown greater dietary changes among men compared to women (Yang and Read, 1996, Gupta, 1975). It is possible that the dietary patterns among male Liberian refugees in the settlement are different than among female Liberian refugees. In spite of these limitations, this study represents a new contribution to knowledge in the field, as it strongly suggests that new arrivals in refugee settlements may not be at a disadvantage with regards to their dietary patterns compared with refugees who have been in a settlement for longer periods of time.

CONCLUSIONS

The results of this study suggest that refugees adhere to less healthy dietary patterns than the local population living in the same setting. It is possible that this is

related to a lack of economic opportunities for refugees given their refugee status. While the exact reasons for this phenomenon remain unclear, this work suggests the need for continued monitoring of the health practices and well-being of refugee populations. Findings also have implications for nutrition education and food assistance for long-term refugees. Given greater adherence to the unhealthy dietary patterns among Liberian refugees compared to Ghanaians, providing culturally-appropriate nutrition education to refugees could assist them with making better dietary choices. Additionally, providing sustainable economic or farming/gardening opportunities could improve their access to healthier foods. Future research should assess the associations between dietary practices and other proxies for acculturation besides time, as well as pre-arrival experiences.

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TABLES

Characteristic	Overall (n=480)	Liberians (n=239)	Ghanaians (n=241)	P**	Liberians <8yrs (n=117)	Liberians ≥8yrs (n=122)	Ghanaians <5yrs (n=58)	Ghanaians ≥5yrs (n=62)	Ghanaians in Awutu (n=120)	P**
Table 1. Characteristics of the sample by population subgroup*										
Age (years), mean ± SD	28.0 ± 6.3	27.6 ± 6.2	28.5 ± 6.3	0.102	26.9 ± 5.7	28.3 ± 6.6	28.1 ± 5.7	28.8 ± 7.3	28.6 ± 6.1	0.190
Household size, mean ± SD	5.8 ± 3.0	5.7 ± 3.1	5.9 ± 2.9	0.369	5.6 ± 3.4	5.8 ± 2.8	5.6 ± 2.4	6.4 ± 3.0	5.8 ± 3.0	0.408
Marital status, n (%)				<0.001						<0.001
No partner	136 (28.3)	111 (46.4)	25 (10.4)		53 (45.3)	58 (47.5)	8 (13.8)	6 (9.7)	11 (9.2)	
Married	239 (49.8)	68 (28.5)	171 (71.0)		35 (29.9)	33 (27.0)	41 (70.7)	49 (79.0)	81 (67.5)	
Living w/ or w/o partner	105 (21.9)	60 (25.1)	45 (18.7)		29 (24.8)	31 (25.4)	9 (15.5)	7 (11.3)	28 (23.3)	
Education, n (%)				<0.001						<0.001
No education	62 (13.0)	18 (7.6)	44 (18.3)		10 (8.6)	8 (6.7)	10 (17.2)	15 (24.2)	19 (15.8)	
1-6 years	74 (15.5)	22 (9.3)	52 (21.6)		12 (10.3)	10 (8.3)	10 (17.2)	15 (24.2)	27 (22.5)	
7-11 years	214 (44.9)	93 (39.4)	121 (50.2)		50 (43.1)	43 (35.8)	27 (46.6)	29 (46.8)	64 (53.3)	
H.S. graduate/higher edu	127 (26.6)	103 (43.6)	24 (10.0)		44 (37.9)	59 (49.2)	11 (19.0)	3 (4.8)	10 (8.3)	
Employment status, n (%)				<0.001						<0.001
Employed	301 (62.8)	115 (48.1)	186 (77.5)		49 (41.9)	66 (54.1)	37 (64.9)	51 (82.3)	98 (81.7)	
Not employed	178 (37.2)	124 (51.9)	54 (22.5)		68 (58.1)	56 (45.9)	20 (35.1)	11 (17.7)	22 (18.3)	
Income, n (%)				<0.001						<0.001
Lower	86 (18.3)	65 (27.5)	21 (8.9)		29 (25.4)	36 (29.5)	6 (10.7)	8 (13.6)	7 (5.9)	
Middle	195 (41.4)	105 (44.5)	90 (38.3)		49 (43.0)	56 (45.9)	19 (33.9)	20 (33.9)	50 (42.0)	
Higher	190 (40.3)	66 (28.0)	124 (52.8)		36 (31.6)	30 (24.6)	31 (55.4)	31 (52.5)	62 (52.1)	
Electricity at home, n (%)				<0.001						<0.001
Yes	371 (77.3)	205 (85.8)	166 (68.9)		101 (86.3)	104 (85.2)	34 (58.6)	41 (66.1)	90 (75.0)	
No	109 (22.7)	34 (14.2)	75 (31.1)		16 (13.7)	18 (14.8)	24 (41.4)	21 (33.9)	30 (25.0)	
Borrowed money†, n (%)				<0.001						<0.001
Yes	195 (40.6)	130 (54.4)	65 (27.0)		68 (58.1)	62 (50.8)	14 (24.1)	20 (32.3)	31 (25.8)	
No	285 (59.4)	109 (45.6)	176 (73.0)		49 (41.9)	60 (49.2)	44 (75.9)	42 (67.7)	89 (74.2)	
Lent money†, n (%)				<0.01						<0.01
Yes	155 (32.3)	94 (39.3)	61 (25.3)		54 (46.2)	40 (32.8)	16 (27.6)	17 (27.4)	27 (22.5)	
No	325 (67.7)	145 (60.7)	180 (74.7)		63 (53.8)	82 (67.2)	42 (72.4)	45 (72.6)	93 (77.5)	
Gardened or farmed, n (%)				<0.001						<0.001
Yes	119 (24.8)	13 (5.4)	106 (44.0)		7 (6.0)	6 (4.9)	23 (39.7)	27 (43.5)	56 (46.7)	
No	361 (75.2)	226 (94.6)	135 (56.0)		110 (94.0)	116 (95.1)	35 (60.3)	35 (56.5)	64 (53.3)	
Cookshops or chop bars, n (%)				<0.01						<0.01
Yes	161 (33.5)	97 (40.6)	64 (26.6)		51 (43.6)	46 (37.7)	14 (24.1)	24 (38.7)	26 (21.7)	
No	319 (66.5)	142 (59.4)	177 (73.4)		66 (56.4)	76 (62.3)	44 (75.9)	38 (61.3)	94 (78.3)	

* Numbers may not sum to totals due to missing data, and column percentages may not sum to 100% due to rounding.

**P-value for t-test or analysis of variance F-test (continuous variable) or χ^2 test (categorical variable).

† From/to any neighbors, family members, or friends.

Table 2. Food/beverage groups used in final analysis and descriptions	
Group	**Description**
Alcohol	Beer (bottled), hausa beer (ginger beer), palm wine, pito
Beans/legumes	Beans/peas, canned beans (e.g. baked beans)
Bread	Local bread (sugar, butter, tea, wheat, or brown)
Butter/margarine	Nkuto (shea butter/doughnut grease), butter/margarine
Candy	Toffees/candies
Cereal	Bulgur wheat, sorghum, Atuku (millet/millet porridge), oats
Cheese	Cheese (e.g. Laughing Cow, Wagashi)
Dark green vegetables	e.g. Lettuce, nunum (fever leaves), ayoyo (plato leaves), santun leaves (potato greens), aleefu (careless greens), gboma (eggplant/garden egg leaves), collard greens, large water greens
Deep yellow vegetables	Carrots, pumpkin, sweet potatoes
Eggs	Eggs (chicken)
Fish (dried, fresh, canned)	Fish, canned fish (e.g. tuna, sardines), momoni (momoi/stinking fish), kobi (salted tilapia/bukor)
Fried/salty snacks	Wele (cow skin), kelewele (ripe plantain chips fried with hot pepper and ground nuts), flour/plantain chips, exotic chips
Fruit	e.g. oranges, pineapple, banana, mango (plum), Papaya (pawpaw), watermelon, sweet apple (soursop/guanabana), sugar apple
Fruit juice	Fresh fruit juice/punch (e.g. pineapple juice)
Meat	Goat, cow meat (beef), pig meat
Milk	Powdered milk, tin/canned milk
Nuts and seeds	Groundnuts/groundnut paste, sesame seeds (beneseed), agushi/ground melon seeds
Oil	Palm oil, cooking/vegetable oil (argo oil), other oils (e.g. coconut)
Other non-starchy vegetables	Alsusua (kitteley/small garden eggs), konsusua, cucumbers, okra, onion, green pepper, cabbage, roroyie (garden egg/bitterball), ntropo (eggplant)
Other starchy vegetables	Roasted/boiled corn, gari/farinas, cocoyams (eddoes)/kooko (taro, batanga buds), irish potatoes, cassava, yam
Pasta	Spaghetti/macaroni
Poultry	Chicken, turkey
Processed meat	Sausages
Ready-to-eat cereal	Semolina (cream of wheat), corn flakes
Rice	Rice
Salad dressing	Mayonnaise
Shellfish	Apofee (kissmeat)/snails, crabs/shrimps (craw fish)
Soft drinks	Soft/mineral drinks (e.g. Coke, Sprite, Fanta)
Sweet baked goods	Bofrot (kala), short/corn/banana/rice/cassava bread, biscuits/cookies, doughnuts
Sweetened fruit drinks	Canned/packed juice, jolly juice/kool aid, sobolo (bissa)
Sugar	Sugarcane
Tomato/tomato-based products	Fresh tomato, tin tomato

Table 3. Highest factor loadings of food groups by dietary pattern			
	Dietary Pattern		
Food Group	**Healthy**	**Sweets**	**Fats**
Other non-starchy vegetables	0.777	---	---
Tomato/tomato-based products	0.774	---	---
Fish (dried, fresh, canned)	0.723	---	---
Nuts and seeds	0.480	---	---
Sugar	0.470	---	---
Fried/salty snacks	0.463	---	---
Beans/legumes	0.357	---	---
Candy	---	0.653	---
Sweet baked goods	---	0.645	---
Sweetened fruit drinks (homemade/imported)	---	0.609	---
Shellfish	---	0.499	---
Fruit	---	0.458	---
Meat	---	0.422	---
Other starchy vegetables	---	0.418	---
Dark green vegetables	---	0.275	---
Alcohol (homemade/imported)	---	0.262	---
Salad dressing	---	---	0.698
Milk	---	---	0.607
Oil	---	---	0.584
Butter/margarine	---	---	0.514
Cereal	---	---	0.495
Poultry	---	---	0.440
Soft drinks	---	---	---
Ready-to-eat cereal	---	---	---
Eggs	---	---	---
Cheese	---	---	---
Deep yellow vegetables	---	---	---
Pasta	---	---	---
Bread	---	---	---
Processed meat	---	---	---
Rice	---	---	---
Fruit juice	---	---	---

Table 4. Mean dietary pattern scores by population subgroup[1,2,3]

Subgroup	Dietary Pattern		
	Healthy	Sweets	Fats
Liberians <8yrs (n=117)	6.5 ± 0.7^x	14.2 ± 0.8^x	17.1 ± 1.2^x
Liberians ≥8 yrs (n=122)	5.4 ± 0.7^x	12.9 ± 0.8^x	14.8 ± 1.2^x
Ghanaians <5 yrs (n=58)	17.3 ± 0.9^y	8.4 ± 1.0^y	10.4 ± 1.5^y
Ghanaians ≥5 yrs (n=62)	15.8 ± 0.9^y	8.3 ± 1.0^y	9.8 ± 1.5^y
Ghanaians in Awutu (n=120)	20.3 ± 0.7^z	7.1 ± 0.8^y	8.9 ± 1.2^y

[1]Mean ± SD
[2]Mean dietary pattern scores represent average adherence within each subgroup to each dietary pattern.
[3]All estimates adjusted for martial status, level of education, employment status, income, whether or not electricity was in the home, and whether or not money had been borrowed from or loaned to others in the past year.
[x,y,z]Means with different subscripts (x,y,z) in the same column differ significantly at $p<0.05$.