PREDICTORS AND CONSEQUENCES OF OVERWEIGHT AND OBESITY IN THE HOUSEHOLD: A MIXED METHODS STUDY ON RURAL GHANAIAN WOMEN AND MEN FARMERS

Arnouk MK[1]*, Marquis GS[1] and ND Dodoo[2]

Meray K Arnouk

*Correspondence author email: meray.arnouk@mail.mcgill.ca

[1]School of Human Nutrition, McGill University, Montreal, Canada

[2]Regional Institute for Population Studies, University of Ghana, Legon, Ghana

ABSTRACT

Overweight/obesity (OW/OB) rates are increasing in Ghana. This study aims to identify the predictors of OW/OB in women, men, and at the household level (having at least one person as OW/OB in the household) in rural Ghana and examine local perceptions of the consequences of having an OW/OB person in the household. This was a cross-sectional mixed methods study. The quantitative data was a secondary analysis of the baseline data from the LinkINg Up (LU) project; a nutrition-sensitive agriculture intervention in eight rural communities in the Eastern Region of Ghana (ClinicalTrials.gov NCT03869853). The sample included 331 women and 205 men, 19-90 years old; there were 196 households that had both a participating woman and man (spouse, son, brother, or father). Logistic regression was used to assess variables associated with OW/OB in women (n=322), men (n=205), and households (n=196). Exposure variables included age, social support, mental health, self-efficacy, food security, the other family members' OW/OB status, and others. Qualitative data included six focus group discussions (FGDs) (three with women and three with men, aged 22-69 years and recruited from the comparison arm of the LU project) were conducted in February-March 2022 in three of the eight project communities. A structured guide and a body figure instrument were used. The FGD recordings were translated and transcribed from Krobo to English. The analysis used an inductive thematic approach. Both women and men's OW/OB were positively associated with age and wealth. Women's OW/OB was negatively associated with age squared, and the score for mental health symptoms. Men's OW/OB was negatively associated with being Krobo compared to other ethnicities. Households in the highest wealth tertile were 2.5-fold more likely to have at least one person who is OW/OB as compared to households in a lower wealth tertile. Participants expressed positive social consequences of having an OW/OB person for their families (for example respect). A person's size was concerning only when it affected one's ability to farm or make money, which would harm the household unit (for example lead to food insecurity, children dropping out of school). Having money was seen as a modifier for the negative effects. No negative consequences were perceived for OW people. The implications of the interruption of an OB person's work on their family are worrisome and call for interventions that address poverty and food insecurity along with nutrition.

Key words: Africa, farmer, household, social norms, perceptions, body image, overweight, obesity, predictors

INTRODUCTION

Overweight (OW; body mass index [BMI] ≥25 and <30 kg/m^2) and obesity (OB; BMI ≥30 kg/m^2) affected 3 out of 10 Africans in 2016 [1]. In Ghana, the prevalence of adult female and male OW/OB tripled from 1975 to 2015, reaching 42% of women and 23% of men [2] and was common even in rural areas where 29% of women and 8% of men were either OW or OB [3]. The 2017 health care expenses of a Ghanaian adult with OW/OB were two to three times higher than that of an adult in the normal BMI range, straining the health system [4].

A multi-layered approach that integrates the interaction of the individual with their environment on multiple levels can help understand this growing problem and its unique nature in rural areas [5]. Predictors of OW/OB in rural women (15-49 y) were analyzed by pulling together nationally representative data from 1993, 1998, 2003, and 2008 [6]. This study found a positive association with age, education, wealth, and having one child compared to two or more children. Ghanaian men and women 50-59 years old had lower odds of obesity than those who were above 60 years [7]. No nationally representative data were available for men. However, one study conducted among 924 men in rural northern Ghana reported that BMI had an inverse relationship with age and a positive relationship with wealth and education [8]. Other individual predictors of OW/OB have been briefly explored in the Ghanaian context. A study completed in four regions in rural northern Ghana, from 2012 (n=2228) to 2015 (n=2039) found that for obese women, BMI was negatively associated with empowerment [9]. However, another study [10] in rural communities of the Eastern Region found no association between BMI and empowerment across a wide range of BMI. Among 2566 rural and urban Ghanaian men and women, 25 to 70 years old, an increase in stress was negatively associated with BMI [11].

Two interpersonal factors that affect the entire family unit are food security and wealth. Consistent evidence in Ghana, among both women [6] and men [8], showed an increased odds of OW/OB with increased household wealth. No studies that addressed the relationship between social support and OW/OB were found in Ghana. However, social support was negatively associated with physical inactivity among 594 rural Ghanaian women [12].

Understanding social norms and perceptions is critical as outcome expectation is one of the determinants of health behavior [13]. One Ghanaian woman described the ideal body size for a Ghanaian woman as a figure that her spouse enjoyed:

"For me an ideal weight for a woman should be one that will make the husband enjoy being with her" (33 years, obese; BMI = 35.5 kg/m^2)" [14].

Previous studies have focused on exploring the effect of OW/OB on individual's health and relationships. Yet, although people often live in social groups (families), the effect of OW/OB on the function of the household is not addressed in the literature. The present study examined the determinants of having OW/OB present in a household and examined the perceptions of residents in rural communities about the influence and consequences for the household of having a family member with a large body size.

MATERIALS AND METHODS

The study site, three districts in the Eastern Region of Ghana, had a high prevalence of OW/OB among women (39.5%); the rate among men was lower (7.1%) [3]. In rural Lower Manya Krobo, Yilo Krobo, and Upper Manya Krobo districts the percentage of households who were engaged in agriculture were 62.4% [15], 72.2% [16], and 89.2% [17], respectively. In one study of 263 women farmers, the average duration of vigorous physical activity was 257±120 minutes/day [18]; the World Health Organization recommendation for vigorous activity is 75 to 150 minutes per week [19].

This is a mixed methods study. The quantitative data were previously collected by the LinkINg Up (LU) project, a quasi-experimental nutrition-sensitive agricultural intervention (ClinicalTrials.gov NCT03869853). The project aimed to improve the livelihood of adult women agripreneurs and their families by testing the sustainability of district-level interventions carried out by local institutions. Intervention women were part of farmer-based organizations (FBO). Half of the women received the intervention in the first phase (2019-2020) and the rest received it in the second phase (2021-2022). The project included a comparison group of women from the same communities who were not part of the FBOs. Project details were described elsewhere [10]. Ethical approval was granted by McGill University and University of Ghana.

Quantitative study
The quantitative study included only baseline information that was collected before the LU intervention began. A total of 331 women living in eight rural communities were enrolled over the two phases (Phase one included 165 women and 122 men; Phase 2 included 166 women and 90 men). Out of the 331 households, 212 had

an adult male family member (spouse, father, brother, or son) who was also enrolled.

Outcome measures: Weight (kg) and height (cm) for were measured using standard methods [20] and individuals were categorized by BMI categories (underweight [<18.5 kg/m^2]; normal [18.5 kg/m^2- 24.9 kg/m^2]; OW [25.0 kg/m^2- 29.9 kg/m^2]; OB [≥30 kg/m^2] [21]. Then, OW/OB cases and underweight/normal weight were grouped, making an OW/OB binary variable. A new household-level binary variable was developed: household with OW/OB present was when at least one person (woman or man) was OW/OB; household with no OW/OB present was when both the woman and man were within the normal or underweight BMI category.

Exposure measures: Variables related to women included: age (years), formal education completed (none, primary education [1-6 years], secondary education or higher [7 years or more]), number of children living in the same household (0, 1, 2 or 3, 4 or more), ethnicity (Krobo or other [Ewe, Akan]), profession (farmer only, farmer and held another profession or were non-farmers), and ownership of a valid national health insurance card (yes, no). In addition, three of the project-level Women's Empowerment in Agriculture Index (Pro-WEAI) empowerment variables were included [22]. First, data on self-efficacy were collected through an 8-item questionnaire, each scored on a 5-point rating scale. Scores ranged from 0 to 40; a dichotomous variable for self-efficacy was defined (adequate ≥32; inadequate <32). Second, attitudes about when intimate partner violence against women was justified were assessed with five scenarios: (i) goes out without telling partner, (ii) neglects the children, (iii) argues with partner, (iv) refuses to have sex with partner, and (v) burns the food. A dichotomous variable was defined as adequate (all negative answers) and inadequate (at least one positive answer). Third, respect among household members was assessed with four conditions: (i) respondent respects relation most of the time, (ii) relation respects respondent most of the time, (iii) respondent trusts relation most of the time, and (iv) respondent is comfortable disagreeing with relation most of the time. Adequate in respect among household members was assessed when there was a positive response to all four questions; inadequate when there was at least one negative answer. Two continuous social support variables were adapted from Stakhanov [23]. The questionnaire assesses social support by asking who provided support (spouse, household members, children, family/relatives, friends, and neighbors) in eight areas: major personal problems, problems obtaining food, money problems, conducting daily business activities, making decisions about the business, business finances, house chores, and taking care of young children. The number

of affirmative answers was added for each area (maximum score of 6). The Principle Components analysis used the Varimax rotation method and included the scores from the eight areas; the first two components were extracted. The first component was similarly weighted in all the areas whereas the second component was heavily weighted on the last two areas (help in house chores and childcare). Finally, the mental health symptoms tool used was the Self-Report Questionnaire (SRQ-20) [24], a non-psychotic 20-item questionnaire. The continuous score was based on the number of affirmative answers. Higher scores indicate a higher number of symptoms of poor mental health. Variables related to men were similar to those of women for age, education, ethnicity, attitudes about intimate partner violence against women, respect among household members, and self-efficacy.

Food security classification was based on the number of affirmative answers of the 15-item Food Insecurity Experience Scale [25]. Scores were categorized as: food secure, mildly food insecure, moderately food insecure, severely food insecure. Households with children under 5 years old (minors) used the 15 items (scores from 0 to 15); households with no minors used only the first 8 items of the scale (scores from 0 to 8). Different cut-offs were used to describe household food security levels based on if they had minors or not. For all households scores of 0 indicated being food secure. For households with and without minors, mildly food insecure was a score or 1-5 or 1-3, moderately food insecure was a score of 6-10 or 7-8, and severely food insecure was a score of 11-15 or 7-8, respectively.

Wealth was measured based on the ownership of 18 household assets by extracting it from the first Principle Components analysis and then categorizing it into tertiles [10]. The assets included dwelling characteristics (improved water source, floor materials, wall materials, roof materials, toilet facility, cooking fuel), ownership of agricultural land, small livestock, non-mechanized farm equipment, mechanized farm equipment, house or building, electricity, motorcycle, bicycle, cellphone, radio, television, and refrigerator [26].

Analysis: The analysis used SAS Studio software. Descriptive statistics included mean (standard deviation), median (25th, 75th percentile), or n (%). Comparisons were tested with independent samples Student's t-test, the Mann-Whitney U test for non-parametric analyses, a Chi-square test with Bonferroni post-hoc test adjustment, and Mantel-Haenszel Chi-square for ordinal categorical variables.

Logistic regression analysis was used to test the relationship between the exposure variables and different outcomes, reporting odds ratios (OR) and 95 %

confidence intervals (CIs). The GIMMIX procedure allowed for accounting for community clustering as a random variable.

Models were constructed for three different outcomes: women's OW/OB versus underweight/normal weight, men's OW/OB versus underweight/normal weight, and household with OW/OB present versus household with no OW/OB present. In all of the models, exposure variables included women's, men's, and households' characteristics; multicollinearity was tested and models were adjusted as needed. The analysis used the backward elimination method, using a $P<0.10$ to retain variables as the cutoff value. Variables that were reported in the literature to be associated with men and women's OW/OB status were added back and retained if $P< 0.10$. The phase of data collection was added to all three models. Finally, two additional models were run on only women and only men who were included in the household model to assess having an OW/OB family member as a risk factor.

Qualitative study
The aim of the qualitative study was to understand the local perceptions about body size, including the criteria residents used to judge a person as healthy or too big, and the perceived influence of having a big body size on people's lives (personal, relationships, work, financial, and health) and on the household. This paper will focus on the perceived influence of having a big body size on a person's household.

The study used ethnographic methodology to examine local beliefs [27]. Between February and March, 2022, the project carried out six focus group discussions (FGDs), three with women and three with men, in three of the eight LU communities. The three communities were chosen based on an adequate number of available participants and one FGD per district. The FGD were carried out in the local language (Krobo) by two local female research assistants who had experience in qualitative research. The number of FGDs was based on the literature suggesting that 80% of themes appear within the first two to three FGDs and 90% within three to six FGDs [28].

The discussion followed a structured questionnaire guide and used a nine-image body figure instrument (ranging from underweight to severe obesity [Figure 1]) that was validated in African Americans to assess body image for men and women [29]. The corresponding BMI categories were adapted from the Stunkard tool [30]. The participants were shown all 18 figures at the same time in random order.

Participants were asked about the consequences of having a person with sizes E to I (Figure 1) on their families.

Figure 1: Body image tool used in focus group discussions [29]
The weight categories have been added here for interpretation based on Stunkard *et al.* tool [30]
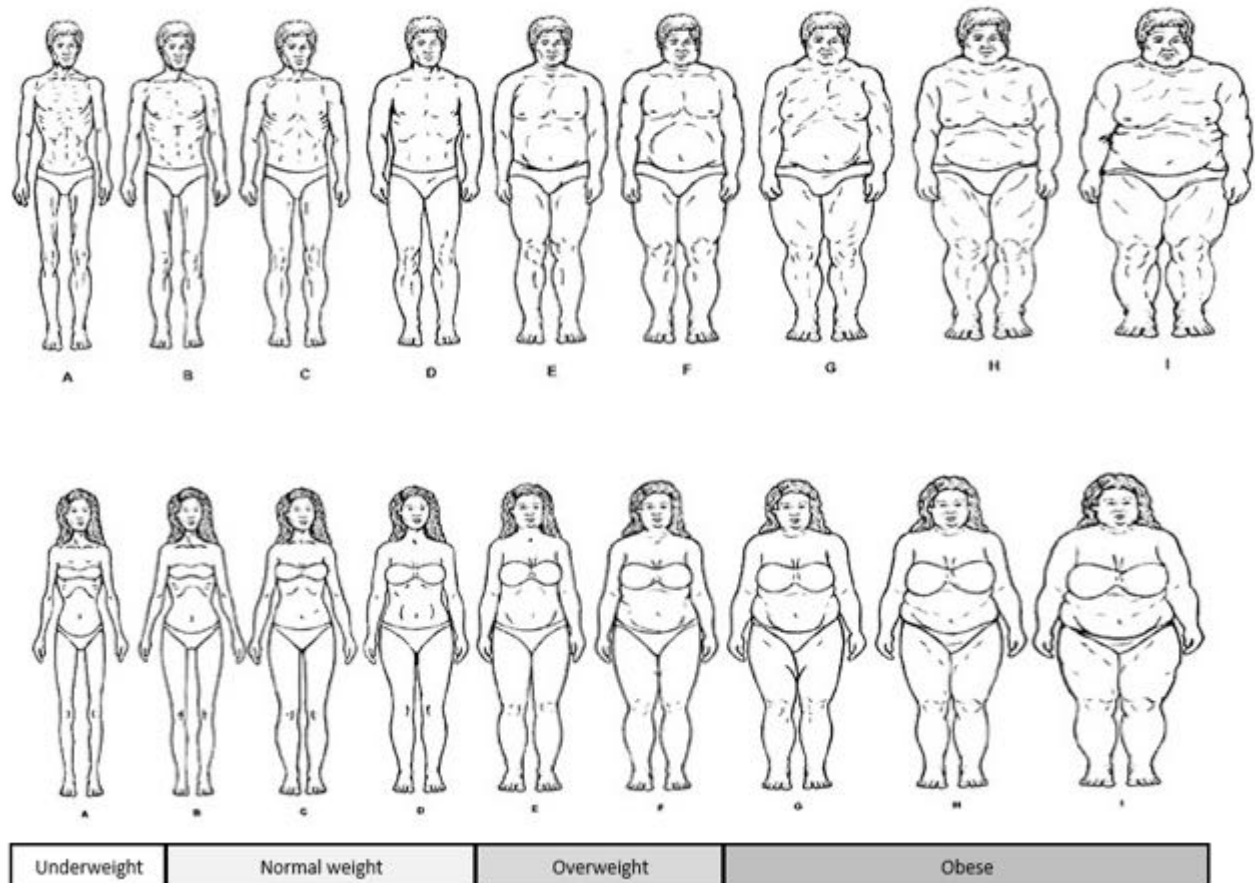
Sample and data collection: Only participants in the comparison arm of the LU project were included to avoid those participants who had been exposed to health and nutrition education from the project. Sampling for each FGD (pre-defined by sex and community) was purposeful based on age to provide as much variation in age as possible. A community contact person assisted with recruitment. Each FGD lasted between 1.75 and 2 hours. The FGDs were conducted all outdoors except for one in a community church. None of the FGDs were interrupted by non-participating residents.

Analysis: The FGDs were audio recorded and the recordings were translated to English and transcribed verbatim. The analysis process was iterative. After each FGD, the first author (MA) and the research assistants discussed the transcript to ensure proper cultural understanding and that enough probing was completed to

adequately answer the questions. The analysis followed an inductive thematic approach and codes were generated from the data [31]. The first author coded the transcripts, and in case of doubt about the interpretation, consulted with the research assistants to ensure a proper understanding of the data.

Participants were de-identified in the transcribed documents. Using MAXQDA software 2022 version, codes related to each objective were generated from the transcribed data and then organized into themes according to the patterns the data represented. Following this, the theme was interpreted and supported with direct quotes from the FGD [32]. The interpretation was shared with the research assistants and local researcher (ND) to establish the reliability of the results and avoid misinterpretation.

To minimize bias, the data collection process did not assume any perceived negative or positive consequences of body size. Questions were open-ended and suggestive vocabulary (for example overweight and obesity) was not used. Instead, all the figures were discussed in relative terms to each other, for example smallest, middle and biggest body size. No personal opinions about the perceived outcome of a certain body size, whether on health or domains of life, were discussed with the facilitators, emphasizing that they were not expecting a certain answer and were only interested in the honest opinions of the participants.

RESULTS AND DISCUSSION

Quantitative outcomes

Women included in the household analysis (n=196) were similar to the full sample of LU project women (n=322; Table 1), except for age and number of children (43.0 ± 11.5 vs. 48.0 ± 15.0 years [P=0.002] and 2.5 ± 1.6 vs. 2.1 ± 1.6 children [P=0.01]). There were no differences between all men (n=205) and men included in the household analysis (n=196). The age range for the whole sample was between 19 to 84 y for women (n=322) and between 22 to 90 y for men (n=205). Almost all the LU women were engaged in farming (86.0%) and 80.0% of the non-farmers were traders. Only a quarter of the women received secondary education or higher while half of the men did. More than half of the women and men lived in food insecure households. Forty-three percent of the 322 women were OW/OB versus 15.6% of the 205 men. More than half (56.1%) of 196 households had at least one person who was OW/OB.

Women-only and men-only models. Out of the 331 women enrolled, six were dropped because they were pregnant and three were dropped because they had

biologically implausible heights. The predictors of OW/OB in the remaining 322 women were age, age squared, wealth, and symptoms of mental health (Table 2). A nationally representative study in rural Ghana reported similar predictors for OW/OB in women (age, education, wealth, and number of children) [6]. The FGD results supported the results on symptoms of mental health, suggesting that being OB could lead to worse mental health. Participants mentioned that the ability to make money was reduced with obesity and that they started to worry about having sufficient food as explained by the following quote:

> *"Sometime you [person with an obese size I on Figure 1] may even die out of hunger because there is no food to feed on because the family that you are depending on, cannot support you again in your welfare and food, sometimes you may find it difficult to sleep at night"* (Woman, 64 years, farmer).

Out of the 212 men enrolled, four were dropped because they had missing anthropometric data and three had implausible heights. Predictors of OW/OB among the remaining 205 men were age, ethnicity, and wealth (Table 2), in agreement with findings in northern Ghana [8]. The absence of an association with education on the risk of OW/OB both in men and women may be explained by the homogeneous sample of farmers. The FGD provided some insight into the link between education and profession, as explained by the following quote:

> *"When you are educated and you are working in the government sector [non-farmers] then if you [were] big or small you can still survive. The office workers can see some [positive] changes in their financial life because they are being pay monthly but as for us farmers there is nothing like that for us"* (woman, 35 years, farmer, primary education).

Household-level model: There were 212 households with a woman and man enrolled in the project. Three households were dropped because the woman was pregnant, seven were dropped because the anthropometric data were missing or biologically implausible, six were dropped because of incorrect identification information. The final model included 196 households with data from both the woman and man. The risk of being an OW/OB household was associated only with wealth (Table 3). The highest tertile for wealth was over 2.5-fold more likely to have at least one person who was OW/OB compared to lowest tertile. These results are consistent with the qualitative data, as noted in the following quote:

"People will say now he is having money that is what he is increasing in his weight. He can eat anything he feels like eating" (Woman).

People who were obese but had money were seen as able to hire someone to work for them on the land and thus could still generate money, resulting in a positive association between OW/OB and wealth. This was consistent with an association with OW/OB only with the highest wealth category.

"Because money speaks more in this current world, he [the obese person] can hire laborers to work and farm for him" (Man, 48 years, primary education, lowest wealth tertile).

Using the sample of women and men in the 196 households, the risk of women (OR=0.93; 95% CI: 0.40 to 2.14) or men (OR=0.89; 95% CI: 0.38 to 2.08) being OW/OB was not associated with having an OW/OB person in the house. In contrast, a national Indian survey reported increased odds for adults having OB when living with another adult member who has obesity; however, no association was found if the household member was a spouse [33].

Qualitative outcomes
A total of 21 women and 20 men who were all Krobo and between 22 and 67 years old participated in the FGDs. Only two women was not a farmer. The FGD women participants were similar in age, BMI, mental health score, profession, and wealth compared to the overall 322 women. However, they had more children (3.3 ± 1.7 vs 2.3 ± 1.6; P=0.008). Qualitative male participants were similar to the overall 205 men.

Participants expressed concern for the household when body size had an economic effect (Table 4). A big size was perceived to affect one's ability to work on the farm, and the risk of illness and related medical expenses. Finances and workload were shared between family members. Therefore, when a person's monetary contribution to the family was reduced, participants regarded this as a danger to the household that could cause problems (for example poverty, debt, selling family property, food insecurity, worse mental health, children dropping out of school, discord). The financial burden on the family came from medical expenses, monthly monetary contributions to take care of the person whose work was affected, and the loss of income because of the need to care for the person. On the other hand, participants did not see big body sizes as problematic if the family member was big and could still work to generate money. The perceived

negative consequences came in the context of a person with an obese size (G, H, or I on Figure 1) who was sick, unable to move, and/or unable to make money.

Participants also mentioned positive effects on the family (for example social prestige) for having a person with a size E, or bigger (Figure 1) which corresponds to a BMI of an OW/OB figure [29] in their household (Table 4). A few participants mentioned that the size alone regardless of a person's financial situation would give the person respect and special positive treatment by their family. A big size would give people the illusion that a person had money and thus would be perceived as powerful in helping others in case of need.

Maslow's Hierarchy of Needs [34] may help to explain why size only became a concern when it affected productivity. The theory suggests five levels of needs ranging from the most basic physiological and safety needs to ultimately self-actualization and transcendence. Researchers argue that a person cannot satisfy a higher-level need without satisfying a lower one. In a review of models affecting health and nutrition behavior, Schlüter et al. [13] argued that health behavior becomes relevant only when it causes ill health thus affecting securing lower-level needs for example food and financial security. This could be the case in this rural sample, where participants continuously stressed the importance of the ability to work because, otherwise, a person would not be able to survive. This would also be supported by the high prevalence of households under the poverty line in the Eastern region (21.7% in 2013) [35]. Participants perceived negative health effects only for people in the figure categories reflecting obesity that were linked to productivity, which explains why they did not see being overweight as disadvantageous for them as participants saw examples of people in their communities with an overweight size as healthy, able to work (for example farm) and produce money. Moreover, the expectation of positive social treatment for people who are big fosters the third level of needs (social belonging). A study in the Netherlands looked at health behavior in relation to the achievement of needs [36]. They found that the higher a person was in their achievement of needs, the more likely they took more healthy food decisions than unhealthy ones. This highlights the need to address poverty and social norms in nutrition interventions.

This study is the first which looks at the predictors of OW/OB at the household level, and the first to look qualitatively into the consequences of OW/OB at the household level. The study included a limited number of FGD to assess local perceptions. However, having local research assistants to collect the data and an experienced Ghanaian qualitative researcher as part of the team helped ensure the cultural appropriateness of data interpretation.

CONCLUSION

Wealthy rural households were more at risk of OW/OB than low and middle-wealth households. The high cost of having OW/OB on the family unit is worrisome and calls for more nutrition-sensitive interventions that address poverty and food security. Quantitative studies can provide a rich assessment of the rural population's different dietary patterns and energy expenditures to better understand areas needing improvement and can be coupled with qualitative research on cultural perspectives affecting diet changes. It is important to understand what nutrition behaviors change when people become wealthier or the changes they would like to make if they were wealthier. Understanding this would help identify the social norms around dietary food choices that need to be addressed to promote good health.

Authorship
Dodoo ND was involved in designing the qualitative study, interpretation of qualitative data, and final approval of article content.
Marquis GS was involved in designing the study, data analysis, revision of intellectual content and approval of the article.

Table 1: Descriptive statistics of all women, all men, and households with paired woman and man included in the LinkINg Up project in rural Ghana

Characteristics	Women N=322	Men N=205	Households with pair N=196
Women			
Age (y)	45.0 ± 13.3		43.1 ± 11.5
Education			
No education	101 (31.4)		58 (29.6)
Primary education	141 (43.8)		81 (41.3)
Secondary education or higher	80 (24.8)		57 (29.1)
Self efficacy[1]			
Adequate	37 (11.5)		173 (88.3)
Inadequate	285 (88.5)		23 (11.7)
Mental health symptoms SRQ[2] score	7 (3, 12)		7 (3, 12)
Number of children			
0	48 (14.9)		26 (13.3)
1	61 (18.9)		30 (15.3)
2 or 3	129 (40.1)		81 (41.3)
4 to 7	84 (26.1)		59 (30.1)
Ethnicity			
Krobo	268 (83.2)		177 (90.3)
Other[3]	54 (16.8)		19 (9.7)
Attitudes about intimate partner violence against women[4]			
Adequate	228 (70.8)		144 (73.5)
Inadequate	94 (29.2)		52 (26.5)
National health insurance card Ownership			
Yes	213 (66.1)		133 (67.9)
No	109 (33.9)		63 (32.1)
Respect among household members [5]			
Adequate	122 (51.0)		88 (49.4)
Inadequate	117 (49.0)		90 (50.6)
Social support[6]			
Component 1	0.002 ± 0.9		2.9 ± 1.0
Component 2	0.2 (-0.7, 0.2)		0.3 (-0.3, 0.3)
Profession[7]			
Engaged in farming	277 (86.0)		
Farming alone	176 (63.5)		110 (56.1)
Farmer + another profession	101 (36.5)		68 (34.7)
Trading	89 (88.1)		
Other	12 (11.8)		
Non-farmer	45 (14.0)		18 (9.2)

Trader	36 (80.0)		
Other	9 (20.0)		
BMI[8]			
Underweight	15 (4.7)		
Normal weight	168 (52.2)		
Overweight	94 (29.2)		
Obese	45 (14.0)		
Men			
Age (y)		48.9 ± 13.5	49.0 ± 13.4
Education			
No education		42 (20.5)	39 (19.9)
Primary education		49 (23.9)	49 (25.0)
Secondary education or higher		114 (55.6)	108 (55.1)
Ethnicity			
Krobo		176 (85.9)	171 (87.2)
Other[3]		29 (14.1)	25 (12.8)
Self-efficacy[1]			
Adequate		185 (90.2)	176 (89.8)
Inadequate		20 (9.8)	20 (10.2)
Attitudes about intimate partner violence against women[4]			
Adequate		176 (85.9)	167 (58.2)
Inadequate		29 (14.1)	29 (14.8)
Respect among household members[5]			
Adequate		142 (70.3)	135 (69.6)
Inadequate		60 (29.7)	59 (30.4)
BMI[8]			
Underweight		30 (14.6)	
Normal weight		143 (69.8)	
Overweight		30 (14.6)	
Obese		2 (1.0)	
Household			
Wealth [9]			
Low	108 (34.0)	62 (31.3)	62 (32.0)
Middle	105 (33.0)	64 (32.3)	61 (31.4)
High	105 (33.0)	72 (36.4)	71 (36.6)
Food security[10]			
Food secure	129 (40.1)	86 (43.0)	83 (42.3)
Mildly food insecure	80 (24.8)	46 (23.0)	46 (23.5)
Moderately food insecure	58 (18.0)	36 (18.0)	35 (17.9)
Severely food insecure	55 (17.1)	32 (16.0)	32 (16.3)
Number of people living in the Household	5.1 ± 1.9	5.2 ± 2.0	5.4 ± 1.9
Overweight/obesity presence[11]			
Yes			110 (56.1)
No			86 (43.9)

Phase[12]			
1	163 (50.6)	118 (57.8)	113 (57.7)
2	159 (49.4)	87 (42.4)	83 (42.3)

Results presented as mean (standard deviation), median (25th, 75th percentile), or n (%). The sample for women was at least 318 except for respect for household members (n=239); the sample for men was at least 198; and the sample for households with pair was at least 194 except for respect for household members (n=178)

BMI: body mass index; SRQ: Self-Report Questionnaire

[1] Self efficacy tool was part of the project-level Women's Empowerment in Agriculture Index (Pro-WEAI) and consisted of 8-item questionnaire, each scored on a 5-point rating scale. Scores ranged from 0 to 40; a dichotomous variable for self-efficacy was defined (adequate ≥32; inadequate <32) [22]

[2] SRQ-20 : a non-psychotic 20-item questionnaire. [24] The continuous score was based on the number of affirmative answers. Higher scores indicate a higher number of symptoms of poor mental health

[3] Other: Ewe, Akan

[4] Attitudes about intimate partner violence against women were part of the pro-WEAI index. Violence as justified was assessed with five scenarios: (i) goes out without telling partner, (ii) neglects the children, (iii) argues with partner, (iv) refuses to have sex with partner, and (v) burns the food. A dichotomous variable was defined as adequate (all negative answers) and inadequate at least one positive answer) [22]

[5] Respect among household members was part of the pro-WEAI index. It was assessed with four conditions: (i) respondent respects relation most of the time, (ii) relation respects respondent most of the time, (iii) respondent trusts relation most of the time, and (iv) respondent is comfortable disagreeing with relation most of the time. Adequate was assessed when there was a positive response to all four questions; inadequate when there was at least one negative answer [22]. n= 249, 82 women with no male family member were not asked about this variable had missing data

[6] Social support: two continuous social support variables were adapted from [23]. The questionnaire assesses who provided support (spouse, household members, children, family/relatives, friends, and neighbors) in eight areas: major personal problems, problems obtaining food, money problems, conducting daily business activities, making decisions about the business, business finances, house chores, and taking care of young children. The number of affirmative answers was added for each area (maximum score of 6). The principle components analysis used the Varimax rotation method and included the scores from the eight areas; the first two components were extracted. The first component was equally weighted in all the areas whereas the second component was heavily weighted on the last two areas of help in house chores and childcare

[7] Other professions: hair dresser, seamstress, bead maker, caterer, mango seller, and soap maker

Other in the Non-farmers: no occupation, salaried worker, seamstress

[8] BMI categories: underweight (<18.5 kg/m^2); normal (18.5 kg/m^2- 24.9 kg/m^2); overweight (25.0 kg/m^2- 29.9 kg/m^2); obese (≥30 kg/m^2)

[9] Wealth: measured based on the ownership of 18 household assets by extracting it from the first principle components analysis and then categorizing it into tertiles [10]. The assets included dwelling characteristics (improved water source, floor materials, wall materials, roof materials, toilet facility, cooking fuel), ownership of agricultural land, small livestock, non-mechanized farm equipment (for example hand tools), mechanized farm equipment (for example tractor), house or building, electricity, motorcycle, bicycle, cellphone, radio, television, and refrigerator [26]

[10] Food security: used the 15-item Food Insecurity Experience Scale [25]. The score was based on the number of affirmative answers. Scores were categorized into four categories (food secure, mildly food insecure, moderately food insecure, severely food insecure). Households with children under 5 years old used the 15 item (scores from 0 to 15); households with no young children used only the first 8 items of the scale (scores from 0 to 8). For all households, scores of 0 indicated being food secure. For households with and without minors, mildly food insecure was a score or 1-5 or 1-3, moderately food insecure was a score of 6-10 or 7-8, and severely food insecure was a score of 11-15 or 7-8, respectively

[11]Households with overweight/obesity presence: Yes, at least one of the participants (woman and/or man) was overweight or obese (BMI ≥ 25 kg/m²); No, both participants (woman and man) were underweight or normal weight (BMI < 25 kg/m²)

[12]Data collection phase 1(2019-2020); and 2 (2020-2021)

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Table 2: Predictors of overweight/obesity in all woman (n=322) and all men (n=205) participants in the LinkINg Up project in rural Ghana

Characteristics	OW/OB[1] women	P value	OW/OB men	P value
Age (y)	1.15 (1.02 to 1.29)	**0.01**	1.03 (1.003 to 1.067)	**0.02**
Age squared	0.99 (0.997 to 1.00)	**0.009**	——	
Ethnicity	——			**0.03**
Krobo			0.27 (0.08 to 0.93)	
Other[2] (ref)			1.00	
SRQ Mental health score[3]	0.94 (0.90 to 0.99)	**0.02**	——	
Household Wealth[4]		**0.01**		**0.04**
Low	0.56 (0.28 to 1.11)		0.31 (0.09 to 1.004)	
Middle	0.40 (0.21 to 0.74)		0.28 (0.09 to 0.85)	
High (ref)	1.00		1.00	
Phase[5]		0.7		0.1
2	0.90 (0.54 to 1.50)		2.02 (0.84 to 4.87)	
1 (ref)	1.00		1.00	

OB: obese; OW: overweight; SRQ: Self-reported Questionnaire

Results reported are odds ratios (OR) and 95% confidence intervals (CIs).

The analysis used the backward elimination method, using a P<0.10 to retain variables as the cutoff value. Dropped variables that were reported in the literature to be associated with men and women's OW/OB status were added back and retained if P< 0.10. The phase of data collection was added to all models. The GLIMIX procedure allowed for accounting for community clustering as a random variable.

[1] OW/OB= body mass index (BMI) ≥ 25 kg/m². Comparison group was BMI <25 kg/m².

[2] Other: Ewe, Aka

[3]Self-Report Questionnaire (SRQ-20) [24], a non-psychotic 20-item questionnaire. The continuous score was based on the number of affirmative answers. Higher scores indicate a higher number of symptoms of poor mental health

[4]Wealth: measured based on the ownership of 18 household assets by extracting it from the first principle components analysis and then categorizing it into tertiles [10]. The assets included dwelling characteristics (improved water source, floor materials, wall materials, roof materials, toilet facility, cooking fuel), ownership of agricultural land, small livestock, non-mechanized farm equipment (for example hand tools), mechanized farm equipment (for example tractor), house or building, electricity, motorcycle, bicycle, cellphone, radio, television, and refrigerator [26]

[5]Data collection phase 1(2019-2020) and 2 (2020-2021)

—— variable not included in the model

Table 3: Predictors of overweight/obesity presence in households participating in the LinkINg Up project in rural Ghana

Characteristics	Households with overweight/obesity presence[1] OR (95% CI)	P value
Household Wealth[2]		**0.04**
High	2.55 (1.001 to 6.50)	
Middle	0.96 (0.44 to 2.12)	
Low (ref)	1.00	
Phase[3]		0.82
2	0.92 (0.47 to 1.82)	
1 (ref)	1.00	

Results report odds ratios (OR) and 95 % confidence intervals (CIs). Sample included 194 households with data for both the woman and man participant

The analysis used the backward elimination method, using a P<0.10 to retain variables as the cutoff value. The phase of data collection was added to the models. The GLIMIX procedure allowed for accounting for community clustering as a random variable

[1]Households where at least one of the participants was overweight or obese (body mass index ≥ 25 kg/m^2). Reference group was households where both participants (woman and man) were not overweight or obese (Body Mass Index < 25.0 kg/m^2)

[2] Wealth: measured based on the ownership of 18 household assets by extracting it from the first principle components analysis and then categorizing it into tertiles [10]. The assets included dwelling characteristics (improved water source, floor materials, wall materials, roof materials, toilet facility, cooking fuel), ownership of agricultural land, small livestock, non-mechanized farm equipment (for example hand tools), mechanized farm equipment (for example tractor), house or building, electricity, motorcycle, bicycle, cellphone, radio, television, and refrigerator [26]

[3]Data collection phase 1 (2019-2020) and 2 (2020-2021)

Table 4: Areas of a family's life affected by having a person with a large body in the household in rural Ghana

Consequence	Area affected	Quotes from the focus group discussion participants
Negative[1]	Worse household financial status (poverty)	"When you are working and you start to grow big in body size, you cannot work as you used to work and that will make you poor. When you are big in body size [women with obese sizes G, H, I in Figure 1], you cannot have a farm because you cannot go out and work on the farm" (Man, 37 years, secondary education or higher, normal weight, highest wealth tertile, mildly food insecure) "We have mentioned fight or quarrel [in a family] because since he is big body size [obese] and cannot work to have money, he will grow poor and because he has no money, it will bring problem to the family" (Man, 38 years old, secondary education or higher, normal weight, highest wealth tertile, food secure). "They [a person with an Obese size "I" in Figure 1] fall sick and it becomes a burden on the family which will leads to poverty in the family. If you are looking for total healing for the sick, you will spend money and the little you have will be spent on the sick. Because of this person who is sick, you cannot work to get money and that will lead you to poverty. If you don't take care, you will begin to beg or borrow money which you cannot pay. That person will irritate the family and that will be a burden on the family" (Man)
	Household and spousal fights	"When the woman begins to put on weight, you will be happy and she will look beautiful for you but when her body size becomes too big, you will not be happy. Anyone who is big looks nice for everyone and so when your spouse is putting on weight or becomes too big and weak, that is where the problem begins in which will bring anger to the family. The woman is not able to work hard as she used to work before" (Man, 50 years, secondary education or higher, normal weight, middle wealth tertile, mildly food insecure) "If the man [size I] is weak in his waist, he will not be able to have sex with the woman. This can generate quarrel in the relationship. There wouldn't be happiness in the relationship" (Man)

Food insecurity and worse mental health	"They [obese women] will not be able to walk to the farm and work so they will not get any food. When the person is big in body size, he is likely attacked by stroke. If this person is attacked by stroke and the he cannot do anything but the family has to carry him before he can do something, he wouldn't produce anything from the farm" (Man)

"She [the obese woman] will be worry[ing] about the sickness that has affected her and maybe it might bring her work progress down, she is not having enough money, not having children then it would be a much worry for her. She need some help from the family and friends like giving her job, money which will keep her happy. Because in everything we do as human we need money to do them, so if you do [not] have [money] you may die out of hunger because you can't go to the market and credit food staff for your living"(Woman, 34 years, farmer, primary education, obese, highest wealth tertile, food secure)

"If the man is working alone while the woman is at home [because of her size], the man will not be happy. Likewise, if the men don't work and the women work, it will bring the same challenge. If the women don't go with the men to work, it will not help at all. It brings fight and quarrels because since they are not working to get money and there is no food in the house, it will bring fight" (Man)

"Sometime you [person with an obese size I on Figure 1] may even die out of hunger because there is no food to feed on because the family that you are depending on, cannot support you again in your welfare and food, sometimes you may find it difficult to sleep at night" (Woman, 64 years, farmer, primary education, normal weight, middle wealth tertile, food secure)

"He [a person with an obese size] will be disturbed and worrying. Some of the challenges are looking for help from other like sending them on an errant" (Woman, 56 years, farmer, primary education, overweight, middle wealth tertile, mildly food insecure)

"If you are big and you are not doing any work, no education where would you get money to take care of yourselves, therefore you will always be worrying and the

family will also face financial challenges" (Woman, 56 years, farmer, primary education, overweight, middle wealth tertile, mildly food insecure)

Risk of children dropping out of school	"If a child has to go to school or learn a skill, for his/her future, they will not allow that child to go because that child has to take care of this big body size man at home. That child will miss all the opportunities he/she has in life and he wouldn't go to school or learn a skill" (Man, 48 years old, primary education, underweight, lowest wealth tertile, food secure)
	"It always put pressure on the women because she is the only person doing all the work and providing for family. Their children education becomes problem and their family issue or problem will also increase" (Woman, 34 years, farmer, primary education, highest wealth tertile, food secure)
	"He [obese person] will put the family in so many problems. The problem of his children, himself and future ones to come. The children education, feeding of his children and himself becomes bedding [a burden] on the family and friends" (Woman)
Having money as a modifier of negative effects	"If he is very big and also strong to work, then the wife will be happy with him but if the work is not going on as excepted then the wife would be very angry" (Woman, 40 years old, trader, primary education, obese, third tertile, moderately food insecure)
	"If you have money you can give your children good education, good trade work that means you can do everything to make your life comfortable" (Woman, voice unidentified)
	"If you [person size G] have money, they [family] will respect you but if you don't have money, even a small child can insult you. If you have money and the family call on you for something, you will give the money for whatever reason you were called" (Woman, 40 years, farmer, primary education, normal weight, lowest wealth tertile, food secure)
	"The family will not be happy with you because if you are in the village with them and you cannot do the work that

all the members in the family are doing, but if you have money that you can also you to support them then there will be happiness but if not problem" (Woman, 35 years, farmer, primary education, normal weight, middle wealth tertile, mildly food insecure)

"If you are very big [man biggest figure I] but has money the family will be very happy with you. When it comes to money issue when you shake your feet now everyone will agree with you." (Woman, 35 years, farmer, primary education, overweight, middle wealth tertile, food secure)

Positive[2]	Appreciation by family, respect, and illusion of wealth	"When someone with a small body in size has money in a family, people don't respect or regard her. An example is my child, if she has a lot of money, as small as she is, they will not regard her or respect her. Some of the questions they normally ask when someone with a small body in size arrives, the question is; is this person an adult or a child? If the two of you come to visit us and we welcome you, because of your body sizes [obese woman with a G size on figure 1], someone will say, our authorities have come. The body size, the stature and everything speaks more about you. Even if you don't have anything on you, the body size and stature makes people to believe you have it [money] and they respect you more even when you don't have anything" (Woman, 46 years old, farmer, no education, normal weight, lowest wealth tertile, food secure)
		"We are not saying when you are big, automatically you have money but what we mean is that, when you are big and you are hardworking, you have money but you are big in your body size and you are lazy, you don't want to work, you will not have money. The good thing about [being] big in body size to the family, it glorifies the individual and the individual is welcome in a special way when he arrives in the family even though he has no money" (Woman, 46 years old, farmer, no education, normal weight, lowest wealth tertile, food secure)
		"If the family has someone with big body size (woman with an obese figure G, H on Figure 1), the family carries a glory and they boldly say we have a big person in our family" (Woman, 34 years, farmer, primary education, overweight, middle wealth tertile, food secure)

[1]Negative effects included sizes from G to I on figure 1 [29]; only obese sizes
[2]Positive effects included sizes from E to I on figure 1 [29]; both overweight and obese figures

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