Overweight and obesity in rural Ghanaian households: A mixed methods study among women and men farmers

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Abstract

Overweight (OW) and obesity (OB) are risk factors for non-communicable diseases which contribute to high health care expenses and accounted for 45% of deaths in Ghana in 2019. Previous studies have focused on studying the predictors of OW/OB mainly in women and the impact on their personal lives. This research, based on the socioecological model, examined quantitatively the individual- and household-level predictors of women's OW/OB, men's OW/OB, and OW/OB presence in the rural Ghanaian household (having at least one person with OW/OB). It also explored qualitatively the cultural predictors, the perceived impact of OW/OB on the household well-being as a unit, to understand if OW/OB is of concern to household members.

This was a cross-sectional, mixed-methods study. The quantitative data were used in 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; 196 households had both a participating woman and man (spouse, son, brother, or father). Logistic regression was used to assess variables associated with OW/OB in separate models for women, men, and households. Exposure variables included individual-level factors (age, ethnicity, education, parity, self-efficacy, social support, and mental health symptoms) and household-level factors (food security, wealth, the other family member's nutritional status, and intra-household relationship empowerment variables [intra-household respect and attitudes towards violence against women]). Primary qualitative data were collected in six focus group discussions (FGDs) (three with women and three with men, aged 22-69 y and recruited from the comparison arm of

the LU project) conducted in February-March 2022 in three of the eight project communities. A structured guide and a body image figure instrument were used. The FGD recordings were translated and transcribed from Krobo to English. The analysis used an inductive thematic approach.

Overweight and obesity prevalence was 43% in women and 16% in men; 56% of the households had an OW/OB presence. Individual-level predictors that were associated with OW/OB were age and mental health for women and age and ethnicity for men. Household wealth was the only household-level predictor that was associated with OW/OB in women, men, and OW/OB presence in the household. Households in the highest wealth tertile were 2.5-fold more likely to have at least one person who was 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 poverty, food insecurity, and children dropping out of school). Having money was seen as a modifier for the negative effects. No negative consequences were perceived for OW people.

Obesity was perceived as a problem that concerns the whole household because it had implications on all family members' well-being as a result of reduced financial productivity of the OB person. 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. The study gave important insights on the rural household reality and suggested the relevance and importance of taking action towards the OW/OB problem in the rural population. Since the households in the higher tertile of wealth were at a higher risk of OW/OB, future nutrition interventions should aim to consider and address the cultural appreciation of OW/OB

and couple poverty reduction policies with nutrition and health education to encourage the consumption of a healthier diet with the improved financial status.

Résumé

Le surpoids et l'obésité sont des facteurs de risque de maladies non transmissibles qui contribuent à des dépenses élevées pour le système de santé. Celles-ci étaient la cause de 45% des décès au Ghana en 2019. Les études précédentes se sont concentrées sur les prédicteurs de l'obésité et du surpoids, principalement chez les femmes, ainsi que l'impact sur leur vie personnelle. Notre recherche, quant à elle, se base sur un modèle socioécologique. Nous examinons quantitativement les prédicteurs, au niveau individuel et du ménage. Il est donc question de l'obésité et du surpoids des femmes, de l'obésité et du surpoids des hommes et de la présence de l'obésité et du surpoids dans le ménage rural ghanéen (au moins une personne obèse ou en surpoids dans un ménage). Notre recherche explore également, de manière qualitative, les prédicteurs culturels, l'impact perçu de l'obésité et du surpoids sur le bienêtre du ménage en tant qu'unité, et ce, dans le but de comprendre si l'obésité et le surpoids préoccupent les membres d'un ménage.

Notre étude est transversale à méthodes mixtes. Les données quantitatives utilisées proviennent d'une analyse secondaire des données de base du projet LinkINg Up (LU), une intervention agricole sensible à la nutrition dans huit communautés rurales de la région orientale du Ghana (ClinicalTrials.gov NCT03869853). L'échantillon comprenait 331 femmes et 205 hommes, âgés de 19 à 90 ans ainsi que 196 ménages dont une femme et un homme étaient participants (conjoint, fils, frère ou père). Une régression logistique a été utilisée pour évaluer les variables associées à l'obésité et le surpoids, et ce, dans des modèles séparés pour les femmes, les hommes et les ménages. Les variables d'exposition comprenaient des facteurs au niveau individuel (âge, ethnicité, éducation, parité, auto-efficacité, soutien social et symptômes de santé mentale) et des facteurs au niveau du ménage (sécurité alimentaire, richesse, état nutritionnel des autres

membres de la famille et variables d'autonomisation des relations au sein du ménage [respect intraménage et attitudes envers la violence faite aux femmes]). Ces données primaires qualitatives ont été recueillies lors de six discussions de groupe (trois avec des femmes et trois avec des hommes, âgés de 22 à 69 ans recrutés dans la branche témoin du projet LU). Ces discussions ont été menées en février-mars 2022 dans trois des huit communautés du projet. Un guide structuré et un instrument d'image corporelle ont été utilisés. Les enregistrements de ces discussions ont été traduits et transcrits du Krobo à l'anglais. Une approche thématique inductive a été utilisée pour l'analyse.

La prévalence du surpoids et de l'obésité était de 43% chez les femmes et de 16% chez les hommes. 56% des ménages avaient une présence d'obésité et/ou de surpoids. Les prédicteurs au niveau individuel qui étaient associés à l'obésité et au surpoids sont l'âge et la santé mentale pour les femmes. Pour les hommes, il s'agissait de l'âge et de l'ethnicité. La richesse du ménage était le seul prédicteur associé à l'obésité et au surpoids chez les femmes, les hommes et dans le ménage. Les ménages du tercile de richesse le plus élevé étaient 2,5 fois plus susceptibles d'avoir au moins une personne obèse ou en surpoids que les ménages du tercile de richesse inférieure. Les participants ont exprimé les conséquences sociales positives de la présence d'une personne obèse ou en surpoids pour leur famille (par exemple, le respect). La taille d'une personne n'était préoccupante que lorsqu'elle affectait sa capacité à cultiver ou à gagner de l'argent, ce qui pouvait nuire à l'unité du ménage (par exemple, entrainer la pauvreté, l'insécurité alimentaire et le décrochage scolaire des enfants). Le fait d'avoir de l'argent était considéré comme une influence sur les effets négatifs. Aucune conséquence négative n'a été perçue pour les personnes en surpoids.

L'obésité est perçue comme étant un problème qui concerne l'ensemble du foyer, car elle a des répercussions sur le bienêtre de tous les membres de la famille en raison de la baisse de productivité financière de la personne concernée. Les conséquences de l'interruption du travail d'une personne obèse sur sa famille sont inquiétantes et nécessitent des interventions qui s'attaquent à la pauvreté et à l'insécurité alimentaire, ainsi qu'à la nutrition. L'étude a donné une aperçue importante de la réalité des ménages ruraux et suggère la pertinence et l'importance de prendre des mesures pour résoudre le problème de surpoids et d'obésité dans la population rurale. Les futures interventions nutritionnelles devraient viser à prendre en compte et à traiter l'appréciation culturelle de l'obésité et du surpoids considérant que les ménages les plus riches étant plus exposés au risque de l'obésité et du surpoids. Il est également important de lier les politiques de réduction de la pauvreté avec l'éducation nutritionnelle et sanitaire afin d'encourager la consommation d'une alimentation plus saine avec l'amélioration du statut financier.

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and Travel (GREAT) Award which helped fund the trip to the study site in Ghana to do the fieldwork for my qualitative study possible.

Contribution to original knowledge

This master's dissertation consists of a quantitative and a qualitative studies; both offer new insights to the literature. The quantitative study is the first to look at the predictors of overweight and obesity at the household level. Moreover, it adds to the limited literature on predictors of overweight and obesity in Ghanaian men. Only one other Ghanaian study offered information on the predictors of overweight and obesity in men in Ghana, focusing on a sample in rural northern Ghana. One advantage of the quantitative study is the inclusion of men and women from a wide range of age (19-90 years old). Previous studies have focused on people below 50 years of age. The only other study focusing on people above 50 years did not report their analysis results separated by sex. The qualitative study is the first to explore the consequences of having a family member with overweight or obesity on the whole household's well-being. Moreover, the inclusion of men in the qualitative study adds important insights on their perceptions about body size as the literature on body sizes that has previously been published has mostly focused on women.

Contribution of authors

This thesis was conducted under the LinkINg Up project that received ethical clearance from McGill University and University of Ghana and was registered at ClinicalTrials.gov (NCT03869853). For the quantitative study, I analysed the data that were already collected by the project team. For the qualitative study, I designed the questionnaire, trained the research assistants on the questionnaire guide, was present in the field during the focus group discussions, and coded and analysed the qualitative data. I drafted the manuscript. The research assistants conducted the focus group discussions in the local language Krobo, transcribed the transcripts to English, and gave consultations about the cultural meaning of the data collected when needed. Dr Naa Dodoo helped shape the qualitative study design, gave comments and recommended edits to the manuscript, and approved it before submission. Dr Grace Marquis was involved in shaping the research questions, study design, consulted in data analysis, provided revisions to the thesis and the manuscript, and gave final approval for submission. Dr Marquis helped administer the LinkINg Up project funds for my field research and supported my application for the Graduate Research Enhancement and Travel (GREAT) Award.

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List of abbreviations

BMI	Body mass index
CLs	Confidence intervals
CBI	Current body image
DHS	Demographic and Health Survey
DALY	Disability-adjusted life years
FGD	Focus group discussions
GDHS	Ghanaian Demographic and Health Survey
HDI	Human Development Index
HR	Hazard ratio
IBI	Ideal body image
LU	LinkINg Up
LMIC	Low- and middle-income countries
NCDs	Non-communicable diseases
OB	Obesity
OR	Odds ratio
OW	Overweight

Pro-WEAI	Project-level Women's Empowerment in Agriculture Index
SRQ-20	Self-Report Questionnaire
SEM	Socioecological model
WEF	World Economic Forum
WHO	World Health Organization
WIAD	Women in Agriculture Development

CHAPTER 1 Introduction

The World Health Organization classifies overweight (OW) and obesity (OB) as forms of malnutrition (World Health Organization, 2021 a). The problem is widespread and affects low- and middle-income countries as well as developed ones (World Health Organization, 2017). In Ghana, OW and OB have been more prevalent than underweight among women since 1975 (Figure 1.1) (Abarca-Gómez et al., 2017). To understand the predictors and consequences of the OW/OB problem, this research is guided by the socioecological model (SEM) (Figure 1.2) that has been used widely in nutrition - for example, to understand childhood obesity (Pereira., et al 2019) and adult food choices (Story et al., 2008). This model describes how health behaviours result from the interaction of the individual with the environment (McLeroy et al., 1988). The interaction occurs at multiple levels, beginning with individual factors, the interpersonal interactions (family and social networks), the institutional influence (rules, regulations, policies, and informal structures), the community (social norms and perceptions), and government policies. My research will aim to understand the determinants of having a healthy household by analyzing predictors on the individual level (age, marital status, parity, education, personal wealth), the interpersonal (household variables of food insecurity, gender equality, wealth, size), and community level by looking into the perceptions of rural communities about the influence and consequences of having a large body size. Thus, the SEM will lead the quantitative and

qualitative analysis. The primary health outcome of interest is overweight and obesity in the household.

Why households? Based on the SEM, individuals are affected by the social and physical environment in which they live (McLeroy et al., 1988). A national Indian survey reported an increased odds ratio of 1.8 for adults having OB when living with another adult member who had obesity (Patel et al., 2017). An Indonesian study that analyzed national data reported that 15% of the variation of body mass index (BMI) between individuals was a result of household variables other than households' per capita expenditure, size, or place of residency (Vaezghasemi et al., 2016). Dropping household variables resulted in inflating the variance of BMI resulting from individual variables. Sączewska-Piotrowska & Piotrowski (2020) also found an 18% variation of BMI due to household factors. Family support is essential for individual's dietary changes. Lack of family support was identified as one of the barriers for successful management of type 2 diabetes in a study done in Tamale, Ghana (Mogre et al., 2019). People in a household share food from one pot prepared by one person. A quote taken from an interview with a nurse that treated diabetic patients explained, "As for the diet and exercise; when you ask most of them, they either tell you their children are not around or their daughter in-laws won't help. Their daughter in- laws cook the family meal and the patients are usually old women or old men and can't cook for themselves. Their daughter-in-law worries about cooking for the entire family to eat and seldom has time for their special needs". In an umbrella review article that included 14 systematic reviews of 47 trials to treat children's obesity, the authors concluded that inclusive interventions were effective (Chai et al., 2019). All but one of the family-based trials, where an

adult family member took part in the intervention, were effective in treating children's overweight or a related behavior.

Overall research aim

The research study aimed to contribute to the understanding of how to build culturally sensitive interventions that encourage, motivate, and facilitate members of rural households to maintain a healthy weight throughout life.

Research objectives and lines of inquiry

Quantitative specific objectives / hypotheses

1.1. Examine the prevalence of OW/OB in women in rural communities of three districts in the Eastern Region of Ghana.

1.2. Examine the prevalence of OW/OB in men in rural communities of three districts in the Eastern Region of Ghana.

1.3 Examine the prevalence of overweight/obesity (OW/OB) presence in households (adult male and/or female is OW/OB) in rural communities of three districts in the Eastern Region of Ghana.

2. Identify the factors that are associated with OW/OB in women, OW/OB in men, and OW/OB presence in households in rural communities of three districts in the Eastern Region of Ghana.

Hypothesis 1: Individual characteristics of the women and men (e.g., age, parity (women only), education, mental health, ethnicity, social support) are associated with the risk of OW/OB in women, OW/OB in men, and OW/OB presence in households in rural communities of three districts in the Eastern Region of Ghana.

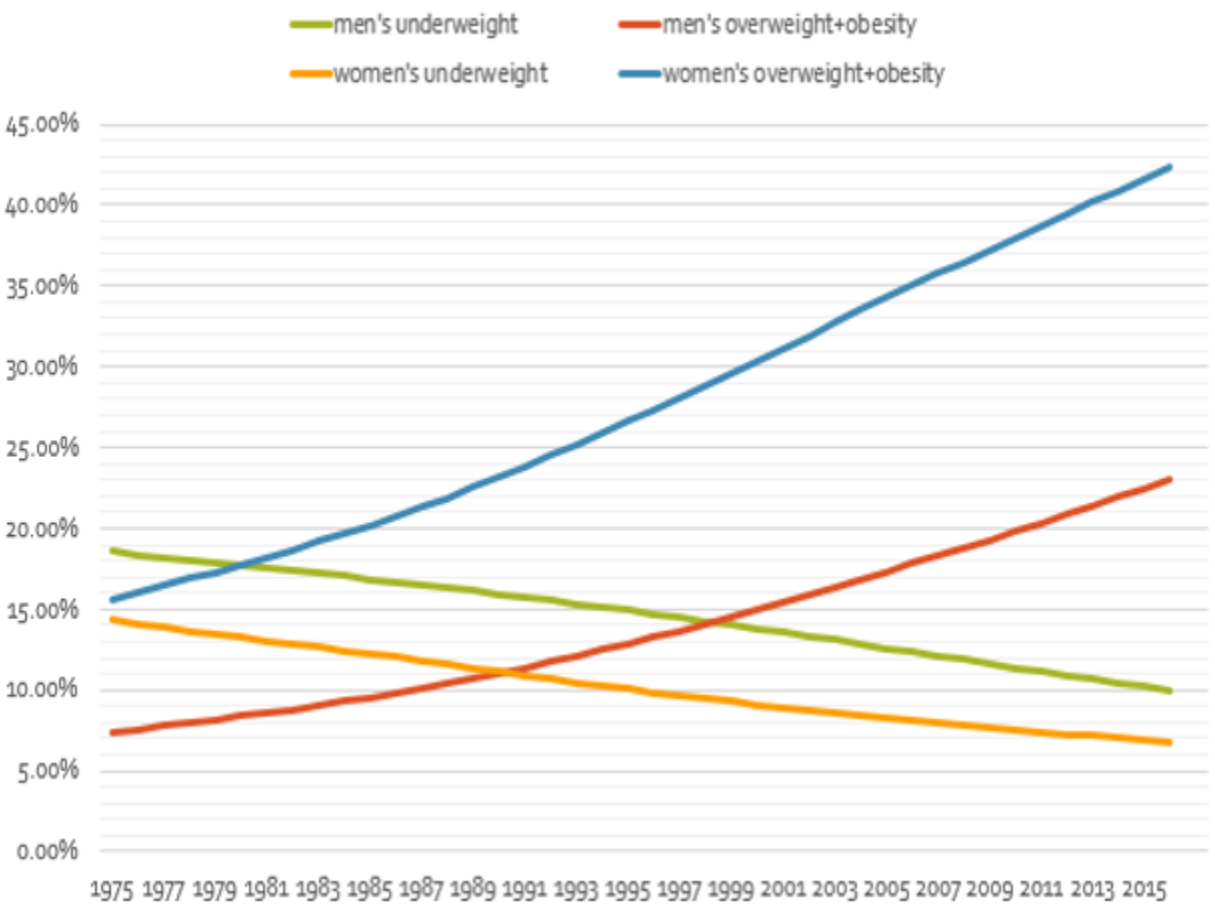
Hypothesis 2: Household characteristics (e.g., food insecurity, household wealth, household size, intra-household relationship variables [respect within the family, attitudes towards domestic violence]) are associated with the risk of OW/OB in women, OW/OB in men, and OW/OB presence in households in rural communities of three districts in the Eastern Region of Ghana.

Qualitative research questions

1. What are the rural communities' perceptions of the influences of adult weight on different domains of life (e.g., work, health, social, and personal)?

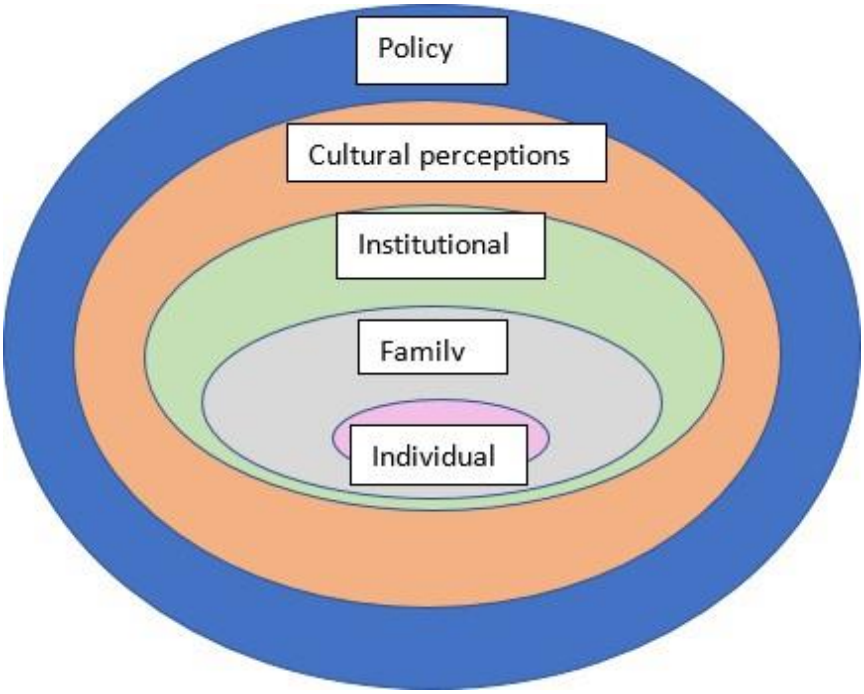
2. What are the perceived consequences of the influences of having an overweight or obese person on the rural household function and well-being?

Figure 1. 1 Ghanaians nutritional status over the years



Abarca-Gómez, L., Abdeen, Z. A., Hamid, Z. A., Abu-Rmeileh, N. M., Acosta-Cazares, B., Acuin, C., Adams, R. J., Aekplakorn, W., Afsana, K., Aguilar-Salinas, C. A., Agyemang, C., Ahmadvand, A., Ahrens, W., Ajlouni, K., Akhtaeva, N., Al-Hazzaa, H. M., Al-Othman, A. R., Al-Raddadi, R., Al Buhairan, F., … Ezzati, M. (2017). Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128·9 million children, adolescents, and adults. *Lancet*, *390*(10113), 2627–2642. https://doi.org/10.1016/s0140-6736(17)32129-3

Figure 1. 2 Socioecological model



McLeroy, K. R., Bibeau, D., Steckler, A., & Glanz, K. (1988). An ecological perspective on health promotion programs. *Health Education Quarterly*, 15(4), 351-377. https://doi.org/10.1177/109019818801500401

CHAPTER 2 Review of the Literature

Prevalence of overweight/obesity and its consequences

Overweight (OW; body mass index [BMI] ≥25 kg/m^2 and <30 kg/m^2) and obesity (OB; BMI ≥30 kg/m^2) affected 1.9 billion of the global adult population (+20 y) in 2016, with a prevalence of 26% and 13%, respectively (World Health Organization, 2021 b). The number of adults with a BMI ≥25 kg/m^2 increased by 49% from 2009 to 2019 (GBD 2019 Risk Factors Collaborators, 2020). Countries of all income levels are challenged by OW and OB but to different degrees (Table 2.1) (World Health Organization, 2017). Whereas, five out of every 20 individuals were OW/OB in low-income countries, in high-income countries 12 out of 20 people were affected. In Africa, OW/OB affected six out of every 20 people (World Health Organization, 2017). In Sub-Saharan Africa (SSA), the prevalence of adult OW/OB in women and men tripled from 1975 to 2016, reaching four out of 10 women and two out of 10 men (Abarca-Gómez et al., 2017). The prevalence of OW/OB in children and adolescents (5-19 y) quadrupled during the same period; the percentage was half that in adults (World Health Organization, 2017).

In Ghana, the prevalence of adult female and male OW/OB surpassed that of underweight (BMI <18.5 kg/m^2) in 1975 and 1999, respectively, tripling for both women and men from 1975 to 2015 (Figure 1.1) (Abarca-Gómez, et al., 2017). Other age groups have been also affected by OW/OB in the country. According to a recent meta-analysis, about two out of every 10 children 19 y and younger have a BMI ≥25 kg/m^2 (Akowuah & Kobia-Acquah, 2020). Moreover, nationally representative data on aging populations (≥ 50 y) gathered by the World Health Organization (WHO) at two time points (2007/2008 and 2014/2015) showed an increase in the

prevalence of OW and OB by 25% and 47%, respectively (Lartey et al., 2019). The latest Ghanaian Demographic and Health Survey (GDHS) in 2014 showed a higher prevalence of OW/OB (more than double) in women compared to men both in urban and rural settings. Furthermore, the prevalence of OW/OB also increased with age, education, and wealth status, and differed in the 10 Ghanaian regions (Tables 2.2 & 2.3) (Ghana Statistical Service et al., 2015). For example, in the Greater Accra region, the prevalence of female OW/OB was almost five times higher than in the Northern region, while male OW/OB was four times higher in Greater Accra compared to the Eastern and Upper East regions. What is also alarming, is that once a person arrives to an OW or OB BMI category they are likely to stay in it (Lartey et al., 2020 a). Lartey et al. (2020 a) reported in his study on 50+ years old Ghanaians that the relative risk of staying in the same weight category was 84.0% (95% CI: 81.9%, 85.8%) for OW people, and 90.2% (95% CI: 87.7%, 92.3%) for the OB. In summary, all areas of the world are experiencing OW and OB and Ghana is no exception with OW/OB prevalence levels comparable with the global prevalence.

These high prevalence rates have substantial consequences. Overweight/obesity is associated with an increased risk of cardiovascular disease, diabetes mellitus, cancer, chronic kidney disease, and musculoskeletal disorders leading to higher Disability-Adjusted Life Years (DALY) and risk of mortality (World Health Organization, 2017). Globally, in 2019 OW/OB was the fifth leading contributor of DALYs (6%) and the fifth and sixth leading cause of death in women and men, respectively (GBD 2019 Risk Factors Collaborators, 2020). Furthermore, both the proportion of DALYs and deaths attributed to OW/OB increased by 53% and 28% from 1990 to 2015, respectively. Importantly, in 2015, more than one-third of deaths and DALYs caused by high BMI occurred in people who were OW not OB. In SSA, the risk of developing diabetes has

even started increasing at a normal weight BMI of 23 kg/m² (Teufel et al., 2021). In Ghana, non-communicable diseases contributed to 45% of total deaths in 2019 (World Health Organisation, 2020). High BMI was the fifth leading risk factor of deaths and DALYs combined (GBD 2019 Risk Factors Collaborators, 2020). Furthermore, OW/OB decreased the life expectancy by two to five years (Lartey et al., 2020 b).

In addition to the health consequences, OW/OB is associated with higher health expenses. In the United States, OW/OB resulted in the direct health care cost of $481 billion and a lost productivity cost of $1 trillion (Milken Institute, October 30, 2018). Combined, these amounts correspond to 9% percent of the country's gross domestic product. Lartey et al. (2020 b) modelled direct health care expenses in Ghana. The 2017 health expenses of an adult with OW/OB were two to three times higher than that of an adult in the normal BMI range. A healthy woman would spend 619 USD (95% CI: 616, 622) on health care whereas, an OW and OB woman's expenses would be two- to three-fold higher, 1298 USD (95% CI: 1290, 1306) and 2057 USD (95% CI: 2043, 2071) respectively. Same trend was see for men. The direct health care expenses of a healthy man in Ghana would be 571 USD (95% CI: 567, 575) whereas an OW and OB man's expenses would be 1177 USD (95% CI: 1169, 1186) and 1831 USD (95% CI: 1817, 1846) respectively. Globally as well as in Ghana, OW and OB are one of the important risk factors for non-communicable diseases, causing additional health care costs and contributing to death and DALYs. Thus, OW/OB is associated with a shorter life expectancy, decreased quality of life, and higher economic costs.

Determinants of overweight and obesity

Individual determinants

Age. Studies in SSA have found an increase of OW/OB with age. An analysis using data collected between 1993 and 2017 from 22 SSA countries reported that the average yearly increase in OW prevalence in adult women (20-49y) is double that is of adolescents (Jiwani et al., 2020). In Ghana the average yearly increase in OW prevalence in adult women (20-49y) is three times that is of adolescents. On the other hand, the annual increase in adolescents' OB was not significant whereas OB prevalence increased significantly yearly for in adult women. The supporting data for all Individual level determinants of overweight and obesity are shared in Table 2.4. A larger increase in the prevalence of OW/OB was observed in older adults (35-49 y vs 20-35 y) (Figures 2.1 & 2.2). A nationally-representative South African study found that the prevalence of female OW and OB increased with age up to 64 years. For people 65 years and older OW continued to increase and OB decreased (Figure 2.3) (Mchiza et al., 2019). An analysis of GDHS data found that the odds of being OW/OB increased with age even after controlling for parity and other covariates (Tuoyire et al., 2016). Using 15- to 24-y-old urban women as the reference group, those 25-34 and 35-49 years old were three times and two times more likely of having a BMI $\geq$25 kg/m^2 (Doku & Neupane, 2015). Similar trends were found for rural Ghanaian women.

Ghanaian men (15-59 y) also experienced an increase in OW/OB with age (Table 2.3) (Ghana Statistical Service et al., 2015). However, the relationship between OW/OB and age does not appear to be linear. The previous studies documented an increase of OW/OB with increased age; however, a study that focused on older adults (40-60 y) in rural northern men and women (40-60

y) found that for every one-year increase there was a decrease in the BMI both in men and women (Nonterah et al., 2018). This study was the only one which presented an analysis of a regression model for OW/OB among men in this age group. The nationally representative Mchiza et al., (2019) and Ghana Statistical Service et al. (2015) studies presented their data for OW/OB among men as proportions and Lartey et al. (2019) -data presented later- did not separate their analysis by sex. Another reason for the different result is that the Nonterah et al. (2018) study was conducted in rural northern Ghana and the patterns for OW/OB differ in different geographical regions.

Authors in the previously presented studies (Mchiza et al. (2019); Ghana Statistical Service et al. (2015); Lartey et al. (2019) did not present their data separated by urban/rural setting. Amoah (2003) carried out a study in urban and rural Accra and reported an increase in the prevalence of OW but a decrease in OB among female and male adults aged ≥ 65 y (Amoah, 2003). In representative samples of Ghanaian men and women above 50 y in 2008/2009 and 2013/2014, only those above 70 y in the 2008/2009 sample had lower odds of being OW compared to the reference group of 50-59 y (Lartey et al., 2019). However, there were lower odds of having OB with increased age in both samples.

Marital status. Some studies have found an association between marital status and OW/OB. A GDHS data analysis by Tuoyire et al. (2016) found that the association was stronger among nulliparous compared to parous women. Compared to 15-49 y old single women, those who were currently or previously married were 1.5 and 2 times more likely to be OW/OB among parous and nulliparous women, respectively. Cohabitating was not associated with OW/OB. A later analysis including only young women (15-24 y) and did not find an association between marital status and OW/OB (Tuoyire, 2020). Similarly, OW/OB was not associated with marital

status in older female and male population (> 50 y) in another Ghanaian nationally representative analysis (Lartey et al., 2019). Focusing on rural Ghanaian women, an analysis of GDHS data showed that marital status was not associated with OW/OB (Doku & Neupane, 2015). Likewise, a study done in rural northern Ghana including 1092 40- 60 y old women, found no association between marital status and BMI (Nonterah et al., 2018).

However, being married was positively associated with BMI among men in this sample (n=924). In summary, in Ghana, the association between marital status and OW/OB is complex and is likely affected by other factors such as parity, age, urban/rural setting and sex.

Parity. To understand the relationship between OW/OB and parity Kim et al. (2006) analysed DHS data from 28 countries and found that the relationship depends on the country's development – measured by Human Development Index (HDI) – and household wealth (Table 2.4). Regardless of HDI, parity was either not significantly or negatively associated with OW/OB in households in the lowest wealth tertile and positively associated for women in the highest wealth tertile. On the other hand, the association between parity and OW/OB was positive for women living in households in the middle wealth tertile, but only for countries in the second and third highest HDI tertiles.

In Ghana, an analysis of GDHS data for young women (15-24 y) did not find an association between parity and OW/OB when women with one child were compared to those who had no children (Tuoyire, 2020). Having two or more children, however, was associated with a 1.5 increased likelihood of OW/OB (Table 2.4). Another analysis of GDHS data, which included all women (15-49 y old) found that those who had two children were 1.5 times more likely to being OW/OB compared to those who had only one child (Tuoyire et al., 2016). Nevertheless, an increase in the number of children beyond 2 was not associated with OW/OB. An analysis that

separated GDHS data by urban/rural areas found that compared to having one child, having two or more children was associated with a lower odds of OW/OB both in rural and urban areas by 70% and 50% respectively (Doku & Neupane, 2015) (Table 2.4). As in the case of age, parity also appears to have a non-linear relationship with OW/OB.

Education. Increased level of education is positively associated with OW in young, parous, and rural Ghanaian women. An analysis of GDHS data from 1993 to 2014 on young women 15-24 y old reported that compared with women with no education there were 1.4, 1.7, and 2.3-fold increase in the odds of OW/OB for women with primary, middle/junior secondary school (JSS), junior high school (JHS), and secondary/higher education (Tuoyire, 2020). This association was not seen in an analysis of GDHS data on nulliparous women 15-49 y old from 2003, 2008 and 2014 (Tuoyire et al., 2016).

However, in the sample of parous women, those with primary education were 1.5 more likely to be OW/OB than women with no education. Another analysis of GDHS 1993, 1998, 2003, and 2008 reported on the relationship of education by urban/rural residence (Doku & Neupane, 2015). The study reported that in urban settings, compared to women with higher education, only women with no education were associated with lower odds of OW/OB (OR=0.5); other educational levels (primary and secondary) were not associated with OW/OB. However, in rural Ghana, compared to women who had higher education, those with primary education or no education had a 0.4 and 0.2 lower odds of OW, respectively. Among men, a study conducted in rural northern Ghana found that any level of education higher than no formal education was associated with increased odds of OW/OB (Nonterah et al., 2018). In contrast, in the Addo et al. (2009) study on men in Accra (urban), there was no significant association between level of

education and OW/OB. In rural Ghanaian men and women, the link between education and OW/OB was positive with increased level of education.

Household determinants

Household wealth. Household wealth is one of the most consistent variables that is positively associated with OW/OB in the literature. Studies in low- and middle-income countries (LMIC) have found a positive association between OW and household wealth. An analysis of DHS data on women 15-49 y old in 54 LMIC found the degree of increase in OW odds for every one quarter increase in wealth index ranged from 26% in Comoros to 68% in Ghana (Subramanian et al., 2010). The supporting data for all household level determinants of overweight and obesity are shared in Table 2.5. For every one asset increase in Ghanaian households, there was a 15% increased odds of the woman being OW and 25% of being OB even after adjusting for physical activity, sedentary behaviour, and other variables (Dake & Fuseini, 2015). A positive non-linear inverted U-shaped relationship between household expenditure and OW/OB was noted in a 1997 survey in Ghana (Abdulai, 2010).

Based on an analysis of GDHS data on women 15-49 y old from 2003, 2008 and 2014, there was an increased likelihood of OW with increased wealth among women; the association was stronger in parous compared to nulliparous women (8 vs 6 higher odds of OW/OB) when comparing the richest vs poorest quintile (Tuoyire et al., 2016). Other analyses that focused on young Ghanaian women 15-24 y old (Tuoyire, 2020) and 50+ y old Ghanaian women (Lartey et al., 2019) found similar results. The increased odds of OW with increased household wealth held true both among rural and urban Ghanaian women, however it was stronger in urban areas (Doku & Neupane, 2015). Household wealth affected the relationship between urban/rural residence and women's OW/OB, and parity and women's OW/OB. In Ghana, when using a cut-off of eight

assets to determine affluent and less affluent households, Madise & Letamo (2017) found that women living in rural affluent households had a higher mean probability of being OW/OB than the ones living in affluent urban households. Women living in less affluent households in rural areas had a lower mean probability of being OW/OB compared to urban less affluent households. Likewise, it was found that in in Ghana, parity was only associated with increased odds of OW/OB in households in the middle and high wealth tertiles (Kim et al., 2006).

Researchers suggested women's control over food spending and educational level as modifiers of the relationship between OW/OB and household wealth. Case & Menendez (2009) reported on 500 South African households. Women's control over their own income and having the most say in food spending explained fully the relationship between women's OW/OB and household wealth. Household wealth was no longer significantly associated with OW/OB when the mentioned two variables were added to the model. Ozodiegwu et al., (2020) argued that education mediated the association between wealth and OW. In their analysis of DHS data from 22 SSA countries on women from 2006 to 2016, they saw evidence of their hypothesis in most countries. Although the mediation effect was not statistically significant in Ghana, they argued

that it was because of the lack of intrinsic credibility of the evidence in Ghana and for this the mediation effect of education on wealth still held true (footnote[1]).

Less information is available on men. Mchiza et al. (2019) found that in a representative study of South African men that compared with those who earned low income those with a medium/high income had two times higher odds of having OB. However, Case & Menendez (2009) in his study on 389 men in South Africa found no relationship between OW/OB and household income. In a study on men in Accra Ghana (n=540), researchers found increased odds of being OB for men who owned five assets or more compared to two or fewer (Addo et al., 2009). However, this association was attenuated after adjusting for physical activity level, smoking, and alcohol consumption. This was the only study that adjusted for physical activity level. Among 50 y old and older Ghanaian men, a positive linear relationship was found between wealth quintiles and OW/OB (Lartey et al., 2019). The only other study conducted on men in Ghana was in the north where 90% of the sample were farmers. The researchers found a positive association only when comparing the least poor with the poorest men (Nonterah et al., 2018).

[1] "Intrinsic credibility in reference to a study finding implies that it provides sufficient evidence of an effect even in the absence of prior studies. Unprecedented findings, which are statistically significant, can be considered intrinsically credible if their most probable value (point estimate) fall outside their SL CPI, that is, their most probable estimate does not correspond to effect sizes that when combined with existing findings includes no effect. Unprecedented non-statistically significant findings with point estimates that support the study hypothesis also follow similar criteria in assessment of intrinsic credibility. For unprecedented non-statistically significant findings contrary to the study hypothesis, they are considered intrinsically credible if the effect sizes supported by their AL are in the opposite direction from those supported by the study hypothesis. The non-significant finding in Ghana lacked intrinsic credibility, meaning that they required further supporting evidence to strengthen their claim of a null effect. On the basis of their central estimate, which is below one, we concluded that the measures of effect modification from all 16 countries provide some support for the study hypothesis." (Ozodiegwu et al., 2020). See Table 2.5 for Ghana-related numbers.

Household wealth is a strong predictor of women's OW/OB and affects the relationship between OW/OB and parity and residence. Women's educational attainment and control over food spending were suggested as mediators. Less consistent results between OW/OB and household wealth were found for men.

Food security. Studies in different regions of the world have reported inconsistent results in the association between food security and OW/OB in adults, with women being more affected than men. A review included 125 studies conducted before 2015 reporting on the association between OW/OB risk and food insecurity by the country's economic development level (Nettle et al., 2017). They found no association between food insecurity and OW/OB in low and middle-income countries (log OR=0.01; 95% CI: -0.11, 0.12), and a positive association in high-income countries (log OR=0.26; 95% CI: 0.19, 0.33). Since they reported on log odds ratio instead of an odds ratio, a log odds ratio of <1 indicates a positive association. Another review included 31 studies done between 2011 and 2017 that found similar results (Moradi et al., 2019). They did not find an association between the least developed and developing countries. Only in the developed countries was there a positive association between the risk of OB and food insecurity (OR=1.14; 95% CI: 1.05, 1.23). Other studies focused on one low or middle-income country showed that the relationship differed by context (supporting data for the individual countries are provided in Table 2.5). A study in Kenya found that food insecurity was negatively associated with OW/OB in women (Keino et al., 2014). A study in Vietnam on men and women found no association between OW/OB and food insecurity (Vuong et al., 2015). Another study in Brazil found a positive relationship between OB and only with mild food insecurity (the reference group was food-secure individuals) (Velásquez-Melendez et al., 2011). A review of studies from LMIC made sense of the conflicting results by reporting that the relationship between food

insecurity and OW/OB in adults depended on five factors (Farrell et al., 2018). These factors included affordability of energy-dense food, the quantity and quality of food consumed, physical accessibility of foods, cultural preferences for certain obesogenic foods and cultural norms on intra-household allocation, and physical activity levels.

Globally women had a higher prevalence of food insecurity than men and might have responded differently when exposed to food insecurity (were more affected), and the relationship if existed, might be nonlinear. In 2020, the world prevalence of moderate or severe food insecurity in adults (15+ years old) was 31.0% in women and 28.1% in men (FAO, 2020). Similarly, in Western Africa women had a higher prevalence of food insecurity than men 70.0% versus 66.6% respectively. Moreover, a review that included 42 studies from both developing and developed countries reported that female-headed households were 75% at a higher risk of being food insecure compared to male-headed households (OR= 1.75; 95% CI: 1.55, 1.98) (Jung et al., 2017). Moreover, Nettle et al. (2017) in the review mentioned earlier, reported that the 41 studies (of all 125) which included information on men, showed no association between food insecurity and OW/OB in men (log OR=0.03; 95% CI: -0.05, 0.10). However, food insecurity was associated with a higher odd of women's OW/OB (log OR=0.32; 95% CI: 0.22, 0.42). In a representative sample of women and men in the US (data from 1994-1996), there was no association between food insecurity and OW/OB in men (Townsend et al., 2001). However, for women, compared to women who were food secure, those who were mildly food insecure were at a higher risk of OW/OB (OR=1.3; 95% CI: 1.08, 1.52), no association existed for the moderately insecure (OR=1.5; 95% CI: 0.90, 2.61), and a reduced risk manifested for the severely food insecure (OR=0.39; 95% CI: 0.05, 2.83). In a nationally representative study in Brazil with data on men, compared to being food secure, being moderately or severely food

insecure was protective of men's OW and OB risk (Domingos et al., 2022). Compared to being food secure, the risk of being OW was lower for those experiencing moderate and severe food insecurity (mild: OR= 0.90 [95% CI: 0.7, 1.03]; moderate: OR=0.75 [95% CI: 0.61,0.92]; severe: OR=0.58 [95% CI: 0.45, 0.75]). Similarly, compared to the men who were food secure, the risk for OB was lower with increased food insecurity (mild: OR=0·87 [95% CI: 0·73, 1·05]; moderate: OR=0·75 [95% CI: 0·58,0·99], and severe: OR=0·61 [95% CI: 0·43,0·87]).

While multiple researchers have discussed the relationship between food insecurity and OW/OB, none have explained the sex difference. Brown et al. (2019) believed that irregular eating patterns were to blame for the positive association between food insecurity and OW/OB. Access to food is not stable in food insecure populations; hence there are cycles of irregular eating patterns of food depravation and overconsumption when food is available. The insurance hypothesis by Nettle et al. (2017) built on this idea. They hypnotized that when people are exposed to food insecurity, they increase their dietary intake when food is available to store fat that would act as a buffer when access to food is not secure. They mentioned that storing fat might even be disadvantageous for men because, historically speaking, it might have hindered them from taking part in violent actions that require a good range of motion. They acknowledged that in modern times, men's OW/OB rates have been increasing in the same way as women. Thus, the food security and OW/OB relationship might have been affected by environmental factors. Further, Nettle et al. (2017) explained the non-significant relationship in LMIC by hypothesizing that the cycle duration of access to might not have been long enough to be able to store fat. Moreover, food might not be as energy-dense as food in high-income countries. Biological factors have also been referenced by Power and Schulkin (2008) to explain that women are at a higher risk of storing fat because of genetic adaptation. Throughout history,

people have been exposed to food insecurity. Since fat is essential for leptin secretion in women, which is vital for fertility (to start menarche and sustain pregnancy). It could be that through evolution, women benefited from the ability to store fat. However, low-fat levels in men do not affect fertility. Martin and Lippert (2012) provided evidence that moves away from genetics or biological factors to behavioral ones (compromising diet quality to feed children) to explain the sex response difference in OW/OB risk when exposed to food insecurity. A nationally representative sample in the United States (data from 1999–2003, n=8151) showed no association between food insecurity and OW/OB in women who do not live with children and in men. However, for women who live with children, the association with weight category was positive (β=1.106 (SD=0.40), $P < 0.01$). The positive association was not related to pregnancy-related weight gain because the association stayed positive (β= 2.357 (SD=1.07) $P < 0.05$) when the analysis focused only on women who lived with children to whom they did not give birth. The authors suggested that women compromise their diet quality to feed children even if they did not biologically give birth to them. They suggested that women do so because of the gender expectation of women being responsible for feeding the children.

In conclusion, evidence on the association between food insecurity and OW/OB in LMIC presented in the meta-analysis showed no association. Individual studies showed mixed results that depended on the context. However, no meta-analysis exists to separate the association in those countries by sex. Globally, women had a higher prevalence of moderate and severe food insecurity by 3% than men, and they seemed to be at a higher risk of OW/OB when exposed to food insecurity. The most common explanation for the association is that people who are food insecure might compromise the quality of food and overeat when food is accessible. This may stimulate storage of fat and put them at a higher risk of OW/OB.

Gender equality. Researchers have looked at the relationship between gender equality and OB to explain the sex differences across 192 countries (Garawi et al., 2014). They used three measures for gender inequality: The World Bank's Gender Inequality Index (GII), Global Gender Gap (GGG), and the 2009 Organization for Economic Co-operation and Development (OECD) Social Institutions and Gender Index (SIGI). They found a positive association when using the GII index, a negative one using the GGG, and no statistically significant association using the SIGI index (Table 2.5). The association between OB and gender inequity was different using different measures. It is worth noting that none of these measures were designed to measure equity in a rural context.

Cultural perceptions

Body size preference. Researchers suggested that there was a preference for a large body size in Ghana. That preference may be associated with socioeconomic (wealth, marriage) and health outcomes as well as perceived preferences of family members. In addition, there may be a distortion of the perception of one's own body size in many cultures that contributes to OW/OB. The next section focuses on studies conducted in Ghana, unless otherwise specified.

Appiah et al. (2014) examined the association between preferred body size and being OW/OB among 394 women in urban Kumasi in central Ghana using a tool with silhouettes reflecting a thin to obese individual (numbered from 1 to 6), corresponding to a BMI of 20, 24, 28, 30, 34, and 38 kg/m^2. They found for every one-unit silhouette increase for preferred body size, there was a 5-fold increase in the odds of being OW/OB (OR=5.2; 95% CI: 1.2, 23.4). Almost all (96%) of the women identified an overweight figure as their preferred body size. The majority (80%) of participants chose an overweight silhouette when asked to choose a socially valued figure. Another study on urban and rural adults in the Ashanti region in Ghana reported on the

preference for an OW body size (Agyapong et al., 2020). Forty-three percent of women chose an OW figure as ideal for themselves and only 4% chose an obese one. Same pattern was shown for men where 48% preferred an OW size for themselves and 2% preferred an obese one. Researchers assessed body image in 305 adult women visiting a clinic in Accra showed that a quarter of women (26%) chose an OW/OB body image as ideal for a woman (Duda et al., 2007). In another Accra study that was carried out in a non-medical environment, the authors recruited 123 men and 62 women from bus stops and markets and asked them to select their ideal body image (IBI) (Jumah & Duda, 2007). When asked about an IBI for women, almost double the percentage of women versus men (29% vs 16%, respectively) chose an OW/OB figure. Seventy percent of men identified figures that corresponded to normal weight as IBI for women. When asked about an IBI for men, double the percentage of women versus men (19% vs 10%) chose an OW/OB figure. Another study that was representative of all women in Accra (N=2814) showed that almost a third (31%) of women chose an IBI as OW and more than a quarter (27%) chose an OB figure as an IBI for a woman (Benkeser et al., 2012). Another study that focused on 370 adolescents 11 to 18 y old living in Accra, reported that a quarter (28%) of them chose an OW/OB as IBI and the majority (68%) said that an OW/OB figure was Ghanaians' IBI (Amenyah & Michels, 2016). However, almost two thirds (64%) of adolescents indicated a normal weight as IBI for themselves. In the Appiah et al. (2016) study the majority (71%) reported an OW figure as physically attractive and as their preferred figure (96%); however, 331 of the 394 participants (84%) chose a normal weight body figure as healthy.

Preference for an OW/OB as IBI differed between studies and by sex, and ranged from 10% to 96% of the studied population. More people personally preferred an OW/OB figure as IBI for a woman versus for a man and more women than men identified OW/OB as the IBI figure. In the

two Ghanaian studies that reported on the body image that was most valued by the culture, the majority of people chose the OW/OB figure.

Predictors of IBI choice. Age, education, income, urban residence in childhood, and BMI were associated with the choice of IBI, satisfaction with weight, and the identification of socially valued body image. Appiah et al. (2016) used a tool with silhouettes reflecting normal weight to obese individual (numbered from 1 to 6), silhouettes numbers 1 and 2 corresponding to a normal weight BMI, 3 and 4 to OW; 5 and 6 to an OB. Ghanaian women who participated in the Appiah et al. (2016) study who were younger than 40 y preferred a smaller body size compared with the ones over 40 y of age (a size of 2.2±1.0 [means ± SD] vs 3.3±1.4 respectively, P<0.001). Those who were younger than 40 y vs older associated a smaller body size with wealth (sizes of 4.2±1.8 and 4.9±1.6 [means ± SD] respectively P=0.002). In a sample of 305 women visiting the health clinic, a higher percentage of women 19 to 50 y old (85%) were willing to change their body size compared with women over 50 y old (15%) if they were told their body size was associated with health risks of hypertension (p = 0.02), stroke (p = 0.01), diabetes (p = 0.01), and myocardial infarction (p = 0.02) (Duda et al., 2006). The IBI was negatively associated with education and income (Duda et al., 2007). On a scale from 1 to 12 featuring thin to obese BMIs, there was a higher likelihood of choosing body sizes from 1 to 6 in women with the highest education and income levels compared to lower levels [(OR)=1.3; 95%(CI): (1.1, 1.5) and OR=1.4; 95% CI: 1.1, 1.6, respectively]. Controlling for BMI, compared to women who spent their childhood (first 12 y of life) in rural places, the ones who spent it in urban places were less likely to desire to gain weight OR=0.7 (95% CI: 0.5,0.9) (Benkeser et al., 2012). The desire to gain weight was measured based on having an ideal body image (IBI) bigger than current body image (CBI). Controlling for BMI, wealth, age, education

and current marital status were not associated with having an IBI smaller or bigger than the CBI (reflected body image satisfaction) P> 0.05 (Benkeser et al., 2012). The IBI was not associated with actual BMI P>0.05, however, it was associated with self-reported BMI (Amenyah & Michels, 2013). Compared to the adolescents who identified normal weight as IBI, those who chose an OW/OB IBI were almost four times more likely to report being OW/OB [OR=4.5 (95% CI: 2.4 to 8.5)]. People with high education level chose a smaller body size as socially valued and preferred IBI than the ones with low education level (sizes of 3.0±1.8 versus 3.5±1.8 [means ± SD] respectively P=0.03) (Appiah et al., 2016). Participants who participated in twelve focus group discussions (FGD) in three urban poor communities in Accra chose a bigger IBI that was accepted by the society for women versus men (Dake, 2014). The study used a tool with nine silhouettes reflecting a thin to obese individual (numbered from 1 to 9). Number 1 corresponding to an underweight BMI, 2, 3 and 4 to normal weight BMI, 5 & 6 to OW BMI, 7 to 9 reflected OB BMIs. People chose an average of a size 6 for young women vs 4.8 for young men; and chose an average of a size 8 for older women vs 6.8 for older men.

In summary, IBI was associated with diverse demographic characteristics. Younger people chose a thinner IBI and were more willing to change their body image for health purposes compared to older individuals. In Accra, current BMI was the only factor that predicted dissatisfaction, defined as having an IBI different than the CBI. However, in the rest of Ghana, body satisfaction was associated with age, education, income, urban residence in childhood, and current BMI.

Ideal body image and stigmatization. Thinness was not a desired characteristic in the Ghanaian culture. It was seen as a sign of malnourishment in 11 out of 36 women residing both in northern (Tamale) and southern Ghana (Accra) and 34 of the women described an IBI for a Ghanaian woman as not too skinny but not too fat (Tuoyire et al., 2018 a). A woman described

the ideal Ghanaian body image as “One should be fat, but not overweight, and not too skinny. Because if you are too skinny, it means you kind of lack nutrients and stuffs like that. (26 years, normal weight; BMI = 22.7 kg/m^2, Tamale)”. Thin women were stigmatized and called names like sticks and often times women wanted to gain weight to avoid being called such names (Aryeetey, 2016). Both underweight and OW/OB adolescents were made fun of by their peers compared to normal weight adolescents (Amenyah & Michels, 2016). Another published quote implies the preference for overweight “The ideal size for a Ghanaian woman should not be as slim as a white person oooh, but it should be normal. (41 years, overweight, Accra)” (Tuoyire et al., 2018 a). Also, 27 out of 36 women in one study emphasized that on top of being not too skinny and not too fat the women need to be voluptuous “you see a little breast, a little buttock, hips and then you are okay. Not too slim without any shape and then not too big without shape.” (33 years, overweight; BMI = 28.6 kg/m^2, Accra). Yet 9 out of 36 women emphasized that even obese figures were admired if the weight was proportional and the belly was flat “An African woman or Ghanaian woman should have enough flesh, but even that is defined by body contours. It doesn’t mean it should be out of shape oo. You can be big, but not out of shape. That’s where the limit is. Out of shape means you can’t see the difference between upper body and a lower body; like you’re straight, just being fat, round and all. You see, some people can be fat, but then you have all the contours at the right places, and they look nice. (44 years, obese; BMI = 33.7 kg/m^2, Accra)”. Participants in the Dake (2014) study reported that people associated being thin with sickness and life stressors “when you are slim people think that you are sick or thinking too much.”.

Obesity is often stigmatized and seen as a sign of laziness. In-depth interviews with obese women in the Arday et al. (2020) study showed that obese women reported being called

derogatory names by the normal weight women, being stared at in the streets, and being blamed for being lazy and sleeping too much. A normal weight 38-y-old woman said “we call such people obolo or bosa (a big marine fish), such people have different names, others also describe them as obigi and when they call them such names we see that they are not happy and it bothers them”. These abuses resulted in the withdrawal of OB women from social gatherings and made them feel embarrassed, anger, and self-pity. Another qualitative study conducted in the Dome - a peri-urban area close to Accra- with 42 overweight and obese women confirmed that some weight gain was desirable; a lot of weight gain was stigmatized (Aryeetey, 2016). The author used the term overweight for both OW and OB women. Eight out of the 10 women who participated in the in-depth interviews reported being called names like okesie (“big person”) and maame agbo (“big woman”) which made them feel uncomfortable. Women also said that OW individuals are handicapped, slow, tire quickly, and not able to perform daily life activities. Most of the 32 OW women who participated in the FGD said that gaining weight in a proportional manner was admirable and made the person look presentable. A similar view point was seen among the viewpoints of Makole market women (n=62) in Accra “fat women are just big and don’t really have strength. They are slow as compared to slimmer women. Women who are not fat are more active, smarter and could do the same work faster than fat people” (46-year old woman) (Wrigley-Asante et al., 2017). So, while thinness was not acceptable because it represented malnourishment and it was a departure from their culture norms, being obese was also not accepted if it meant not being able to be physically active. Women added that an IBI should be voluptuous and seemed receptive to accepting obesity in a woman if her weight was proportionally distributed. Only in one study which happened in South Africa did people perceive having OB as an advantage because it offered protection against the cold and being sick

as captured by the following quote: “We know that fat people have no problem with winter you know, they can go outside and not shiver or whatever, and they don’t get sick” (Men 26–35 years) (Bosire et al., 2020)

Underestimating body size. Not correctly measuring OW and underestimation of body size was a problem evident in many studies in the Ghanaian context. Most (99%) of the women who participated in the study conducted in Kumasi pointed to an obese [a mean size of 5.2 ± 1.2 (SD), a size 5 was associated with a BMI of 34 kg/m^2] figure when asked to point an overweight one (Appiah et al., 2014). In the Arday et al. (2020) study, 10% of the women who perceived themselves as normal weight were overweight according to their measured BMI and more than half (56%) of the women who perceived themselves as overweight were obese. A study was done in three urban poor communities in Accra on 917 adults and reported that 61% of women and 39% of men underestimated their body weight (Christian & Frempong, 2020). Out of the 61% women who underestimated their body size 31% were OW and 60% were OB. Similarly, two-thirds (65%) of the OW/OB adolescents thought their weight was normal (Amenyah & Michels, 2016). A study in Tamale included 121 men and 65 women and showed that almost all (89%) of OW/OB people had a distortion of body image (the perceived weight category did not match with the measured waist-to-hip ratio) (Mogre et al., 2013). People who perceived a community’s IBI as overweight had a tendency to underestimate their body size (*b*= -0.4 SE=0.3 P=0.08). Compared to the non-educated, people who had primary education or secondary or higher education were less likely to underestimate their body size (*b*= -0.1 SE=0.5 and *b*= -1 SE=0.5, respectively). Compared to people who are aware that OW/OB has health risks, people who were not aware of OW/OB health risks had a four times higher likelihood of having a distorted body image [OR= 3.7 (95% CI: 1.3,11)]. In summary, almost all OW/OB

people in the Ghanaian studies underestimated their body size. There was some evidence that education and knowledge of health risks influenced this underestimation.

Body size as status. Body size represents a status of wealth, happiness, and stress-free life in Ghana. Both men and women identified an OW figure as the most suitable for a wealthy person (Agyapong et al., 2020). When participants were asked to identify a suitable body figure for a wealthy woman, 73% of women and 78% of men chose an OW/OB size. Same pattern was found when asked to identify a suitable body figure for a wealth man, 84% of women and 89% of men chose an OW/OB size. The association between an OW/OB body size and perception of wealth seems bigger in rural versus urban places. On a scale of sizes from 1 to 9 where 1 is underweight, 2, 3 and 4 are normal weight, 5 and 6 overweight, 7 to 9 are obese both rural and urban residents expected an OW for a wealthy woman, however, rural residents chose one size bigger [chose a size 6(2) median (Interquartile range)] compared to urban residents [chose a size 5(2) median (Interquartile range); $P<0.001$]. Same trend was observed for a wealthy man, both rural and urban residents chose an OW figure, however; rural residents chose a one size bigger body size vs urban ones [6(3) vs 6(2) median (interquartile range) respectively; $p <0.001$]. Moreover, 65% of the women from a Kumasi study chose an obese silhouette when asked about a figure that was ideal for an affluent person (Appiah et al., 2016). In the Aryeetey (2016) study, women said that it is expected that women would gain weight after marriage because it represented financial support and stability from the husband. Some weight gain at any stage in life was considered desirable because it was a symbol for good living. Eighty-four percent of the women from the Kumasi study chose an obese figure as a symbol for a person perceived to eat well (Appiah et al., 2014). However, a qualitative study on 62 women in the Makole market in Accra challenged the association of wealth with fatness “Fatness is not caused by good living. .

.it's not about wealth and beauty. If money makes people fat and beautiful then some of our leaders' wives will be as big as houses. It is true that having a sound mind makes one look nice and good, but there are rich people who are slim and there are poor people who are fat (41-year old woman)" (Wrigley-Asante et al., 2017). Women in the Dake (2014) study associated being happy and having peace of mind with weight gain: "when you get married to a good man you will get your peace of mind and therefore you will put on weight." and "when your job enables you to see money always, you can also put on weight because you are always happy". (Dake, 2014). In summary, an OW/OB figure may be considered to reflect wealth and good living and being taken care of. However, this concept was challenged by one study, suggesting that economic change in the country meant that one's size and wealth were not related (Wrigley-Asante et al., 2017).

Social pressure. Social expectations and family and spousal pressure affect Ghanaian women's decision to change their body size. Weight gain was particularly expected after marriage and childbirth (Aryeetey, 2016). Married women preferred a bigger body size than single women [on a scale of body sizes from 1 to 6, people chose a size of 3.1±1.3 (means ± SD) vs 2.7±1.3 respectively, P=0.002] (Appiah et al., 2016). The majority of men (60%) and women (58%) pointed to an OW or OB figure as the ideal for a woman who had children and no longer reproducing versus a normal weight figure as ideal for a woman who does not have children (73% of men and 63% of men) (Agyapong et al., 2020). All the 42 women in the Aryeetey (2016) study reported that it was expected that a woman gain weight after delivery to look good in clothes usually worn after delivery and to be able to breastfeed the baby. Women felt obligated to eat energy-dense food so they would gain weight and be able to breastfeed. Most of the women participated in the in-depth interviews reported that their overweight only started

after delivery. Duda et al. (2006) reported that 73% of the 299 women from Accra said that they were willing to change their body size if asked by their spouse. Of these, 63% chose a figure that was two sizes smaller than her size and 8% chose a bigger size as her perceived spouse's preference. However, men in another study in Accra tended to overestimate the body size that women wanted for themselves P=0.05 (Jumah & Duda, 2007). Most men (70%) identified figures that corresponded to normal weight as ideal for women; only 16% identified an overweight or obese figure as ideal. However, when they were asked about women's preference, less than half of the men (45%) thought women wanted a normal body size and 42% said that women would like an OW/OB figure. In fact, more than half (57%) of the women chose the normal weight figure as ideal and only 29% chose an OW/OB figure. Eight out of 10 women in the Aryeety (2016) study reported that they were motivated to initiate weight loss by their spouse's comments that they gained too much weight. Others said that women sometimes actively induced weight gain to meet their spouse's preference and it was a common perception that spouses did not like a thin partner. One woman mentioned that her husband threatened to divorce her if she did not gain weight. One woman in the Tuoyire et al. (2018 a) study 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. So being overweight or slim does not mean that your husband will not enjoy you. (33 years, obese; BMI = 35.5 kg/m^2, Tamale)". Adolescent girls who believed that males preferred females with heavy bodies compared to the ones who did not were two times more likely to choose overweight as ideal (OR=1.6; 95% CI: 1.1, 2.5) (Amenyah & Michels, 2016).

Family and friends acted as an added pressure on women to gain weight. Women were encouraged by their mothers to gain weight after childbirth so they looked good and were able to

breastfeed the newborn. “Our mothers told us that when you give birth to a baby, for the first three months, you need to eat good food so that both you and the child will gain” (Aryeetey, 2016). Twenty-six out of 36 women living in Tamale and Accra said they felt pressured to gain weight by people in their immediate social environment. “My auntie has been asking me ‘why, don’t your parents give you food to eat? Come to my house to eat.’ She says as a woman I should eat and put on some flesh to look good. Every time she sees me she says the same thing. (20 years, normal weight; BMI = 22.6 kg/m^2 Tamale)” (Tuoyire et al., 2018 a). Another woman reported being teased by her friends to gain weight “When I was in secondary school, I was very slim and my friends used to make fun of me and all that. So there was this ice kenkey I was told when you take it, it makes you put on weight. So in the morning I would go and buy it just to put on weight. It was when I completed school that my weight started changing and now they don’t worry me. (31 years, obese; BMI = 36.5 kg/m^2, Accra)”. A third (34%) of the women in the study were advised to gain weight as adults (Duda et al., 2007).

Most of the studies reported that women experience societal expectations and pressure to gain weight especially after important life events like marriage and childbirth. This may be also self-induced. The spouse’s preference of body size also seemed to have an important role in the women’s willingness to change her body size, however, this preference may be misinterpreted. The evidence suggested there may be internal and external forces on the pressure for women to gain weight.

Satisfaction with weight. Satisfaction with weight status and desire to lose and gain weight differed among Ghanaian women. Based on a study on 266 adult women vendors in the Kaneshie Market, a suburb of Accra, 60% of the women who identified themselves as normal weight wanted to gain weight, most of the OW women (59%) wanted to maintain their weight,

and most (73%) of the obese wanted to lose weight (Arday et al., 2020). A study that measured satisfaction with body weight (by subtracting the IBI and CBI sizes) showed that underweight and normal weight participants had a bigger IBI than their CBI [of −1.0±1.1, and −0.33±1.2 (means ±SD) sizes], while OW and OB women had a smaller IBI than their CBI [of 0.7±1.3 and 2.0±1.4 sizes (means ±SD)] (Agyapong et al., 2020). Overweight and OB women were two and four times more likely to be dissatisfied with their body weight compared with normal weight women (OR=1.5; 95% CI:1.3,1.9 and OR=4.1; 95% CI: 2.7, 6.2, respectively) (Duda et al., 2006). Nearly three quarters (72%) of all women in the representative sample of women in Accra were dissatisfied with their CBI, 57% of normal weight women wanted to be heavier. Out of the women who were not satisfied, 42% preferred a slimmer image and 30% preferred heavier. The majority (60%) of the women who were satisfied with their CBI were OW or OB (Benkeser et al., 2012). In summary, results about satisfaction with current weight were mixed. There was a preference to gain weight among the majority of normal weight women. However, while some studies reported that OW/OB women wanted to maintain their weight, others reported that they were dissatisfied with their weight status.

Health considerations. Health considerations were one of the drivers for the choice of an IBI. However, there was a discrepancy between healthy figures and preferred body figures. According to Arday et al. (2020), drivers of weight preference in vendor women in Accra were health considerations (34%), followed by societal acceptance (28%), self-satisfaction and confidence (26%), and then meeting media's ideal weight discrepancy (11%). Adolescent boys who believed that thin bodies resemble health and OW/OB bodies resembles sickness, compared to the ones who did not think this, were less likely to choose OW as an ideal body weight (OR=0.7; 95% CI: 0.5,0.9) (Amenyah & Michels, 2016). Another study documented that

compared to non-OB women, OB women were two times more likely to be willing to change their body size to improve health (OR= 2.0; 95% CI: 1.6 to 2.4) (Duda et al., 2006). In the Appiah et al. (2014) study, 84% of people identified a normal weight figure as healthy, however, 96% chose an OW IBI. This was different in adolescents; the majority chose a normal weight figure as ideal (64%) and healthy (61%) (Amenyah & Michels, 2016). In a representative study of women in Accra, a higher percentage of people (58%) chose a normal weight figure as healthy versus choosing it as ideal (42%) (Benkeser et al., 2012). When asked about unhealthiest body image, 41% chose the thinnest figure (BMI of 20.1 kg/m^2) versus 57% who chose the heaviest figure (BMI 43.7 kg/m^2). Men were asked about the unhealthiest body image for each sex; 9% of men chose underweight, 88% OW/OB (Agyapong et al., 2020). When women were asked about unhealthiest for each sex 11% chose underweight, 2% chose the figure that corresponded to a BMI of 34.3 kg/m^2, and the majority (84%) chose a figure that corresponded to a BMI of 38.6 kg/m^2 and bigger. The women who were OW/OB associated a smaller body size with health than the ones who had normal weight [a size of 2.0±1.3 (means ± SD) vs 2.5±1.6 respectively, P=0.006] (Appiah et al., 2016). However, they still chose a preferred body size that was significantly bigger than the choice of the people who had normal weight [a size of 3.1±1.3 (means ± SD) vs 2.5±1.6, P=0.001].

So, about half of people chose a normal weight figure as healthy but a healthy body image was not the same as an ideal body image in most studies. A body figure that was most suitable for a person who ate well, was socially valued, was wealthy, or was physically attractive was larger than the figure associated with being healthy. Only adolescents chose normal weight figures as healthy and ideal.

Health awareness. Ghanaians' awareness about the effects of OW/OB on health varied among studies; in some cases, the awareness did not translate into better outcomes. Almost all (95%) of women visiting a health clinic in Accra said that they are aware of the health risks associated with OB and 86% of the OW/OB women said they are willing to reduce their weight if it meant a healthier life (Duda et al., 2007). Out of 400 participants -a representative sample- in a hospital study (49% men and 51% women) in Cape Coast, 74% of people were aware that OB has a large effect on health (Tuoyire et al., 2018 b). Seventy-nine percent of 195 obese participants said they would change their body size if it meant an improved health, however, 4% of them chose a bigger body size as the perceived healthier body image and 17% of the obese said they would not change their size for health purposes. Out of the 103 non-obese participants, 19% chose a bigger size for a better health and 38% said they would not change their size (Duda et al., 2006). Despite the high percentage of people (91%) of urban and rural Ghanaians in the Ashanti region who perceived OB as a threat to health, 61% of rural and 55% of urban residents did nothing to lose weight (Agyapong et al., 2020). Contrary to the expectations, in a cross-sectional study, compared to the ones who thought they were not likely to develop hypertension, the ones who perceived themselves as likely to develop hypertension were two times more likely to be OW/OB after adjusting for age, sex, marital status, education status, mass media exposure, and knowledge of health risks of OW/OB (Tuoyire et al., 2018 b). Almost all women (92%) reported an awareness of the health risk associated with OW/OB and more than half (52%) said that they were willing to change their body size to lead a healthier life; 42% of the women wanted a body image smaller than their current size (Benkeser et al., 2012). In a medical clinic in the Sekondi-Takoradi area of Ghana, half of the patients (n=100) knew that OW raises blood pressure (Spencer et al., 2005).

The perception of consequences for a big body size was affected by the lived experience of people and the people around them. The following quotes from a South African study explained this (Okop et al., 2015).

"It is people who are fatter than my size that are at risk of disease—because they can have high blood pressure or heart attack. …they are eating what they are not supposed to eat." [Overweight- Woman]

"My relative who is very fat like me had serious health problems—hypertension, and arthritis." [Obese-Woman]

"I was once fat (obese), then I suffered diabetes. I don't think I will ever be fat any more. You can see an 'overweight' person walking proudly, but (you don't know) that (her) body is painful (i.e. aching). I do know it from my experience". [Overweight-Woman]

One woman out of 10 who participated in the in-depth interviews in the Tuoyire et al., (2018 a) study said that health should be the determinant for IBI, however, she failed to make the association between body size and health. "Yes, so far as they are healthy, and it doesn't have any negative health implication for the person, any size is ok. Because some people are big but are healthy. So I don't think there should be just one size or a range of sizes that all Ghanaian women should fall into but I think once the person is healthy. So there is no ideal for Ghanaian women. Every woman should choose their own ideal depending on the health implications. (29 years, overweight; BMI = 28.2 kg/m^2, Accra)". In a study on 62 women who worked in the Makola, Accra showed that women showed awareness of health risks of OW. "in the past when our mothers were in the market, they were fat and it was associated with riches but these days being fat means you are unhealthy. . . now we know that eating a lot of fatty foods, lack of

exercise and eating late at night are all factors that create diseases like diabetes, high cholesterol and others (39-year old woman)" (Wrigley-Asante et al., 2017).

The following study in rural Cameroon demonstrated rural people's point of view about the acceptability of a big body size. The differentiation between an acceptable and not acceptable weight status was the ability to be physically active, and having a proportional fat deposition. People considered fat people a burden on their community because they could not cultivate their own land or build their own house. Someone who was obese could be accepted if their excess weight was proportionally distributed. Fatness for them included obesity type 2 (BMI $\geq$35 kg/m^2 and <40) and 3 (BMI $\geq$40 kg/m^2) not type 1 (BMI $\geq$ 30 kg/m^2 and <35) (Cohen et al., 2013). In another study in South Africa, people acknowledged not knowing the normal weight (Manafe et al., 2017). "In our Zulu culture we do not know exactly which weight is correct or normal" (33-year-old male).

In conclusion, the majority of the people recognized that OW/OB had health risks, however, most of the studies documenting this awareness were quantitative and did not specify what health meant for these people and the type of risk they perceived; some misidentified the healthy body size. Among the people who had awareness of health, only a minority made the connection between a big body size and worse health outcomes and said they were willing to decrease their body size to improve health.

Perceived causes and consequences of OW/OB varied among countries (Ghana, South Africa, and Cameroon) and by setting of each study. The frequency of the attributed causes differed between urban and rural settings. Perceived causes were heredity (32% rural, 21% urban), child bearing (27% in both rural and urban places), food consumption (10% rural, 16% urban), increasing age (10% rural, 5% of urban), sedentary lifestyle (5% rural, 20% urban)

(Agyapong et al., 2020). The women blamed the obesogenic food environment of the market for being fat. “Most of the women in the market eat a lot of rich and oily foods. They buy every food that passes by. . .most also have shop attendants who do all the hard work, so they hardly get up to walk, so from morning till evening, they stay at one place and that is why most of them are fat (51-year old woman)” (Wrigley-Asante et al., 2017). Among 16 FGD in 8 urban and 8 rural communities Ashanti region Ghana, supernatural causes of OW/OB were mentioned in more than half of the FGDs (Aikins et al., 2019). “Sometimes we hear people say ‘family sickness’, but what that actually means is that a member of the family has bought that sickness for the entire family and its passed on to you if you let down your guard. So, satanic sicknesses do exist. [Rural Ghana –older than 35 Male Group]”. In addition, OW/OB was mentioned as a cause of type 2 diabetes in less than half of the FGD. “Someone can buy diabetes for you spiritually. [Urban Ghana UG -Younger than 35 Female Group YFG]”

Finally, in a qualitative study in Ghana, a woman said “For some women, being fat is normal. No matter how much they try, if fatness runs through one’s family, then you will become fat as you grow. For others, fatness triggers just after childbirth. Such women are not able to shed the weight they gain during pregnancy and maternity and as such with two or more children, the weight piles up and they become fat (43-year old woman)” (Wrigley-Asante et al., 2017).

In summary, a few studies in Ghana documented the perceived causes of OW/OB which were genetics/heredity, childbearing, increased age and supernatural reasons and only a very small minority attributed OW/OB to unhealthy food and sedentary behavior. As a result, the qualitative studies imply that people had low self-efficacy of their ability to control OW/OB.

Table 2. 1 Prevalence of overweight/obesity body mass index ≥25 kg/m^2 age standardized estimate (%; 95% CI) in adults 18+ years old, by year, sex, and the World Bank income groups[1]

	2016		
World Bank incomegroup[2]	Both sexes	Men	Women
Global	38.9 (37.5,40.3)	38.5 (36.5,40.6)	39.2 (37.3,41.1)
Low Income	25.8 (23.9,27.8)	19.1 (16.5,21.8)	32.0 (29.3,34.9)
Lower-middle income	27.0 (25.2,28.9)	23.9 (21.4,26.7)	30.0 (27.6,32.6)
Upper-middle income	43.3 (41.0,45.7)	43.5 (40.0,47.1)	42.9 (39.9,46.0)
High Income	57.6 (55.9,59.2)	63.0 (60.6,65.3)	52.0 (49.6,54.4)

[1] World Health Organization, 2017. *Global Health Observatory data repository.* Retrieved September 29, 2022, fromhttps://apps.who.int/gho/data/view.main.CTRY2430A?lang=

[2] Low-income economies are defined in 2016 as those with a Gross National Income (GNI) per capita, calculated using the World Bank Atlas method, low income of $1,045 or less; lower middle-income economies are those with aGNI per capita between $1,046 and $ 4,125; upper middle-income countries GNI $ 4,126 and $12,735; high income economies are those.

with a GNI per capita of $12,736 or more. Reference: *World Bank Country and Lending Groups, 2016.* The World Bank. https://datahelpdesk.worldbank.org/knowledgebase/articles/906519

Table 2. 2 Nutritional status of Ghanaian women; data from the 2014 Demographic and Health Survey[1]

	Underweight[2]	Normal weight[3]	Overweight or obese[4]	Total n
Age (years)				
15-19	14.4	76.9	8.7	778
20-29	5.4	58.7	36.0	1390
30-39	4.3	42.5	53.2	1197
40-49	2.7	41.1	56.2	903
Residence				
Urban	5.2	45.8	49.0	2340
Rural	7.4	63.3	29.3	1929
Region				
Western	5.1	51.8	43.1	501
Central	3.5	55.8	40.7	431
Greater Accra	4.5	38.2	57.3	877
Volta	7.2	61.6	31.1	323
Eastern	7.1	54.4	38.5	373
Ashanti	6.1	48.5	45.4	781
Brong Ahafo	6.4	59.0	34.6	349
Northern	11.2	76.4	12.4	371
Upper East	9.3	71.6	19.1	165
Upper West	7.0	72.3	20.6	98

Education				
No education	6.2	66.9	26.9	807
Primary	8.1	54.3	37.6	778
Middle JSS/JHS	5.6	51.9	42.5	1753
Secondary+	5.6	45.4	49.0	929
Wealth quintile[5]				
First[6]	10.8	76.6	12.6	708
Second	8.3	67.1	24.6	727
Third	4.7	56.4	38.9	888
Fourth	4.9	42.8	52.3	955
Fifth	3.9	35.8	60.3	991
Total	6.2	53.7	40.1	4268

Prevalence (%)

JHS: junior high school; JSS: junior secondary school

[1] Ghana Statistical Service (GSS), Ghana Health Service (GHS), and ICF International 2015. *Ghana Demographic and Health Survey 2014.* https://dhsprogram.com/pubs/pdf/FR307/FR307.pdf

[2] Underweight: Body Mass Index < 18 kg/m^2

[3] Normal weight: Body mass Index ≥18 and ≤ 24.9 kg/m^2

[4] Overweight or obese: body mass index ³25 kg/m^2

[5] Wealth was defined as household's assets data for example a television, bicycle, or car, and dwelling characteristics, such as a source of drinking water, sanitation facilities, and type of

flooring material

[6] First poorest quintile

Table 2. 3 Nutritional status of Ghanaian men; data from the 2014 Demographic and Health Survey[1]

	Underweight[2]	Normal weight[3]	Overweight or obese[4]	Total n
Age (years)				
15-19	27.2	71.0	1.7	834
20-29	5.3	84.5	10.2	1157
30-39	4.0	71.5	24.5	994
40-49	6.7	65.8	27.5	790
Residence				
Urban	9.2	68.3	22.5	1989
Rural	11.1	80.8	8.1	1786
Region				
Western	10.8	77.1	12.1	432
Central	8.9	77.2	13.9	373
Greater Accra	6.7	63.4	29.9	805
Volta	12.6	77.2	10.2	290
Eastern	15.7	77.2	7.1	359
Ashanti	8.9	73.4	17.7	657
Brong Ahafo	10.6	78.6	10.8	314
Northern	10.3	82.2	7.5	312
Upper East	15.8	76.9	7.2	144
Upper West	8.6	80.9	10.5	89

Education				
No education	8.5	80.9	10.6	357
Primary	17.8	75.7	6.5	523
Middle JSS/JHS	11.3	75.2	13.5	1587
Secondary+	6.0	70.5	23.5	1308
Wealth quintile[5]				
First[6]	13.7	82.4	3.9	631
Second	16.1	78.4	5.5	633
Third	9.5	81.6	8.9	751
Fourth	7.0	76.7	16.4	827
Fifth	6.8	57.7	35.5	933
Total	10.1	74.2	15.7	3775

Prevalence (%)

JHS: junior high school; JSS: junior secondary school

[1] Ghana Statistical Service (GSS), Ghana Health Service (GHS), and ICF International 2015. *Ghana Demographic and Health Survey 2014.* https://dhsprogram.com/pubs/pdf/FR307/FR307.pdf

[2] Underweight: Body Mass Index < 18 kg/m^2

[3] Normal weight: Body mass Index ≥18 and ≤ 24.9 kg/m^2

[4] Overweight or obese: body mass index ³25 kg/m^2

[5] Wealth was defined as household's assets data for example a television, bicycle, or car, and dwelling characteristics, such as a source of drinking water, sanitation facilities, and type of

flooring material

[6] First poorest quintile

Table 2. 4 Studies reporting on individual level predictors (age, marital status, parity, education) of overweight (OW) and obesity (OB)

Study information	Type of outcome and results
Predictor: Age	
Amoah; 2003; cross sectional; 25 years old and above men (n=1857) and women (n=2874); two urban and one rural communities in Accra Ghana	Outcome: percentage of OW and OB by age group Men: 25-34 y: 8.80% OW, 2.00% OB 35-44 y: 20.70% OW, 4.70% OB 45-54 y: 25.80% OW, 6.10% OB 55-64 y: 16.30% OW, 7.80% OB 65 y and above: 19.40% OW, 4.50% OB Women: 25-34 y: 22.60% OW, 11.10% OB 35-44 y: 31.40% OW, 22.00% OB 45-54 y: 27.30% OW, 26.00% OB 55-64 y: 26.30% OW, 32.90% OB 65 y and above: 30.2% OW, 18.70% OB
Doku & Neupane; 2015; cross sectional secondary data analysis; GDHSdata on women 19-49 years old	Results separated by urban rural dwelling. Outcome: BMI Multivariate multinomial logistic regression analysis Compared to 15-24 years old women in rural places: those who were 25-34 years old (OR)= 3.25 (95% CI: 2.46, 4.29), 35- 49 years old (OR)= 2.21 (95% CI: 1.74, 2.82)

from 1993, 1998, 2003 and 2008; Ghana	In urban areas: Those who were 25-34 years old (OR)= 3.64 (95% CI: 2.76–4.78), 35- 49 years old (OR)= 2.57 (95% CI: 2.03, 3.25)
Jiwani et al; 2020; secondary analysis of cross-sectional DHS data onwomen 15–49 years between 1993 and 2017; 35 countries in SSA	Outcome: percentage points in the change of nutritional outcome in women One percentage point (95% CI) corresponds to a 1% average increase in the prevalence of OW or OB among women each year In SSA 15-19 years old: 0.23 (0.15, 0.31) OW, 0.03 (−0.01, 0.07) OB 20-49 years old: 0.49 (0.42, 0.56) OW, 0.36 (0.30, 0.42) OB In Ghana: 15-19 y: **10.3** (7.9, 12.7) OW, 1.5 (0.5, 2.5) OB 20-49 y: **28.6** (26.7, 30.5) OW, **18.5** (16.6, 20.3) OB
Lartey et al; 2019; secondary analysis of data from the World Health Organization's (WHO) 2007/2008 (wave 1= 4158), 2014/15 (wave 2 n=	Outcome: BMI Multivariable linear regression analysis In year 2007/2008 Compared to 50-59 years' old Those who were 60-69 years old (OR)= 0.79 (95% CI: 0.61, 1.10) of having OW and (OR)= 0.67 (95% CI: 0.49, 0.91) of having OB,

1663) repeated cross sectional study on global AGEing and adult health (WHO-SAGE) on people 50+ years old men (n=682) and women (n=981); Ghana	70 +years old (OR)= 0.70 (95% CI: 0.54, 0.90) of having OW and (OR)= 0.54 (95% CI: 0.36, 0.80) of having OB In year 2014/2015 Compared to 50-59 years' old Those who were 60-69 years old (OR)= 0.77 (95% CI: 0.55, 1.09) of having OW and (OR)=0.59 (0.36, 0.97) of having OB, 70 + years old (OR)= 0.87 (95% CI: 0.57, 1.31) of having OW and (OR)= 0.34 (95% CI: 0.18, 0.62) of having OB
Nonterah et al; 2018; cross-sectional study; men (n=924) and women(n=1092) 40-60 years old; Northern Ghana where 90% of people are farmers	Outcome: log BMI Multivariable linear regression analysis the reported values are for Adjusted β-coefficients (95% CI), outcome: log BMI Men's age (years): P< 0.001 −0.003 (95% CI: −0.004, −0.001) Women's age (years): P< 0.001 −0.004 (95% CI: −0.01, −0.002)
Tuoyire et al.; 2016; cross sectional secondary data analysis; GDHS data on women 15-49 years old from 2003, 2008 and 2014; Ghana	Results separated by parity (parous vs non parous) Outcome BMI Multivariate logistic regression analysis for the odds of being OW/OB adjusted for (age, educational level, marital status, wealth quintile, occupation, type of locality, ethnicity, number of children (only parous women), and survey year) Age group: compared to 15-24 years old women

	Parous women: 25-34 years old (OR)= 2.40 (95% CI:1.92, 2.99), 35-44 years old (OR)=3.52 (95% CI:2.76, 4.51), 45+ years old (OR)= 3.31 (95% CI: 2.50, 4.38) Nulliparous women: 25-34 years old (OR)=2.03 (95% CI:1.56, 2.64), 35-44 years old (OR)=3.58 (95% CI:2.15, 5.96), 45+ years old (OR)=3.20 (95% CI:1.00, 10.22)
Tuoyire; 2020; cross sectional secondary data analysis; GDHS data on women 15-24 years old from 1993, 1998, 2003, 2008 and 2014; Ghana	Multivariate logistic regression analysis for the odds of being OW/OB adjusted for (age, educational level, marital status, wealth quintile, occupation, type of locality, ethnicity, number of children (only parous women), and survey year) Compared to 15-19 years old women Those 20-24 years old (OR)= 1.47 (95% CI: 1.19, 1.82)
Predictor: Marital status	
Doku & Neupane; 2015;	Compared to the never married In rural places the currently married were OR=0.90 (0.56, 1.46), formerly married OR= 0.91 (95% CI: 0.54,1.53) In urban places: the currently married were OR= 1.48 (95% CI: 1.04, 2.10), formerly married OR= 1.48 (95% CI: 1.00, 2.18)
Lartey et al; 2019;	Compared to being single

	the currently married/cohabiting were OR= 1.84 (95% CI: 0.69, 4.85) of being OW and OR= 0.87 (95% CI: 0.28, 2.73) of being OB, formerly married/widowed OR= 1.18 (95% CI: 0.44, 3.18) of being OW and OR= 0.95 (95% CI: 0.29, 3.08) of being OB
Nonterah et al; 2018;	For men: P=0.005 Compared to being married Single −0.06 (95% CI: −0.12, 0.003) Divorced/separated −0.03 (95% CI: −0.06, −0.01)
Tuoyire et al.; 2016;	Compared to the never married in parous women The married OR= 1.49 (95% CI: (1.11, 2.00), formerly married OR= 1.42 (95% CI: 1.04, 1.96), cohabiting OR= 1.12 (95% CI: 0.82,1.53) In nulliparous women The married OR= 1.78 (95% CI: 1.20, 2.64), formerly married OR= 2.16 (95% CI: 1.19, 3.92), cohabiting OR= 1.51 (95% CI: 0.99, 2.28)
Tuoyire; 2020; cross sectional secondary data analysis; GDHS data on women 15-24 years old from 1993,	Compared to the never married, the married OR=1.37 (95% CI: 0.97, 1.94), formerly married OR= 1.37 (95% CI: 0.83, 2.25), cohabiting OR= 0.95 (95% CI: 0.69, 1.34)

1998, 2003, 2008 and 2014; Ghana	
Predictor: Parity	
Doku & Neupane; 2015;	Compared to having one child: In rural places: compared to having one child, those who had 2 or more OR= 0.70 (95% CI: 0.58, 0.84) In urban places: compared to having one child, those who had 2 or more OR= 0.52 (95% CI: 0.44, 0.60)
Tuoyire et al.; 2016;	Compared to having one child women who have two children are OR=1.36 (95% CI: 1.12, 1.67), having three children OR= 1.11 (95% CI:0.89, 1.38), four children OR= 1.17 (95% CI: 0.93, 1.48), five children OR= 1.10 (95% CI: 0.85, 1.41), six children OR= 1.30 (95% CI: 0.99, 1.72), seven children or more OR=1.34 (95% CI: 1.03, 1.75)
Tuoyire; 2020;	Compared to not having a child, women who had one child were OR=0.90 (95% CI: 0.66, 1.22), women who had two or more children had an OR=1.46 (95% CI: 1.01, 2.11)
Kim, S. A., Yount, K. M., Ramakrishnan, U., &	Reported adjusted odds ratio for overweight in women adjusted for age, schooling, urban residence, previous short birth interval, months of

Martorell, R. (2006). Secondary analysis of cross sectional nationally representative surveys in 28 countries between 1996 and 2003 on women 15-49 years old (n=275 704)	breastfeeding during the recall period. Human development index refers to the development of the country a woman lives in. Reference category in each HDI tertile is having one child while living in the lowest household wealth tertile. **Parity number of children n=0** Human Development Index (HDI) tertile: 1 Household wealth tertile Lowest: 0.93 (0.71, 1.23) Middle: 0.99 (0.76, 1.29) High: 1.19 (0.92, 1.53) Human Development Index (HDI) tertile: 2 Household wealth tertile Lowest: **0.83 (0.69, 0.99)** Middle: 1.03 (0.88, 1.22) High: **1.40 (1.19, 1.65)** Human Development Index (HDI) tertile: 3 Household wealth tertile Lowest: **0.76 (0.67, 0.86)** Middle: **0.81 (0.71, 0.91)** High: **0.87 (0.76, 0.99)** **Parity number of children n=1** Human Development Index (HDI) tertile: 1 Household wealth tertile Lowest: 1.00 Middle: 1.04 (0.78, 1.39)

	High: **1.62 (1.25, 2.10)**
	Human Development Index (HDI) tertile: 2
	Household wealth tertile
	Lowest: 1.00
	Middle: **1.27 (1.07, 1.51)**
	High: **1.98 (1.68, 2.34)**
	Human Development Index (HDI) tertile: 3
	Household wealth tertile
	Lowest: 1.00
	Middle: **1.35 (1.19, 1.53)**
	High: **1.57 (1.38, 1.78)**
	Parity number of children n=2-3
	Human Development Index (HDI) tertile: 1
	Household wealth tertile
	Lowest: 0.86 (0.66, 1.12)
	Middle: 1.09 (0.84, 1.41)
	High: **1.94 (1.51, 2.48)**
	Human Development Index (HDI) tertile: 2
	Household wealth tertile
	Lowest: **0.73 (0.64, 0.83)**
	Middle: **1.21 (1.05, 1.40)**
	High: **2.32 (2.00, 2.70)**
	Human Development Index (HDI) tertile: 3
	Household wealth tertile
	Lowest: 1.10 (0.99, 1.23)

	Middle: **1.70 (1.52, 1.90)** High: **1.97 (1.75, 2.21)** **Parity number of children n=4 or more** Human Development Index (HDI) tertile: 1 Household wealth tertile Lowest: **0.70 (0.55, 0.91)** Middle: 1.17 (0.91, 1.49) High: **1.98 (1.54, 2.55)** Human Development Index (HDI) tertile: 2 Household wealth tertile Lowest: **0.73 (0.62, 0.87)** Middle: 1.15 (0.98, 1.35) High: **2.17 (1.86, 2.53)** Human Development Index (HDI) tertile: 3 Household wealth tertile Lowest: 1.00 (0.89, 1.12) Middle: **1.71 (1.53, 1.92)** High: **2.16 (1.87, 2.49)**
Predictor: Education	
Addo et al; 2009; cross sectional data collection conducted in 2006; civil servants men=615 and women	Outcome: OB for men and women The results reported are logistic regression-derived odds ratio (OR) for men Model 1 adjusted for age

n=400 aged 25 years old and above;Accra Ghana	Model 2 adjusted for age, level of physical activity, smoking and alcohol Model 2: Level of education: Primary: reference Secondary: OR=1.02 (0.46, 2.27) Tertiary: OR=1.26 (0.62, 2.59)
Doku & Neupane; 2015;	Compared to women with higher education In rural places: those with secondary education (OR)= 0.52 (95% CI: 0.23, 1.02), primary education (OR)= 0.44 (95% CI: 0.22, 0.88), no education (OR)= 0.22 (95% CI: 0.11, 0.44) In urban places: those with secondary education (OR)= 0.84 (95% CI: 0.58, 1.22), primary education (OR)= 0.84 (95% CI: 0.57, 1.25), no education (OR)= 0.48 (95% CI: 0.32, 0.72)
Nonterah et al; 2018;	Men: P= 0.028 Compared to no formal education Primary education 0.01 (95% CI: −0.01, 0.02) Secondary education 0.01 (95% CI: 0.01, 0.03) Tertiary education 0.07 (95% CI: 0.02, 0.12) Women: P= 0.001 Compared to no formal education Primary education 0.02 (95% CI: −0.004, 0.04) Secondary education 0.06 (95% CI: 0.02, 0.11)

	Tertiary education 0.17 (95% CI: 0.05, 0.29)
Tuoyire et al.; 2016;	Education: compared to women with no education Parous women: with primary education (OR)= 1.51 (95% CI:1.25, 1.83), Middle/JSS/JHS (OR)=1.29 (95% CI:1.09,1.53), secondary/higher (OR)= 1.46 (95% CI:1.20, 1.79) Among nulliparous women: primary (OR)=0.88 (95% CI:0.56,1.39), Middle/JSS/JHS (OR)=0.93 (95% CI:0.62,1.38), secondary/higher (OR)=1.17 (95% CI:0.76, 1.79)
Tuoyire; 2020;	Compared to women with no education Those with primary education (OR)= 1.42 (95% CI: 1.00, 2.03), Middle/JSS/JHS (OR)=1.65 (95% CI: 1.17, 2.31), secondary/higher (OR)= 2.28 (95% CI:1.47, 3.53)

Table 2.5 Studies reporting on household level predictors (household wealth, food security and gender equality) of overweight (OW) and obesity (OB)

Predictor: Household Wealth	
Abdulai; 2010; cross sectional secondary analysis of data from by the International Food Policy Research Institute (IFPRI) between January and April 1997; 559 households; Accra, Ga and Tema districts in Ghana	Dependent variables: mother OW, mother OB Reported values are bivariate estimates of whether mother has OW or OB (Coefficient), t-values errors, and P values Per capita household expenditure **0.044** (2.25) P<0.05 Per capita household expenditure squared **–0.0055** (_1.97) P<0.1 Dependent variable: OB mother Secondary school _0.31 (_2.38) P<0.05 Tertiary education _0.44 (_2.86) P<0.001 Per capita household expenditure 0.077 (2.43) P<0.05 Per capita household expenditure squared _0.02 (_1.88) P<0.1
Addo et al; 2009;	Wealth determined by the number of assets owned. The assets considered were a flush toilet, electricity, refrigerator, family car and television. The results reported are logistic regression-derived odds ratio (OR) for men Model 1 adjusted for age

	Model 2 adjusted for age, level of physical activity, smoking and alcohol Model 1: Current wealth: Two assets or fewer: ref Three assets: OR=0.96 (0.27, 3.44) Four assets OR=2.19 (0.72, 6.66) Five assets OR=3.09 (1.03, 9.29) Model 2: Current wealth: Two assets or fewer: ref Three assets: OR=0.87 (0.24–3.17) Four assets OR=1.95 (0.63–6.03) Five assets OR=2.42 (0.78–7.52)
Dake & Fuseini; 2015; secondary analysis of 2008 GDHS on women15-49 years old; Ghana	Dependent variable: Women's OW and women's OB Multinomial logistic regression analysis for every one additional houseasset ownership there was an additional OR of having overweight OR=1.15, and obesity OR=1.25 P < 0.001 (they controlled for respondent's level of physical activity and sedentary behavior sociodemographic characteristics age highest level of education, current marital status, region of residence,

	type of place of residence, parity)
Case & Menendez; 2009; cross sectional; women (n=517), men (n=389) urban African township in South Africa	Explain the sex difference in obesity prevalence between men and women Outcome: obesity in adulthood variables: Regressions are controls for age, age squared, survey year, number of household members, and a constant term The results reported are OLS regression coefficients with standard errors Dependent variable obesity in adulthood in women Model 1: Total household income per month (R1000) **0.03** (0.02) P<0.05 Model 2: Total household income per month (R1000) 0.02 (0.02), Own earnings from work per month (R1000) **0.05** (0.03) P<0.1, Model 3: Women has 'most say' on food spending **0.15 (0.07) P<0.5** Total household income per month (R1000) _0.001 (0.01) P>0.1 Own earnings from work per month (R1000) 0.01 (0.03) P>0.1 Monthly child support grant receipt (R1000) **0.44 (0.19) P<0.5** Model 4: Log (income/member) **0.05** (0.02) P<0.05 Education **0.02** (0.01) P<0.05 Depression index _0.01 (0.01) P>0.1

	Model 5: Childhood hunger index 0.07 (0.02) P<0.01 Childhood family finances were ‘‘Very comfortable’’ or ‘‘comfortable’’ 0.13 (0.11) P>0.1, ‘‘Just getting by’’ 0.02 (0.09) P>0.1, ‘‘Poor’’ _0.02 (0.09) P> 0.1, Father did not have a ‘‘regular pay job’’ 0.01 (0.05) P>0.1 In men: Model 6: Total household income per month (R1000) 0.01 (0.01) P>0.1 Model 7: Total household income per month (R1000) 0.00 (0.01) P>0.1 Own earnings from work per month (R1000) 0.02 (0.02) P>0.1 Childhood hunger index 0.01 (0.01) P>0.1 Model 8: (income/member) _0.001 (0.06) P>0.1 Education 0.01 (0.01) P>0.1
Doku & Neupane; 2015; cross sectional secondary data analysis; GDHSdata on women 19-49 years old from 1993, 1998, 2003 and 2008; Ghana	Predictors of women’s OW/OB separated by urban/ rural (wealth, education, age, parity and marital status, place of residence urban/rural, survey year) Outcome: BMI Compared to women in the fifth quintile (richest)

	In rural places: those in the fourth wealth quintile are (OR)= 0.44 (95% CI: 0.34, 0.56), third quintile (OR)= 0.38 (95% CI: 0.30, 0.49), Second quintile (OR)= 0.41 (95% CI: 0.32, 0.53), first quintile poorest (OR)= 0.26 (95% CI: 0.20, 0.34) In urban places: those in the fourth wealth quintile are (OR)= 0.58 (95% CI: 0.49, 0.70), third quintile (OR)= 0.45 (95% CI: 0.36, 0.56), second quintile (OR)= 0.44 (95% CI: 0.36, 0.55), first quintile poorest (OR)= 0.33 (95% CI: 0.25, 0.45)
Kim et al; 2006; secondary analysis of cross sectional nationally representative surveys in 28 countries between 1996 and 2003 on women 15-49 years old (n=275 704)	Relationship between parity, mother's overweight by household wealth and the country's Human Development Index (HDI) Odds ratio are reported in table 2.4 The relationship between parity and overweight depends on the household wealth and the country's human development index. In countries that fall in the second HDI tertile like Ghana, the odds of being overweight with increased number of children happens only in the second and third households' wealth tertiles. The model is adjusted for parity, age, household wealth tertile, schooling, urban residence, previous short birth interval, months of breastfeeding during the recall period and the product term: parity X household wealth tertile
Lartey et al; 2019;	Compared to women in the first quintile (poorest)

	those in the second wealth quintile are (OR)= 1.13 (95% CI: 0.64, 1.99) of being OW and OR=1.43 (95% CI: 0.43, 3.73) of being OB, third quintile (OR)= 2.00 (95% CI: 1.18, 3.40) of being OW and (OR)= 3.72 (1.98, 6.87) of having OB, forth quintile (OR)= 2.56 (95% CI:1.53, 4.28) of being OW and OR=4.26 (95% CI:2.81, 8.25) of being OB, fifth quintile richest (OR)= 3.27 (95% CI: 1.92, 5.58) of being OW and OR= 5.17 (95% CI: 3.07, 10.10) of being OB
Madise & Letamo; 2017; secondary analysis of DHS cross sectional data collected between 2006 and 2012 on women (n=208,650) from 30 Sub-Saharan African countries	Explore the relationship between urban/rural residence and women's OW/OB by household wealth Outcome: Women's OW/OB Independent variable wealth calculated as the number of assets people have. Assets were: bicycle, car, working radio, working television, telephone, piped water, refrigerator, sole use of toilet facility, types of material for flooring, walls, and roofing, and farm equipment In Ghana, DHS 2008 data was used. Ghanaian Women living in rural affluent households (9 assets or more) have higher estimated mean probability of being overweight than urban women 0.56 vs 0.46 respectively. Whereas rural women who own 8 commodities or less have lower means estimated probability of being overweight than urban (0.21 vs 0.28 respectively). That suggests household

	income as an important modifier of the relationship between urban/rural dwelling and women's overweight status. In Ghana wealth*Urban/rural OR= **0.89** (95% CI: 0.83, 0.98) of being OW The model adjusted for age, breastfeeding status, highest educational level, marital status, contraceptive use, religion, and region of residence.
Mchiza et al; 2019; secondary analysis of a cross sectional study; representative sample men=1655 and women n=3104 15-98 years old; South Africa	Predictors of OW/OB among South African men and women (Ethnicity African/not African), education, wealth, marital status, employment (employed not employed), poor mental health (no, yes) assessed by the Kessler Psychological Distress Scale Outcome: BMI Multivariate logistic regression analysis for the odds of being OW and OB adjusted for age, ethnicity, education, wealth, marital status, employment, poor mental health Wealth: Men (n=1140) Compared to men who earn low income those with no income have OR= 0.76 (95% CI: 0.47, 1.24) of being OW and OR=1.77 (95% CI: 1.00, 3.13) of being OB,

	those who earn medium/high income (OR)= 1.48 (95% CI: 0.90, 2.42) of being OW and OR=2.14 (95% CI:1.22, 3.75) of being OB
Nonterah et al; 2018;	Men: P < 0.001 Compared to men in the first quintile (poorest) Men in the second wealth quintile are −0.01 (95% CI: −0.04, 0.01), third quintile 0.02 (95% CI: −0.004, 0.05), forth quintile 0.01 (95% CI: −0.01, 0.03), fifth quintile (least poor) 0.07 (95% CI: 0.04, 0.10) Women: P < 0.001 Compared to women in the first quintile (poorest) women in the second wealth quintile are −0.01 (95% CI: −0.03, 0.02), third quintile 0.01 (95% CI: −0.01, 0.04), forth quintile 0.03 (95% CI: 0.01, 0.06), fifth quintile (least poor) 0.10 (95% CI: 0.07, 0.14)
Tuoyire et al.; 2016;	Wealth: compared to women in the first quintile (poorest) Parous women: in the second wealth quintile are (OR)= 1.50 (95% CI: 1.22, 1.85), third quintile (OR)= 2.22 (95% CI: 1.78, 2.75), forth quintile (OR)= 4.13 (95% CI: 3.24,5.26), fifth quintile (OR)= 7.64 (95% CI: 5.83, 10.02)

	Nulliparous women: second quintile (OR)= 1.12 (95% CI: 0.65, 1.94), third quintile (OR)= 2.23 (95% CI:1.34, 3.73), forth quintile (OR)= 4.48 (95% CI:2.67, 7.49), fifth quintile (OR)= 5.82 (95% CI:3.43, 9.86)
Tuoyire; 2020;	Compared to women in the first quintile (poorest) Those in the second wealth quintile were (OR)= 0.90 (95% CI: 0.61, 1.30), third quintile (OR)= 1.23 (95% CI: 0.86, 1.77), forth quintile (OR)= 1.81 (95% CI: 1.27, 2.59), fifth quintile (OR)= 2.07 (95% CI: 1.42, 3.01)
Ozodiegwu et al; 2020; DHS data from 2006 to 2016 on women, 22 Sub-Saharan African countries	In Ghana, compared to women with no or primary education, those with secondary education or more and living in the middle income households' wealth tertile OR=0.86 (95% CI:0.55, 1.35) of having OW/OB, and compared to women with no or primary education, those with secondary education or more and living in the high rich household wealth tertile OR=0.77 (0.45, 1.30) of having OW/OB
Predictor: Food security	
Keino, et al;2014; cross sectional; ;women n=648 (15-45 years old); Kenya	Household Food Insecurity access scale: HFIAS A continuous 9 item scale. The total score of a maximum of 27. The higher it is, the higher food insecure the individual

	The odds ratio for having OW/OB and being food insecure OR=0.97(95% CI: 0.94, 1.00)
Vuong et al; 2015; cross sectional 250 households; Vietnam	Latin American and Caribbean Household Food Security Scale (ELCSA), households were categorized to food secure or mildly, moderately or severely food insecure No difference in BMI categories between the food secure or mildly, moderately or severely food insecure households P= 0.40
Velásquez-Melendez et al; 2011; Women's National Demographic and Health Survey; Brazil	EBIA (Brazilian Food Insecurity Scale) Multivariable Poisson regression model for obesity with food insecurity level Compared to food secure there was a difference in obesity among groups with different food security levels P=0.01

Predictor: Gender equality

Garawi et al; 2014; cross sectional; men and women; 192 countries	Outcome: Obesity prevalence in men and women from 192 countries Covariates: per capita Gross National Income (GNI) adjusted for purchasing power parity; 2010 Gini coefficient of inequality, smoking, total fertility rate, urbanization and total energy availability Exposure variable: gender inequality measured by three measures

The 2010 UNDP Gender Inequality Index GII, Global gender gap WEF GGG Index, and 2009 OECD SIGI Social Institutions and Gender Index "(1) The 2010 UNDP GII. The GII is a composite measure reflecting 'inequality in achievements between women and men in three dimensions':34 (i) reproductive health measured by maternal mortality ratio and adolescent fertility rate; (ii) empowerment measured by male and female secondary school educational attainment, and women's level of parliamentary representation; and (iii) labor market measured by labor force participation of men and women. The GII ranges from 0 (equality) to 1 (maximum inequality). In 2010, the first year for which GII was available, 138 countries were included in the ranking. (2) The 2010 WEF GGG Index.31 The GGG examines the gap between men and women in four categories: (i) economic participation and opportunity; (ii) educational attainment; (iii) health and survival; and

(iv) political empowerment. The 2010 GGG is available for 135 countries and ranges from 0 to 1 (maximum equality). (3) The 2009 OECD SIGI.29 The SIGI measures the underlying drivers of gender inequality, capturing discriminatory social institutions, such as early marriage,

discriminatory inheritance practices, violence against women, son preference, restricted access to public space and restricted access to land and credit. The SIGI ranges from 0 to 1 (maximum inequality) and is available for 102 non-OECD countries" Garawi et al., 2014

Standardized regression coefficients (beta) (95% CI)

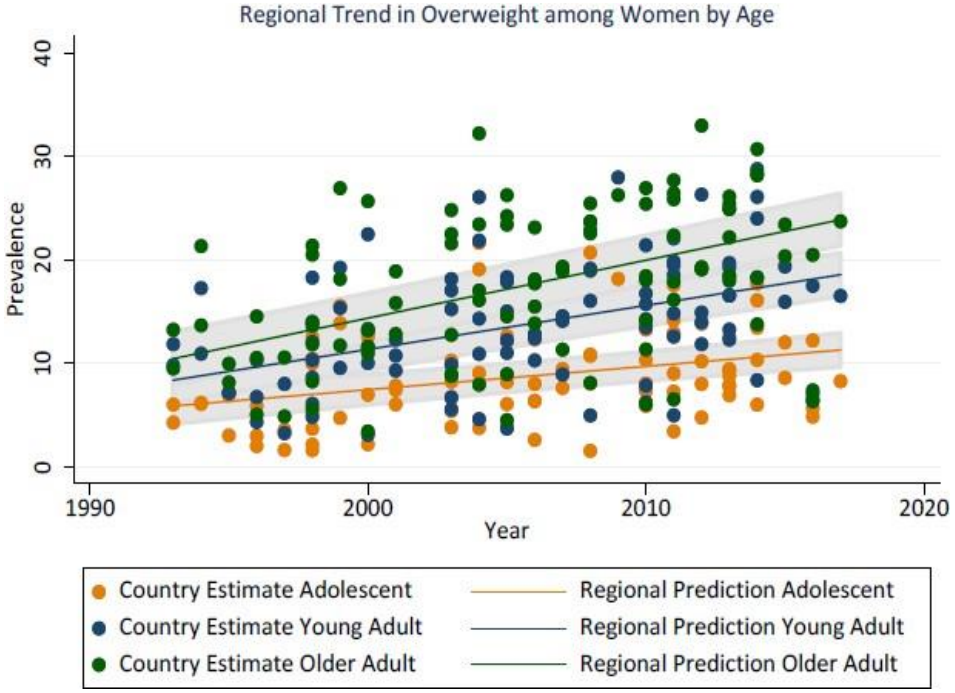
outcome: sex difference in obesity prevalence

GII: 3.83 (0.64, 7.01)

GGG: -1.66 (-2.96, -0.37)

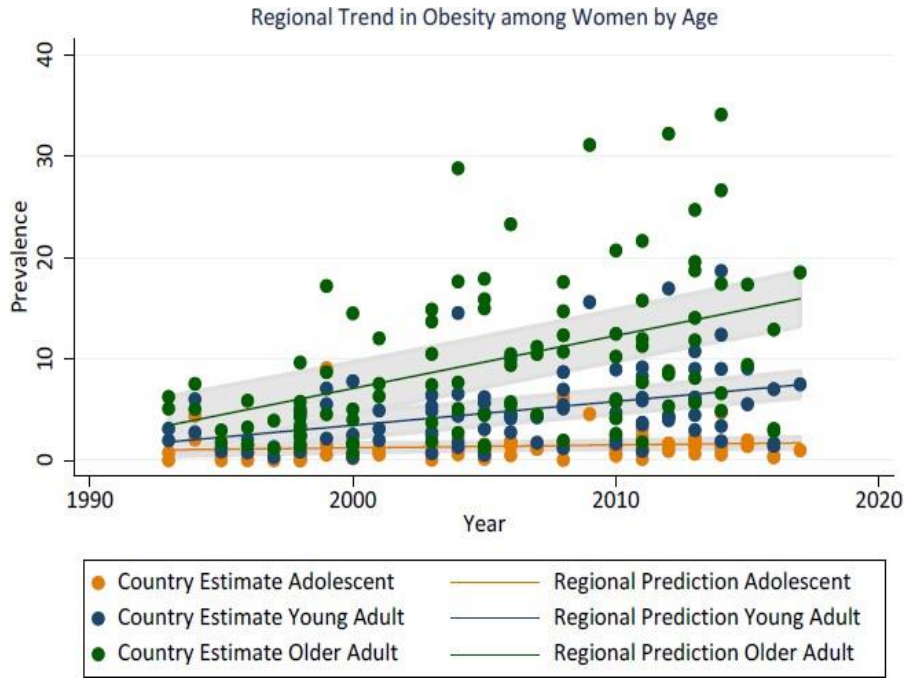
SIGI: 1.67 (0.54, 3.88)

Figure 2.1 - Regional Sub-Saharan African trend in prevalence (%) of overweight according to women's age (3 categories: 15-19 years, 20-34 years, 35-49 years)



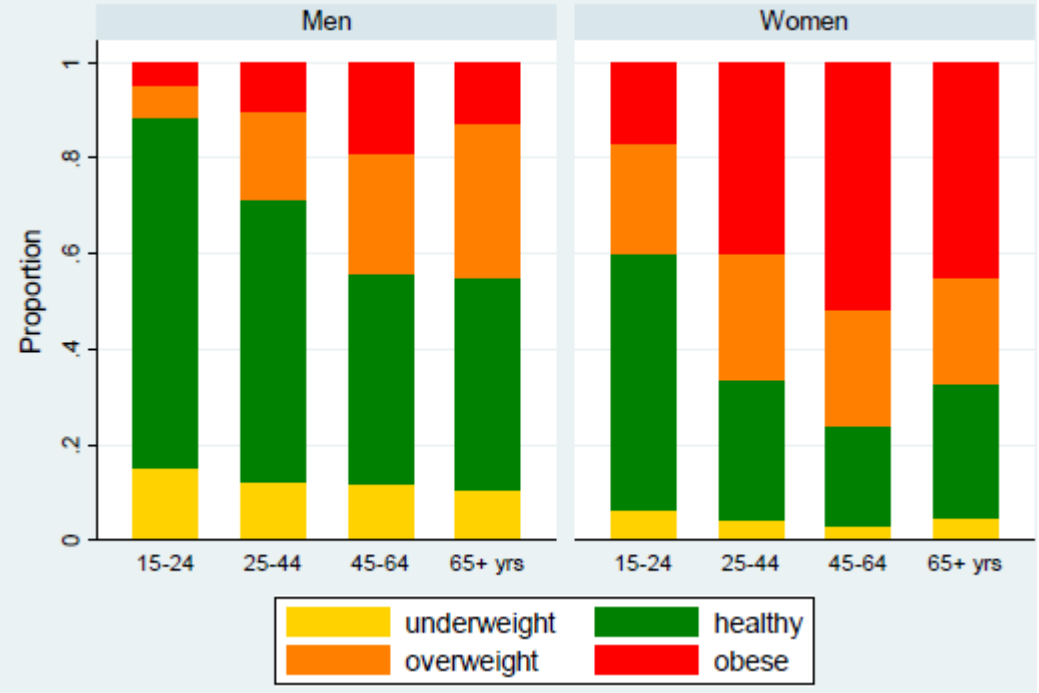
Note. From: "Trends and inequalities in the nutritional status of adolescent girls and adult women in Sub-Saharan Africa since 2000: a cross-sectional series study," by Jiwani, S. S., Gatica-Domínguez, G., Crochemore-Silva, I., Maïga, A., Walton, S., Hazel, E., Baille, B., Bose, S., Bosu, W. K., Busia, K., CA, T., Coulibaly-Zerbo, F., Faye, C. M., Kumapley, R., Mehra, V., Somda, S, M, A., Verstraeten, R., & Amouzou, A. (2020). BMJ Global Health, 5(10), e002948. http://dx.doi.org/10.1136/bmjgh-2020-002948. Copyright 2020 by CC BY 4.0

Figure 2. 2 Regional Sub-Saharan Africa trend in prevalence (%) of obesity according to women's age (3 categories: 15-19 years, 20-34 years, 35-49 years)



Note. From: "Trends and inequalities in the nutritional status of adolescent girls and adult women in Sub-Saharan Africa since 2000: a cross-sectional series study," by Jiwani, S. S., Gatica-Domínguez, G., Crochemore-Silva, I., Maïga, A., Walton, S., Hazel, E., Baille, B., Bose, S., Bosu, W. K., Busia, K., CA, T., Coulibaly-Zerbo, F., Faye, C. M., Kumapley, R., Mehra, V., Somda, S, M, A., Verstraeten, R., & Amouzou, A. (2020). BMJ Global Health, 5(10), e002948. http://dx.doi.org/10.1136/bmjgh-2020-002948. Copyright 2020 by CC BY 4.0

Figure 2. 1 Distribution of body mass index (in percentiles and kilograms per square meters) categories among representative sample of South Africans



Note. From "Social and Psychological Predictors of Body Mass Index among South Africans 15 Years and Older:SANHANES-1" by Mchiza, Z. J.-R., Parker, W.-A., Hossin, M. Z., Heshmati, A., Labadarios, D., Falkstedt, D., & Koupil, I. (2019). *International Journal of Environmental Research and Public Health*, 16(20), 3919. Retrieved from https://www.mdpi.com/1660-4601/16/20/3919. Copyright © 2019 by the authors.

CHAPTER 3

Predictors and consequences of overweight and obesity in the household: A mixed methods study in rural Ghanaian women and men farmers

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Abstract

Overweight/obesity (OW/OB) rates are increasing in Ghana. We aimed 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 member's OW/OB status, and others). Qualitative data included six focus group discussions (FGDs) (three with women and three with men, aged 22-69 y 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 in detail elsewhere [10]. Ethical approval was granted from McGill University and University of Ghana.

Quantitative study:

The quantitative study included only baseline information which 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. A.

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 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 child care). 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 cutoffs 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 GLIMIX 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:

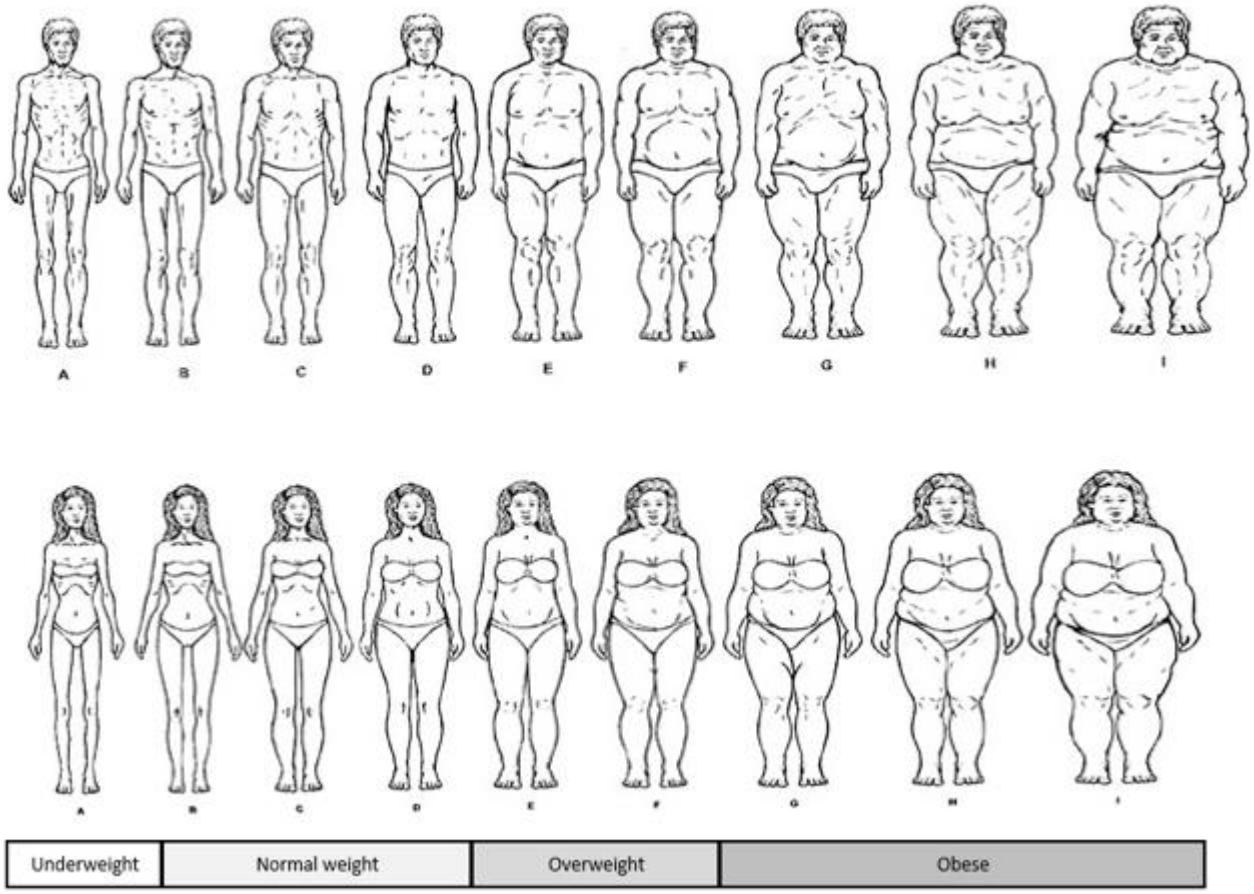
The aim of the qualitative study was to understand the local perceptions about body size, including the criteria residents used to judge a person as healthy or too big, and the perceived influence of having a big body size on people's lives (personal, relationships, work, financial, and health) and on 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. (1983) 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.

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represent those of IDRC or its Board of Governors. The qualitative part of the study was possible thanks to the Graduate Research Enhancement and Travel (GREAT) Award at McGill University.

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 child care.

[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 (e.g., hand tools), mechanized farm equipment (e.g., 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 $\geq$ 25 kg/m^2); No, both participants (woman and man) were underweight or normal weight (BMI < 25 kg/m^2).

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/m^2. Comparison group was BMI <25 kg/m^2.

[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 (e.g., hand tools), mechanized farm equipment (e.g., 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 $\geq$ 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 (e.g., hand tools), mechanized farm equipment (e.g., 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	*"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*

	dropping out of school	*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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CHAPTER 4 Discussion

This thesis built on the literature that focused on the predictors of OW and OB on the individual level. It introduced a new perspective by looking also at the predictors of OW/OB presence in the rural household as a whole and its potential consequences on the family unit. To understand who was at risk of OW and OB, the quantitative study explored: *i)* the predictors that were associated with women's OW/OB and men's OW/OB, and *ii)* the predictors of having a presence of OW/OB in the household defined as having one or both the woman and man family members as OW/OB. The predictors of OW/OB tested in the analysis of women's OW/OB, men's OW/OB, and household OW/OB presence went beyond the use of traditionally examined predictors (e.g., age, ethnicity, education, parity, wealth, food security) and looked at intra-household relationship empowerment variables (intra-household respect, and attitudes towards violence against women), individual's self-efficacy and mental health symptoms, social support as well as the nutritional status of the other family member. The qualitative study complemented this knowledge by understanding if having an OW/OB person in the household is of concern to other household members. Both studies were conducted with the same population, as part of the *LinkINg UP (LU)* nutrition-sensitive agricultural intervention in three districts of the Eastern region in Ghana. The LU project aimed to improve the livelihood of rural households by improving their socioeconomic status through an agriculture-business loans program along with nutrition and health education among other services.

One might blame Ghana's nutrition transition for our sample's high prevalence of OW/OB with over half of the households having at least one person who was OW/OB. Nutrition

transition manifests in the transition from a stage of receding famines to a stage of a high prevalence of nutrition-related non-communicable diseases. The transition was hypothesized to happen due to increased levels of sedentariness and changing diets from traditional diets to ones that are high in fats and sugars, high in animal protein, and low in fruits and vegetables (Popkin and Crawford, 2010). The study sample indeed had a high prevalence of OW/OB. However, the physical activity and dietary patterns that are driving it is unknown. First, in our study sample, women had a higher daily vigorous activity level than the recommended weekly level by the WHO (Asante, 2020). Second, information on the rural population's dietary patterns is lacking, making it hard to comment on their consumption of sugary and sweetened foods or if they are still following a traditional diet. A meta-analysis, including studies until 2018 that focused on urban Ghana and urban Kenya, reported that only 51.6% of the population consumed vegetables and fruits, and 39.9% consumed sweetened beverages (Rousham et al., 2020). Low vegetable and fruit consumption and high consumption of sugary beverages are two behavioural changes that occur in the nutrition transition, which led Rousham et al. (2020) to report that Ghana was in a nutrition transition phase. However, patterns of change of consumption might happen in different ways all over the country, and it might differ by region and rural/urban setting. A study looked at the change in dietary patterns in two regions in Ghana (northern and southern) between 2005–2006 and 2012–2013, separating their analysis by urban and rural (Ecker and Fang, 2016). They found different change patterns depending on if the area were rural or urban and depending on the region. In southern Ghana, there was no significant change in animal protein consumption in urban and rural areas. They found a 12% increase in vegetable and fruit consumption in urban areas versus a 5% increase in rural areas. In northern Ghana, animal protein consumption did not

change in urban areas, but it increased by 11% in rural areas. Vegetable and fruit consumption increased by 10% in urban places and did not change in rural ones.

The quantitative results demonstrated that both individual level factors and household level factors (first two layers in the SEM model in Figure 1.1) were associated with OW/OB in women and men. For women, individual factors associated with OW/OB were age and mental health. For men, individual level factors associated with OW/OB were age and ethnicity. However, when looking at the outcome of OW/OB presence in a household, individual level characteristics of the household residents were not associated with OW/OB presence in the household. The household level factor (household wealth) was predictive of an increased risk of OW/OB in women, OW/OB in men, and OW/OB presence in households. Women, men, and households in the wealthiest tertile were at a higher risk of having OW/OB compared to those in the poorest wealth tertile.

There is a long history of research on the link between economic status and OW/OB. An early study conducted in the US from the 1965 showed a significant difference in OB risk between different social classes however it was an inverse relationship (Goldblatt et al., 1965). Women in the lower socioeconomic status had a 30% obesity risk, versus 16% among the middle and 5% in the highest socioeconomic class ($P<0.001$). Similar results were for men; however, the difference between the highest and lowest socioeconomic class prevalence of OB was 1:2. They also reported on social mobility (moving from one social class at 8 years old to their current one). For women, the lowest prevalence of OB was among those who moved up in their social class (12%), followed by the ones who stayed in the same social class category (17%), and the ones who moved down in social class (22%) ($P<0.001$). The same trend was observed for men; however; it did not reach statistical significance. The authors argued that OB was a not an

individual problem but rather a shared problem of people from certain social groups, and thinness could be a response to societal expectations of women. Since expectations differ across cultures, it is understandable that the association was positive in the study sample mentioned in this thesis.

The Ghanaian literature supports the strong and consistent association of OW/OB and increased wealth (Tuoyire et al., 2016; Tuoyire, 2020; Lartey et al., 2019; Doku and Neupane, 2015). A nationally representative Ghanaian study that collected data on adults older than 50 years from two time periods showed that being in the fourth and fifth highest wealth quintiles (the richest) was significantly associated with a higher hazard ratio (HR) of moving from normal weight category to an OW category compared to people in the low wealth quintile [HR=1.54 (95% CI:1.02, 2.65) and HR=1.72 (95% CI:1.03, 2.87) respectively] (Lartey et al., 2020 a). To understand this association, I looked at the studies that examined how diet differed by increased wealth. Evidence suggests that a higher socioeconomic status does not always translate to a healthier diet. In urban Accra in Ghana, Codjoe et al. (2016), in their regression analysis of data from 452 households, reported that compared to households in the poorest wealth quintile, households in the richest quintile had an improved diet diversity score (score range from 0 to 9) of 0.149 ± 0.385 ($P<0.05$). Similarly, a nationally representative study in Ethiopia used data from 2367 rural households and reported a significant association between wealth and dietary diversity profile ($P<0.001$) (Rasmussen et al., 2020). The majority (45%) of households in the richest tertile consumed highly diverse diets versus 14% of households in the poorest tertile. However, a more diverse diet was higher not only in fruits and vegetables but also in oils/fats and sugars. To link diet diversity score and its association with BMI, a nationally representative Ghanaian study reported on the association by separating their analysis by different categories (quantiles) for

their outcome variable women's BMI (Amugsi et al., 2016). They concluded that diet diversity score was only significantly associated with women's BMI for those who were in the highest 90% quantiles of BMI. For women in the highest 90% quantiles of BMI, a one-unit increase in diet diversity score was significantly associated with an increase in BMI of 0.245 ± 0.116 kg/m^2 ($P<0.01$).

The qualitative results suggested that community perceptions (level 4 in the SEM model in Figure 1.1) might have contributed to the OW/OB problem. Participants took pride in having an OW/OB family member; OW/OB was only considered problematic if it impeded someone's ability to make money. Only OB sizes were perceived as problematic on one's productivity and health. If body size affected financial productivity, the household as a unit could be affected badly, causing poverty, food insecurity, discord, and risk of children dropping out of school. Similarly, in a study in Cameroon, people considered size as a problem when it prevented a person from cultivating their land, which made them be perceived as a burden to their communities (Cohen et al., 2013). While Dotse and Asumeng (2015) reported the importance of positive body image on psychological well-being, when a person does not perceive or is not aware of the negative health consequences of a health condition, the person would be less likely to change their health behavior (Schlüter et al., 2020). Thus, this thesis study population could benefit from health and nutrition education to raise awareness about the negative health consequences of having an above normal BMI regardless if it affected work productivity or not.

Poverty and the hard environment in which participants of the *LU* project lived might have contributed to i) the cultural appreciation of big body sizes and ii) size only being a concern when it affected their ability to work. The qualitative results suggest that current wealth

moderates access to food. The wealthy can afford to eat what they desire. On the contrary, a reduced financial ability led to concern over access to food.

These results give important insights about cultural aspects that need to be considered and addressed in future interventions. Aikins (2010) reported that people found it difficult to comply with health advice when it contradicted their community values and culture. For example, participants found it hard to comply with health advice to give up meat because in doing so their community members would perceive them as stingy. While, it is important to be sensitive to the cultural environment, I argue that one should not be discouraged as cultures are not stagnant, and people's opinions and perceptions might change with time, increased education, and increased financial resources. This is documented in a Ghanaian study where people stopped perceiving OB body sizes as advantageous when everyone in the community was doing better financially than the old days (Wrigley-Asante et al., 2017). "Fatness is not a sign of richness. . .you know business is no longer buoyant in the market like in the olden days". Thus, participants of the study presented in this thesis might benefit from health education regarding the risks of OW/OB on their health, and improved access to resources that would help them improve their economic status and provide them with stable access to food.

The need for nutrition education and poverty reduction measures led me to investigate the resources available to the Ghanaian population, and policies (level 5 of the SEM in Figure 1.1) implemented by the Ghanaian government that could be helpful to improve the nutritional status of the population or could be built on for future interventions. Nutrition education and support are mainly targeted towards school children in Ghana (Tandoh et al., 2022). Nutrition education is offered in schools starting from kindergarten to senior high school and taught as part of the science modules. However, teachers lack support and training on health and nutrition topics, and

are not obligated to adhere to teaching it. Moreover, only in junior high school do students learn about food classification, and the topic of a healthy balanced diet is only addressed in senior high school. With the high school dropout rate in the Eastern region, only 39% of male and 38% of female 12-17 years attended secondary schools in 2014 (Ghana Statistical Service et al., 2015). I believe that the exposure to nutrition education in the rural Eastern Region is limited. Moreover, schools offered nutritional support through the *Ghana School Feeding Program* which provides one hot meal per student during a school day in primary schools in about 9000 schools in all Metropolitan, Municipal and District Assemblies, benefiting over 2,600,000 students (Ghana School Feeding Program, n.d.). It was criticized for not monitoring the quality or the nutritional balance of the meals offered (Tandoh et al., 2022). Regardless of the weaknesses in implementation, since the programs already exist, Tandoh et al. (2022) reported that they offer a window of opportunity to be adjusted and used to implement and monitor food-based dietary guidelines to promote healthy eating habits throughout life.

Nutrition education targeted towards adults was communicated through the Regenerative Health and Nutrition (RHN) program, community health workers, and the Women In Agriculture Development (WIAD) Directorate's meetings with women farmers. The RHN was a government program offered by the Ministry of Health and was launched and pilot tested in 2006 in 10 districts (Aikins, 2010). The RHN program was mentioned in the 2014 GDHS (Ghana Statistical Service et al., 2015); however, no updates were offered on its current state or its results, through the Government of Ghana's Ministry of Health website (Ministry of Health, Republic of Ghana, n.d.). The results in its pilot testing report were promising. The program's beneficiaries incorporated the knowledge they learnt when resources were available and disseminated the

knowledge acquired to others. Since its current implementation is not documented since 2014, I think that the rural Eastern Region's adult population may not have been exposed to it. The role of community health workers in Ghana included home visits in rural communities and offering nutrition education among many other health services (Schwarz et al., 2019). Baatiema et al. (2016) argued that providing a wide variety of services could undermine the efficiency and efficacy of the services provided. The WIAD (one of the technical directorates of the Ministry of Food and Agriculture) also played a role in nutrition education through their meetings with women farmers (Ministry of Food & Agriculture Republic of Ghana, n.d.). The WIAD nutrition mandate aimed to improve diet quality and food production through nutrition education. One of their training guides on nutrition education included messages to increase not only to diversify food sources but also to increase food quantities for pregnant and lactating women "if you are pregnant, eat one extra meal every day to be healthy", and "Mothers, when you are giving breastmilk, eat two extra meals a day to maintain your health and the health of your baby" (Abidin and Amoaful, 2015). The messaging of the nutrition education was not targeted towards preventing OW/OB and might be a contributing factor. A multi-site study done by the WHO reported on women's post-partum weight change from the time of child birth until two years after delivery (Onyango et al., 2011). They found that Ghanaian women, unlike women in other countries, not only did not lose the weight gained during pregnancy but also their weight was 800 grams higher at two years after delivery relative to their weight 15 days after delivery. Moreover, no information was found on the extent community health workers and WIAD prioritized providing nutrition education over their other services. However, having nutrition education as part of their services and being on regular contact with the rural communities

provides a great window of opportunity for nutrition education to be delivered and be adjusted to address OW/OB prevention and healthier diets.

It is important to acknowledge that in order for the acquired nutritional knowledge to be implemented, certain barriers need to be lifted. For example, people often cited food prices as preventing them from eating healthy (Aikins, 2010; Liguori et al., 2022). On top of nutrition and health education, the government of Ghana might consider subsidizing healthy food prices. According to the 2020 FAO report, the cost of an energy sufficient diet in Ghana per day was 0.82 USD; 5.3% of the population could not afford it (FAO et al., 2020). However, the cost of a nutrient-adequate diet (contains balanced and adequate proportions of carbohydrates, fats and protein and essential vitamins and minerals) was more than twice as costly (2.08 USD) and 26.5% of the population could not afford it. Moreover, the cost of a healthy diet (a diverse diet of all food groups and nutrient adequate) was more than four times more expensive than the energy-sufficient diet (4.65 USD) and the majority of the population (64.9%) could not afford it. The 2022 FAO report did not offer diet cost data from Ghana; however, it mentioned that the increased cost of a healthy diet worldwide as a result of the COVID-19 pandemic, so the situation has probably worsened than improved (FAO et al., 2022). Considering that adult obesity worldwide is strongly associated with the unaffordability of a healthy diet (FAO et al., 2020), I think it is important and relevant to take action towards subsidizing healthy food prices. In terms of poverty reduction, many policies were available to the Ghanaian population (Tandoh et al., 2022). For example, the *Livelihood Empowerment Against Poverty* provides cash transfers (12 to 20 USD bimonthly) for people older than 65 years, the extremely poor, and orphans and vulnerable children. This program was criticized for not being consistent in payments so one

would argue that it might have limited impact in terms of facilitating access to food for the poor. Other countries have coupled social protection programs with food coupons and stamps (World Health Organization, 2018). Moreover, the ability of these programs to motivate healthier food choices and impact the population's health and nutritional status was weakened by the fact that the program did not include nutrition and health education components in it (Laar et al., 2017). Incorporating nutrition and health advice would be important to make sure people made healthier food choices with the cash offered to them (Laar et al., 2017). The study in this thesis showed that people who were wealthier were at a higher risk of OW/OB. Ghadirian et al.'s (2022) work with adolescents in the same region supports the need to raise health and nutrition awareness. The adolescents reported that when money was available in their households, the adults would chose to spend it on non-food items (for example, clothes) instead of buying nutritious food. The girls explained that their caregivers did not have knowledge about nutritious foods. Laar et al. (2017) recommended incorporating nutritional objectives as well as health and nutrition education with social support systems to make them nutrition sensitive and increase their chances of having nutritional results.

Considering the low resources available to the participants in the study included in this thesis (low levels of school education, no effective nutrition specific education programs targeted towards the adult population, and the unaffordability of a healthy diet) one could see the culture that celebrates OW/OB as a result of these factors. The cultural perceptions can be targeted and may be changed by raising awareness and improving the environment to support healthier food choices. I have presented from a qualitative point of view the perceived severity of the OW/OB problem on the rural household, and the need to take action on it.

Limitations:

The cross-sectional nature of the study does not allow for establishing causality, however, the qualitative component helped us understand the direction of associations. The limited number of participants, 331 women and 205 men in the 196 households, might have prevented us from capturing associations with variables that might have had a small effect size with OW/OB. The use of BMI to assess OW/OB was criticized for not being able to capture central obesity (Bosomworth, 2019) and being a poorer predictor of cardiovascular disease risk than waist-to-hip ratio (Yusuf et al., 2005). However, it has been widely used in the Ghanaian context which allowed us to compare results to the broader Ghanaian population (Tuoyire et al., 2016; Tuoyire, 2020; Lartey et al., 2019; Doku and Neupane, 2015). More sophisticated measures of adiposity, for example magnetic resonance imaging or dual energy X-ray absorptiometry (Borga et al., 2018), were not accessible in the field. Having only the first author code the qualitative transcripts is a limitation. It is a common practice in a qualitative study that two or more people would code the same transcript and compare codes to establish inter-coder reliability (O'Connor and Joffe, 2020). However, considering time and budget limitations, that was not an option. However, having the research assistants and the first author read the majority of transcripts together made me more confident of the coding and accuracy of the interpretation.

Final conclusion and summary

The objectives of the study were met. The study identified the prevalence of women's OW/OB as 43%, men's OW/OB as 16%, and household OW/OB presence in the study population as 56.1%. I identified being in the third tertile of wealth as being a predictor of OW/OB in women, men, and household OW/OB presence. The qualitative study showed the perceived cost of OW/OB on the household as a whole and how it affected its function. It suggested that participants perceived OW/OB as a problem that could affect negatively and concerned not only the individual but rather the whole family unit in rural Ghana leading to poverty, food insecurity, and spousal and familial discord. It was perceived to threaten the survival and well-being of all family members as a result of decreased financial income.

Future directions:

Identifying the characteristics that are associated with OW/OB helps future interventions to target groups at risk (households with increased wealth) of OW/OB, or on the contrary, target the healthy in OW/OB prevention programs. This is important to help best utilize resources as well as the importance of approaching OW/OB from a prevention point of view. Prevention is important as Lartey et al. (2020 a) reported in his study on 50+ years old Ghanaians; once a person reaches a weight category, they are likely to stay in it. The qualitative study gave important insight on the rural household reality and suggested the relevance and importance of taking action towards the OW/OB problem in the rural population.

Poverty reduction is one of the Sustainable Development Goals (United Nations Department of Economic and Social Affairs Sustainable Development, n.d.) and is considered one of the pathways to improved nutrition and was recommended to be targeted in nutrition-sensitive

interventions (Food and Agriculture Organization of the United Nations Rome, 2016). However, reducing poverty alone might not be enough to improve health as I have identified being wealthy as a driver of OW/OB household presence. For that reason, future nutrition interventions should aim to i) consider and address the cultural appreciation of OW/OB, ii) couple poverty reduction measures with providing healthy food coupons to facilitate food access to the poor, iii) couple social protection and poverty reduction policies with nutrition and health education to encourage the consumption of a healthier diet with the improved financial status, iv) work with the government services to raise nutrition education awareness in adults in the rural communities, and v) improve the food environment by subsidizing healthy food prices to help people apply the acquired knowledge. Without all the above efforts, overweight and obesity will likely persist and continue to affect the rural household's well-being.

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Appendixes

Appendix 1: Characteristics of study site

Characteristics	Eastern region			Upper Manya Krobo district[1]			Lower Manya Krobo district[2]			Yilo Krobo district[3]		
	Rural	Urban	Total	Rural	Urban	Total	Rural	Urban	Total	Rural	Urban	Total
Percentage out of the Eastern region population			2,633,154 persons			2.6			3.4			3.3
Percentage of urban/rural	56.6	43.4		87.3	12.7		16.3	83.7		69.1	30.9	
Technology use												
Mobile phones	34.3	56.8	36.6	19.9	52.9	24.4	38.6	53.4	51.1	36.6	57.8	43.5
Internet	2.2	8.2	4.1	1.1	6	1.8	2.1	5.1	4.6	3.1	7.6	4.6
Electricity for lighting				13.1	88.1		43.6	80.8		39.6	86.3	
Total fertility rate[4]			3.3			3.7			3.0			2.9

Household size (n of members)			2 to 6			4.6			4.0			4.2
Education												
Never attended			21.2			37.5			20.5			23.6
Primary			14.5			18.5			14.5			13.2
JSS/JHS/middle			45.3			35.2			42.1			45.4
SSS/SHS			9.3			4.9			12.5			9.3
Secondary			1.3			0.9			1.9			1.7
Vocational/Technical/Commercial			2.2			0.6			2.2			1.6
Post middle/secondary certificate			1.6			0.8			1.6			1.4
Post-secondary diploma			2.5			1.2			2.7			2.5
Bachelors			1.5			0.6			2.0			1.2
Tertiary			0.3			0.1			0.4			0.2

Occupation												
Skilled agricultural forestry and fishery workers			45.2			73.3			19.7			41.9
Service and sales workers			19.3			7.3			27.9			21.7
Other[6]			35.3			11.5			24.8			18.1

Results presented are percentages unless specified otherwise. Empty boxes data not available

[1] Ghana Statistical service October, 2014. *Upper Manya Krobo District District analytical report.* https://www2.statsghana.gov.gh/docfiles/2010_District_Report/Eastern/UPPER%20MANYA%20KROBO.pdf

[2] Ghana Statistical service October, 2014. *Lower Manya Krobo Municipal District analytical report.* https://www2.statsghana.gov.gh/docfiles/2010_District_Report/Eastern/LOWER%20MANYA%20KROBO.pdf

[3] Ghana Statistical service October, 2014. *Yilo Krobo Municipal District analytical report.* https://www2.statsghana.gov.gh/docfiles/2010_District_Report/Eastern/YILO%20krobo.pdf

Improved: piped public water into homes, public standpipe, borehole, protected (lined) well, protected spring, rainwater collection. Unimproved unprotected wells and springs, vendors, Tanker-trucks

[4] Total fertility rate as the number of children a woman would have by the end of her childbearing years if she were to pass through those years bearing children at the current age-specific fertility rates (Ghana Statistical Service (GSS), Ghana Health Service (GHS), and ICF

International 2015. *Ghana Demographic and Health Survey 2014.* https://dhsprogram.com/pubs/pdf/FR307/FR307.pdf. Age-specific fertility rates aid in understanding the age pattern of fertility. Numerators of ASFRs are calculated by identifying live births that occurred in the period 1 to 36 months preceding the survey (determined from the date of interview and date of birth of the child); they are then classified by the age of the mother (in five-year groups) at the time of the child's birth. The denominators of these rates are the number of woman-years lived by the survey respondents in each of the five-year age groups during the specified period.

[5] Ghana Statistical Service June, 2013. *Eastern Regional Analytical Report.* https://www2.statsghana.gov.gh/docfiles/2010phc/2010_PHC_Regional_Analytical_Reports_Eastern_region.pdf

[6] Other managers, professionals, technicians and associate professionals, clerical support workers, craft and related trade workers, plant and machine operators and assemblers.

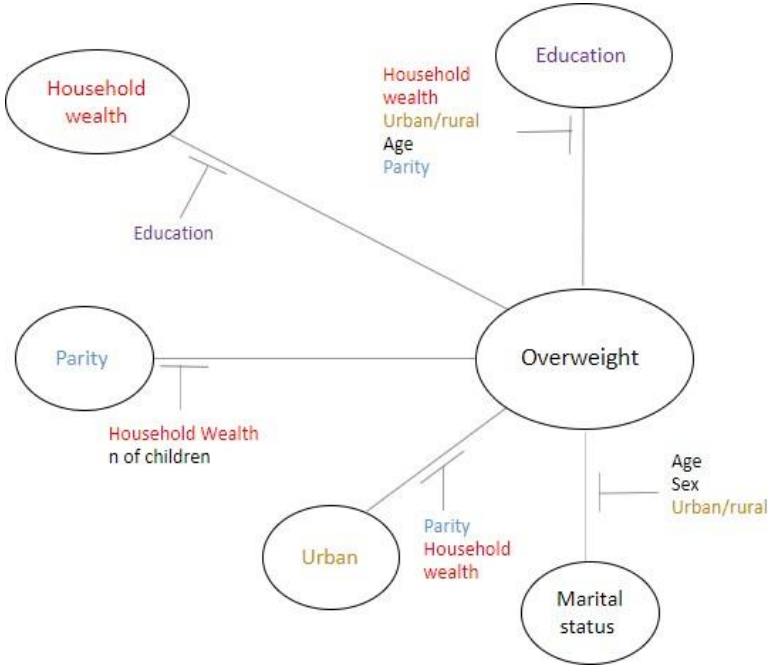
Appendix 2: Percent distribution of the population by wealth quintiles, according to residence and region, Ghana 2014

Wealth	Ghana	Eastern region	Rural	Urban
First (poorest)	20.0	12.6	35.7	4.0
Second	20.0	29.5	32.7	7.0
Third	20.0	27.7	21.8	18.2
Forth	20.0	17.9	8.7	31.5
Fifth	20.0	12.4	1.1	39.2

Wealth was defined as household's assets data for example a television, bicycle, or car, and dwelling characteristics, such as a source of drinking water, sanitation facilities, and type of flooring material

Ghana Statistical Service (GSS), Ghana Health Service (GHS), and ICF International 2015. *Ghana Demographic and Health Survey 2014.* https://dhsprogram.com/pubs/pdf/FR307/FR307.pdf

Appendix 3: A conceptual map of the interaction terms for the relationship between overweight/obesity predictors based on the studies presented in the literature review



Appendix 4. Focus group discussion questionnaire guide

Thank you so much for joining us today. Today we would like to discuss with you how people in your community think of body sizes for men and women. There is no right or wrong answer. We are interested in your own opinion so feel free to share it.

1) Community's expectations towards body size and definition of too big:

1. We see people have different body sizes from small to big.

 Can you please choose for me from the pictures the figures do you see for women who live in your community? (show all figures of women)

2. Please choose all the figures that you think your community members expect a woman who is healthy to look like. Follow up question: what is healthy to you? Can you elaborate more.

Follow up question: If we defined healthy as free from diseases or not in danger of developing diseases. Which figures do you choose for healthy and why? Can you explain further.

What about figure F, how do you see their health is like? What about E, what about G how is their health like?

3. When people in your community look at a woman, how do you identify that the woman's size is too big for her? Probes: clothes, comments from others, mobility, ability to work in the farm, link to health problems

4. Can you please choose all the figures that people in your community consider too big for a woman. What made you choose these women?

Repeat the questions for men 

5. Can you please choose for me from the pictures the figures do you see for men who live in your community? (show all figures of men)

6. Please choose all the figures that you think your community members expect a man who is healthy to look like. Follow up question: what is healthy to you?

Follow up question: If we defined healthy as free from diseases or not in danger of developing diseases. Which figures do you choose for healthy and why? Can you explain further.

What about figure F, how do you see their health is like? What about E, what about G how is their health like?

7. When people in your community look at a man, how do you identify that the man's size is too big for him? Probes: clothes, comments from others, mobility, ability to work in the farm, link to health problems

8. Can you please choose all the figures that people in your community consider too big for a man. What made you choose these men?

2) Consequences of having different body sizes on the family unit

Let's **focus** our thinking on those people **you identified as too big** and their families and discuss different areas of family life and how body size might affect them

9. If we look at women  who you identified as too big in your community, can you give me an example of changes that happened in their lives? Can you please tell me which size you are referring to? **How is her family affected by her size?** Can you give me an example please?

10. If we look at men  who you identified as too big in your community, can you give me an example of changes that happened in their lives? Can you please tell me which size you are referring to? **How is his family affected by his size?** Can you give me an example please?

Work/productivity related consequences:

11. Let's think of women  who you identified as are too big. How do you expect their farming to be? What about market business is it affected and how? Can you please tell me which size you are referring to? **How does that affect the family?** Can you give me an example please?

12. Let's think of men  who you identified as are too big. How do you expect their farming to be? What about market business is it affected and how? Can you please tell me which size you are referring to? **How does that affect the family?** Can you give me an example please?

Financial consequences:

13. What about family's financial expenses, would the financial expenses of a family differ depending on a woman's  size? How do they differ? What are these financial expenses? **Can you please tell me which size you are referring to? How does that affect the family?** Can you give me an example please?

14. What about financial expenses would the financial expenses of a family differ depending on a man's  size? How do they differ? What are these financial expenses? **Can you please tell me which size you are referring to? How does that affect the family?** Can you give me an example please?

Social consequences and effects:

15. How do you think people in the family treat this  woman who has the following sizes (E, G, F). what about the figures that you chose as too big? how is their social life like? Probe: spouse, children, extended family, friends.

16. How do you think people in the family treat this  man who has the following sizes (E, G, F), what about the figures that you chose as too big? how is his social life like? Probe: spouse, children, extended family, friends

17. How would a man  in your community feel if his spouse put on weight? how would the spousal relationship differ? would it affect the way a man treats her? and if yes in what way? when do you notice this happening from which from which size to which size?

18. How would a woman  in your community feel if her spouse put on weight. How would the spousal relationship differ? would it affect the way she treats her man? and if yes in what way? when do you notice this happening from which from which size to which size?

19. How would people in your community comment on this woman  who put on weight? what would they tell this woman? What would her extended family and friends say to her and treat her?

20. How would people in your community comment on this man  who put on weight? what would they tell this man? what would his extended family and friends say to him and treat him?

Health related consequences:

21. What do you think the health status of this woman  that you identified as too big is like? Can you please tell me which size you are referring to?

What do you think some of the health challenges that you have noticed with these sizes? Probe for all the diseases that they can think of if they mentioned challenges

Let's suppose that a woman had health diseases, **how does that affect the family?** Can you give me an example please?

22. Let's move to men  . What do you think the health status of this man that you identified as too big is like? Can you please tell me which size you are referring to?

What do you think some of the health challenges that you have noticed with these sizes? Probe for all the diseases that they can think of if they mentioned challenges

Let's suppose that a man had health diseases, **how does that affect the family?** Can you give me an example please?

24. Now after we have talked about social, economic, and health consequences of different body sizes is there anything we have not talked about you would like to tell us about …

25. If a change were to be made in a family regarding health who is the person that should be addressed or who is the most influential person in your opinion? What if we want to change a family's dietary choices who should we talk to? What about changes regarding body size, who should we talk to? Why did you choose these people?

26. If a person in your community were to persuade a woman to reduce her size? what would they tell her?

27. If a person in your community were to persuade a man to reduce his size? what would they tell him?

28. We notice that sometimes people grow bigger. Why do you think this happens? do you think this happens naturally or intentionally?

29. When do you notice this increase in size happening? And what motivates it?

Appendix 5. Consent form for focus group discussion participation

UNIVERSITY OF GHANA

COLLEGE OF BASIC AND APPLIED SCIENCES

Official Use only Protocol number

Ethics Committee for Basic and Applied Sciences (ECBAS)

PROTOCOL CONSENT FORM – **Additional Interviews & Focus Group Discussions**

Section A- BACKGROUND INFORMATION

Title of Study:	Scaling up women's agripreneurship through public-private linkages to improve rural women's income, nutrition, and the effectiveness of institutions in rural Ghana
Principal Investigator:	Esi Colecraft, DrPh, Department of Nutrition and Food Science, University of Ghana, Legon Tel: +233- 244-107633 Email: colecraft_s@hotmail.com
Co-Investigators:	University of Ghana: Naa Dodoo
	McGill University: Grace Marquis and Nii Addy
Funder:	International Development Research Centre (IDRC)
Certified Protocol Number	

Section B– CONSENT TO PARTICIPATE IN RESEARCH

General Information about Research

This research activity is being undertaken to identify opportunities for improving the well-being of women in agricultural livelihoods and their households. Recently, our project staff may have interviewed you and you may have participated in a focus group discussion about women's livelihoods. If you did not previously participate in our project, you are being invited because you live or work in rural communities. Today, we would like to invite you to participate in interviews and/or focus group discussions that will help us to have a more thorough understanding about women's lives in rural Ghana and issues of concern about gender.

If you agree to participate, members of our research team will interact with you individually or in a group with other residents like yourself for up to a maximum of four times over the next two years of the project. You will be asked to give your perceptions about women's roles, gender equity, and experiences of empowerment throughout your life and in your community. Each discussion will take at most two hours of your time. So that we do not miss anything from the discussion we will tape record the discussion.

Benefits/of the study

There is no direct benefit to you for participating in the study. However, by participating, you will help us better understand how to work with local institutions to better support women in agriculture-based livelihoods.

Risk of the study

There are no foreseeable risks for you.

Confidentiality

All information from the discussions will be confidential, which means that we will not tell anyone what you say or give out any information about you. Only the research team will have access to this information; this includes the field workers who collect the information from you, translators when needed, and the staff who analyze the data. Data sets will be shared for analysis only if all personal identifiers have been removed. You will not be named in any of the oral or written reports and no reference will be made that could be linked to your information.

During the focus group, all participants will be asked not to talk to others about anything in the discussions. By agreeing to participate you agree to not to talk to others about anything said. Nevertheless, we cannot assure you about the confidentiality held by other participants of the group discussions.

Written copies and the tape recordings will be stored in a protected computer and a locked cabinet in the project office until the data entering is completed. Data will be reported as a summary, no names will be used. Selected codes may be used but without names. We will assure that nothing that is published can be linked to you.

Compensation

You will receive a small token of appreciation, such as cake of bathing soap, for your participation.

Withdrawal from Study

You are invited to participate in this part of the research project and your participation is voluntary. You may refuse to answer any of the questions and you may withdraw from the project at any time without any consequences. Please feel free to ask questions at any time regarding this study. You will be given a copy of this consent form.

Contact for Additional Information

If you have any questions, at any time, about the research project or procedures used in this part of the project, you may contact any of the following individuals.

University of Ghana	Esi Colecraft, DrPh, Department of Nutrition and Food Science, University of Ghana, Legon Tel: +233- 244-107633 Email: colecraft_s@hotmail.com	Naa Dodoo, PHD, Regional Institute of Population Studies, University of Ghana, Legon Tel:+233-244574434 Email: ndodoo@ug.edu.gh
McGill University	Grace S. Marquis, PhD, School of Dietetics and Human Nutrition, CINE Building, Macdonald Campus of McGill University, 21,111 Lakeshore Road, Ste-Anne-de-Bellevue, QC, H9X 3V9, Canada Tel: +1 514-398-7839, Fax: +1 514-398-1020 Email: grace.marquis@mcgill.ca	Nii Addy, PHD, McGill University Tel: +233-262800401 Email: nii.addy@.mcgill.ca

If you have any issues on your rights as a participant, you can contact the address below:

Administrator, Ethics Committee for Basic and Applied Sciences, College of Basic and Applied Sciences, University of Ghana, P. O. Box LG 68, Legon – Accra, Tel: + 233 277493259 , Email: ekacquaah@ug.edu.gh

In addition, if you have any ethical concerns or complaints about your participation in this study, and want to speak with someone not on the research team, please contact the McGill Ethics Manager at 514-398-6831 or lynda.mcneil@mcgill.ca".

Section C- VOLUNTEER AGREEMENT

"I have read or have had someone read all of the above, asked questions, received answers regarding participation in this study, and I am willing to give consent to participate in this study. I have not waived any of my rights by signing this consent form. Upon signing this consent form, I will receive a copy for my personal records."

_____

Name of Volunteer

_____

_____

Signature or mark of volunteer Date

If volunteers cannot read the form themselves, a witness must sign here:

I was present while the benefits, risks and procedures were read to the volunteer. All questions were answered and the volunteer has agreed to take part in the research.

_____

Name of witness

_____

_____

Signature of witness Date

I certify that the nature and purpose, the potential benefits, and possible risks associated with participating in this research have been explained to the above individual.

_____

Name and signature of Person who obtained Consent

_____

_____