Title:

Health service utilisation and direct healthcare costs associated with obesity in older adult population in Ghana

Running Title:

Obesity and healthcare cost in sub-Saharan Africa

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Presentations:

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Also, an earlier draft of this paper was presented at the 2018 Australia Health Economics Association in Hobart, Australia. We are thankful to all anonymous reviewers who made this feat possible.

Keywords:

Obesity, older adults, health service utilisation, direct healthcare costs, WHO SAGE Wave 2, Ghana

Key Messages of this study

1. No study has examined the utilization and direct costs of health services associated with overweight and obesity in the older adult population in Ghana. We analysed the most current data collected from a nationally representative multistage sample of people aged 50+ years in WHO SAGE Ghana Wave 2.
2. Overweight and obesity both were associated with additional health service utilization as well as high incremental direct healthcare costs of which the government's cost share was about 60% per person.
3. Even though the combined prevalence was 36%, the total cost burden of overweight and obesity was almost double that of normal weight.
4. The results suggest the need for preventative and weight management programs to mitigate the high cost burden of overweight and obesity.

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Declarations:

Ethics and permissions:

Ethics approval and consent to participate

WHO SAGE was approved by WHO's Ethical Review Committee (reference number RPC149) and the University of Ghana Medical School Ethics and Protocol Review Committee in Ghana (Kowal et al., 2012). Secondary analyses of data were done for this study; therefore, the authors

were not required to obtain a separate ethics approval. The NHIS claims data used to estimate medication costs in this study is secondary data that did not require ethical approval from the Ghana Health Service Ethical Review Committee (GHSERC). However, permission was obtained from the NHIA to use the data for this study.

Authors' Institutes:

This paper received ethical approval from the authors' institutes.

Data Availability Statement: Data from SAGE Ghana Wave 2 was used for this study. WHO SAGE was approved by the WHO Ethics Review Committee (reference number RPC149) with local approval from the University of Ghana Medical School Ethics and Protocol Review Committee (Ghana). The necessary permission was obtained from the World Health Organization to use these data. All files were obtained from the World Health Organization Study on global AGEing and adult health (WHO-SAGE). Details on data can be found at http://www.who.int/healthinfo/sage/cohorts/en/. The authors used the GhanaINDDataW2 and GhanaHHDataW2. The codes for the measured weight and height used to calculate body mass index (BMI), as used in the data are q2506 for weight and q2507 for height. The authors confirm that they had no special access privileges to the data. Interested researchers will have to submit a data request to WHO. Upon approval, the researchers will be granted access.

Compliance with ethical standards

Competing Interest: The authors declare that no competing interests exist.

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Conflicts of interest statement: Authors declare no conflict of interest.

Authors' Contribution

STL, BdG, CGM, LS and AJP conceived and designed the study. STL, LS, BdG, and AJP analysed the data. STL, LS, CGM, BdG, GOB, MA and AJP wrote the original draft. STL, BdG, CGM, GOB, MA, NM, PK, LS and AJP validated the results, reviewed and edited the manuscript. All authors read and approved the final manuscript.

Abstract

Obesity is a major risk factor for many chronic diseases and disabilities, with severe implications on morbidity and mortality among older adults. With an increasing prevalence of obesity among older adults in Ghana, it has become necessary to develop cost-effective strategies for its management and prevention. However, developing such strategies is challenging as BMI-specific utilization and costs required for cost-effectiveness analysis are not available in this population. Therefore, this study examine the associations between health services utilisation as well as direct healthcare costs and overweight (body mass index, BMI ≥25.00 and < 30.00 kg/m^2) and obesity (BMI ≥30.00 kg/m^2) among older adults in Ghana. Data was used from a nationally representative, multistage sample of 3350 people aged 50+ years from WHO SAGE (2014/15). Health service utilisation was measured by the number of health facility visits over a 12-month period. Direct costs (2017 US dollars) included out-of-pocket payments and the National Health Insurance Scheme (NHIS) claims. Associations between utilisation and BMI were examined using multivariable zero-inflated negative binomial regressions; and between costs and BMI using multivariable two-part regressions. Twenty-three percent were overweight and 13% were obese. Compared with normal weight participants, overweight and obesity were associated with 75% and 159% more inpatient admissions, respectively. Obesity was also associated with 53% additional outpatient visits. One in 5 of the overweight and obese population had at least one chronic disease, and having chronic disease was associated with increased outpatient utilization. The average per person total costs for overweight was $78 and obesity was $132 compared with $35 for normal weight. The NHIS bore approximately 60% of the average total costs per person expended in 2014/15. Overweight and obese groups had significantly higher total direct healthcare costs burden of $121 million compared with $64 million for normal weight in the entire older adult Ghanaian population. Compared with normal weight, the total costs per person associated with

overweight increased by 73% and more than doubled for obesity. Even though the total prevalence of overweight and obesity was about half of that of normal weight, the sum of their cost burden was almost doubled. Implementing weight reduction measures could reduce health service utilization and costs in this population.

Introduction:

Whilst obesity is among the leading risk factors for non-communicable diseases (NCDs) globally, the prevalence of obesity has substantially increased since 1980 (Global Burden of Disease 2015 Obesity Collaborators, 2017; Mendis et al., 2014). Obesity (body mass index, BMI ≥30 kg/m^2) has immediate negative health consequences (Global Burden of Disease 2016 Disease and Injury Incidence and Prevalence Collaborators, 2018), and a complex aetiology that ultimately results in increased morbidity, disability, mortality, and reduced quality of life (Koenig et al., 2015; Prospective Studies Collaboration et al., 2009). In many developing countries, mortality of older adults (50+ years) is commonly due to NCDs rather than infectious or parasitic diseases (World Health Organization, 2014). In other countries, it has been established that overweight and obesity and obesity-related conditions in the older population siphon considerable resources from the health system due to the associated increased health services utilisation and healthcare costs (Colagiuri et al., 2010; Doherty et al., 2012; Hugh et al., 2015; Konig et al., 2015; Musich et al., 2016; Suehs et al., 2017; Wilkins et al., 2012). Even though overweight and obesity prevalence are increasing (Agyemang et al., 2015; Stella T. Lartey et al., 2019), there is no way to estimate whether the current prevalent rates among the older population have similar effects on health service utilisation and costs in Ghana. Also, there are few studies that have examined such effects globally (Awoke et al., 2017; Saeed et al., 2016). Additionally, this has been a major concern for policy makers, stakeholders and financiers of healthcare who can only speculate an increase in health resource utilization and cost, without any published estimates.

Healthcare in Ghana is financed mainly by the government, development partners and households (H. Wang et al., 2017). To improve equity in healthcare delivery and sustainable health financing, the Government of Ghana in 2003 introduced the National Health Insurance Scheme (NHIS) (Nsiah-Boateng et al., 2017) and commenced implementation in 2005. Administered by the government's National Health Insurance Authority (NHIA), the scheme is

financed through the national health insurance (NHI) levy and deductions by Social Security and National Insurance Trust (SSNIT); and funds are largely expended through claims (H. Wang et al., 2017). Since the introduction of the NHIS, increase health service utilization and costs to the government has been reported (Nsiah-Boateng et al., 2017; H. Wang et al., 2017). Yet there is no evidence of how overweight and obesity have influenced the process.

As Ghana is among the few countries in Africa experiencing an ageing population (He et al., 2016) in addition to increasing life expectancy (World Health Organization, 2014). Therefore, a concurrently increasing obesity prevalence (Agyemang et al., 2015; Stella T. Lartey et al., 2019; Ofori-Asenso et al., 2016) which may increase the risk of chronic diseases (Singh et al., 2013) will likely impose major financial costs (Akazilia et al., 2017; World Health Organization, 2005), especially to the government's NHIS. Due to a lack of adequate health care cost data reported in many developing countries, it is difficult to estimate the cost burden overweight ($25 \geq BMI < 30$ kg/m^2) and obesity impose on households and the health systems. However, such research is essential for forecasting, planning, and development of cost-effective and sustainable obesity interventions. Estimating utilization and costs can be used in health economic modelling studies, including those that will simulate progression impact of changing prevalence obesity on economic outcomes.

Since results from modelling are to inform health care decisions and resource allocation in specific populations, it is important that the parameters such as costs, utilization and health state utilities used are developed basically from the same or very similar population (Briggs et al., 2012). This is because the circumstances like economic or political conditions, and how populations value their health differ. Therefore, using parameters such as BMI-specific utilization and costs from different countries in economic evaluation and using its results to inform local health care decisions and resource allocation might lead to choosing unaffordable, inaccessible and unsustainable interventions. As evidence of association between utilization,

costs and high BMI are porous in Ghana, this study aimed to examine the associations between health service utilisation, healthcare costs, and excess weight in the older adult population of Ghana in 2014/15.

Methods:

Study Sample

Data from a sub-sample of 3350 respondents aged ≥50 years with complete responses from the World Health Organization's Study on global AGEing and adult health (WHO SAGE) Wave 2 were used. SAGE used a stratified multistage cluster design to collect data that yielded national and subnational estimates with acceptable precision using region and locality type (rural/urban) as the primary sampling unit (Charlton et al., 2016; Kowal et al., 2012). Of the 4735 survey respondents, a final sample for analysis was determined after missing weight (227) and height (229) measurements and biologically implausible weight and height measurements (25) were excluded. Biologically implausible values were determined to be height <100cm or >250cm, weight <30.0 kg or >250.0 kg and waist circumference < 25.0 cm or > 220 cm, and were excluded (Cois & Day, 2015; Subramanian et al., 2011). Overall, 246 (5.2%) missing anthropometric measurements and 25 (0.5%) biologically implausible values were excluded. Out of this, only 160 (4.8% of 3350) were excluded from those 50 years and above. Since the focus of the study was those aged 50 years and above, person below age 50 years (1114) were excluded from this study. Thus, the final sample for analysis was 3350.

We used the GhanaINDDataW2 that had responses to the individual questionnaire in this study. Further information on the WHO SAGE can be found at http://www.who.int/healthinfo/sage/cohorts/en/.

Outcome Variables

This study focused on four outcome variables. We examined the annualized health service utilisation and total direct healthcare costs including costs that were stratified by out-of-pocket and NHIS costs.

Health service utilisation: The SAGE questionnaires included information on self-reported health service utilisation in the 12 months prior to data collection. This included the number of visits to a specific type of health facility (this includes pharmacy, health centre, clinic, polyclinic, district hospital, regional hospital, teaching/tertiary hospital), for outpatient visits and inpatient admissions over the period. Based on the assumption that those who did not provide response to visiting a health facility did not make any visits, their missing values were considered to be zero in the analysis. The number of unreported inpatient admissions was 3010 (90% of the 3,350) and outpatient visits was 980 (29% of the 3350).

Out-of-pocket (OOP) costs: Respondents who have had inpatient and/or outpatient visits were asked to indicate the OOP costs they incurred during the most recent visit. This included fees for healthcare provider, medication, laboratory tests, transportation, and other incidental costs related to the hospital visit. These costs were summed and multiplied by the total number of visits a respondent made to a health facility in the past 12 months. Using the health-related mean consumer price index (CPI) for years 2015 and 2017, these costs were converted into real costs in 2017 in Ghana cedi (Ghana Statistical Service, 2012 & 2017; Konig et al., 2015).

NHIS Costs: Where an insured respondent had an inpatient admission, or an outpatient visit and indicated in the out-of-pocket costs sections that this was 'free', it was acknowledged that the NHIS as a public health insurance system covered the costs of such services (healthcare provider and medication fees). People who visited a health facility and incurred transport, laboratory tests or other incidental costs but not health provider or medication fees, were assumed to have incurred both OOP and NHIS costs. The NHIS reimburses healthcare providers mostly for health services and medication costs per person per visit using their diagnosis, the level of the facility visited dosage of medication consumed. These services and medication costs were based on the Ghana Diagnosis Related Groupings (G-DRG), 2015 and fee-for-service payment methods, respectively (H. Wang et al., 2017). The NHIS costs were calculated in four steps: 1) diseases

that were reported as the main reason for outpatient visit or inpatient admission in a health facility in the WHO SAGE were mapped to diseases in the G-DRG, stratifying by level of health facility. Minimum costs were assigned based on the service and type of health facility visited (Appendix 1); 2) to obtain medication costs, claims data on mean medication costs were accessed from five districts stratifying these by outpatient or inpatient services for the 2017 fiscal year (Appendix 2) (NHIA, 2018). These NHIS claims data were the most current and validated data that used the 2015 G-DRG. Claims data from two districts (Gonja East and Shai-Osudoku) were excluded because service costs were not separated from medication costs. It is important to note that the costs of medications do not vary by district, rather the costs depend on the dosage prescribed for specific diagnosis (H. Wang et al., 2017); and 3) the NHIS costs were calculated as the sum of service (from the G-DRG) and medication costs (mean of medication costs from the districts) per visit based on the purpose of visit, the department (inpatient or outpatient) and level of health facility visited.

4) finally, the NHIS costs obtained per visit per person was then multiplied by the total number visits the respondent made to a health facility in the past 12 months for which health provider and medication fees were free.

Total healthcare costs: These were estimated as the sum of the OOP and NHIS costs per person in the 12 months prior to the study. All costs were converted into US dollars ($) equivalent using the 2017 mean exchange rate ($1≈ GHS 4.3562) (Bank of Ghana, 2018).

Explanatory variable:

Overweight and obesity: Overweight and obesity were the main explanatory variables. In the WHO SAGE data, anthropometric measurements of body weight and height of respondents were taken by trained assessors using standardized protocols (World Health Organization, 2006). BMI was calculated as weight in kilograms divided by the square of height in meters (kg/m^2) (National Institute of Health, 1998). BMI was classified into four categories: underweight,

BMI<18.50kg/m^2; normal weight, 18.50≥BMI<25.00/m^2; overweight, 25.00≥BMI <30.00kg/m^2; and obesity, BMI ≥30.00 kg/m^2 (National Institute of Health, 1998; World Health Organization, 2000).

Covariates

Covariates considered as confounders included age, sex, marital status, educational level, location, employment status, household wealth, having health insurance and being diagnosed with at least one chronic disease or none. Covariates were specified based on Andersen behavioural model for studying factors that facilitate or impede health service utilization (Andersen, 1995) and factors that affect costs(Brinda et al., 2015; Konig et al., 2015). In particular, the Andersen model shows that the individual accesses and utilizes health services depending on three groups of characteristics described below: 1) predisposing factors, also known as the socio-cultural characteristics of the person including age, gender, marital status, educational level, occupation. 2) enabling factors focus on the operational or logistical requirements needed to seek care such as individual or family income, having health insurance, availability of health personnel and facilities. 3) need factors that are the immediate cause for which a person seeks care including diseases or disabilities.

In this study, sex was categorized as male/female while age was a continuous variable. Educational level was grouped into low education where the highest level of education was less than secondary or high school, and high education where a person completed secondary/ high school and above. Marital status was coded as (1) single, (2) married/cohabiting and (3) divorced/separated/widow/widower. Location of residence was coded as rural or urban residence; and employment status was categorised as employed or not employed. Furthermore, household wealth index served as a proxy for household economic status (Filmer & Pritchett, 2001; Rutstein & Staveteig, 2014). This was constructed using principal component analysis

from a total of 22 assets/characteristics/items (S T Lartey et al., 2019; Rutstein & Staveteig, 2014). These included having radio, television, refrigerator, computer, mobile or fixed telephone, livestock, land, jewellery, bicycle, motorcycle, car; access to utilities such as electricity, having improved sanitation facility, having improved source of drinking water, cooking fuel and housing characteristics, such as the type of floor or wall materials. The Cronbach's alpha for the 22 assets/characteristics/items that measured household wealth was 80.8%, indicating that assets/characteristic/ items included measured wealth appropriately. The derived index was converted into wealth quintiles coded as quintile one representing the lowest household status; with quintile two as low; quintile three representing moderate; quintile four representing high, and quintile five representing highest household wealth status. Insurance status was defined uninsured or insured. A respondent was insured if he had an unexpired insurance card. From previous studies, having obesity-related medical conditions included diabetes (ICD-9-CM code 250 for type 2 or unspecified type); hypertension (ICD-9-CM code 401-405); unspecified angina pectoris (ICD-9-CM 413.9); arthritis (ICD-9-CM code 716.9 for unspecified arthritis); stroke or cerebral artery occlusion (ICD-9-CM 434.91); and depression (ICD-9-CM code 311) (Kortt & Clarke, 2005). Thus, having chronic disease was defined as yes if a respondent had at least one of these diseases.

Statistical Analysis

As population health service utilisation typically has many zero values, we employed survey zero-inflated negative binomial regression models in univariable and multivariable analyses to examine the association between healthcare usage and BMI categories. Characteristic of population healthcare cost data, cost was a continuous outcome variable and right skewed with excess zeroes (Brinda et al., 2015; Finkelstein et al., 2009). Therefore, we employed a survey two-part regression model in univariable and multivariable analyses to explore associations between costs and the BMI categories (Duan et al., 1984). The two-part model involved two steps: the first step estimated the probability of having a health cost; then the second step estimated the total costs conditional on having positive costs. We employed a two-part model that used a logit model in the first part and a generalized linear model with gamma distribution and a log link function in the second part (Finkelstein et al., 2009; Manning & Mullahy, 2001).

We report the exponentiated coefficients (incidence rate ratios, IRR of health service usage, and predicted mean and incremental costs). We applied the WHO post-stratified person weights to all estimations. A two-tailed p value<0.05 was considered as statistically significant. As costs incurred during the last visit were used to calculate annual costs, a sensitivity analysis around costs was conducted by varying the average per person costs by ±20% (Briggs et al., 2012). All analyses were performed using STATA v.15 (Stata Corp., College Station, Texas, USA).

Results:

Of the 3350 respondents aged 50+ years used in this analysis, approximately 53% were female, of mean (standard deviation) age 62 (9.9) years, 48% lived in urban areas and 72% were insured (Table 1). Ten percent were underweight, 54% had normal weight, 23% were overweight and 13% were obese. Twenty-three percent of the 3350 respondents came from the highest income households and 17% were diagnosed with at least one chronic disease. Twenty-three percent (p value=0.001) forming about one in five of the total number of respondents who were overweight or obese (1209) had at least one chronic disease.

Health Service Utilisation

Of the 3350 respondents, 1703 (51%) made at least one visit in the 12 months prior to data collection. At least one inpatient admission was reported by 182 (5%) of which 10% were underweight, 24% were overweight and 12% were obese. About half of the sample (49%, n=1631) reported at least one outpatient visit; of this group, 11% were underweight, 22% were overweight and 13% were obese (Table 1). Among the overweight group who visited any health facility, the unadjusted mean number of inpatient admissions was 2.1 (95% CI: 1.8, 2.2) and outpatient visits was 2.8 (95% CI: 2.4, 3.2) (Table 2). In the obese group, the unadjusted mean number of inpatient stays was 2.5 (95% CI: 2.4, 2.6) and outpatient visits was 3.7 (95% CI: 3.4, 4.2) (Table 2). The univariable and multivariable associations between annual health service utilisation and BMI categories showed that both overweight and obesity were associated with significantly higher health services (Table 3). However, the magnitude reduced in the multivariable analysis where persons who were obese had 53% (IRR=1.53; 95%; CI: 1.19, 1.98) more outpatient visits and 159% (IRR=2.59; 95% CI: 1.20, 5.51) more inpatient admissions compared with those of normal weight. Being overweight was also associated with 75% (IRR=1.75; 95% CI: 1.21, 2.53) more inpatient admissions compared with those of

normal weight. Underweight was not significantly associated with any health service utilisation domain. Another important factor that was associate with high outpatient utilization was having at least one chronic disease (IRR=1.38; 95% CI: 1.07, 1.78). Other factors associated with more outpatient visits included being female, high education and high household wealth. Being unemployed and having high or higher household wealth were associated with more inpatient admissions.

Healthcare Costs

Tables 4 shows the annualized costs of direct healthcare. In this population, the unadjusted annualized average costs per person incurred through either OOP or NHIS were higher among persons who were overweight or obese versus those with normal weight. Government bore approximately 60% of the total direct healthcare costs per person in 2014/15 (Figure 1). Results of the sensitivity analyses around the per person costs are presented in Appendix 3. Based on the estimated prevalence (Table 1) and the entire 50+ years population in year 2015 (Ghana Statistical Service, 2014), the prevalence-based unadjusted mean total direct healthcare costs for normal weight were estimated to be $ 64,817,248, overweight were $ 61,442,129 while those of obesity was $60,276,468 (Table 5). Overweight and obese groups had significantly higher total direct healthcare costs burden compared with that for normal weight in the entire older adult Ghanaian population.

Table 6 shows the univariable and multivariable analyses of the association between annual healthcare costs and BMI categories. Overweight and obesity were significantly associated with higher costs versus normal weight in all cost domains. In the multivariable analyses, the mean annualized direct healthcare costs for the normal weight reference group was $51.79 (95% CI: 46.35, 57.22) per person for total costs including $21.16 (95% CI: 17.51, 25.84) for OOP and $30.24 (95% CI: 27.73, 32.75) for NHIS costs. However, being

overweight was associated with $37.86 (95% CI: 26.71, 49.02) additional total costs per person, $17.68 (95% CI: 9.67, 25.68) additional OOP costs and $20.13 (95% CI: 15.08, 25.18) increase in NHIS costs. Being obese was associated with total incremental costs of $63.96 (95% CI: 48.71, 79.20), $28.16 (95% CI: 18.83, 37.48) as OOP and $34.64 (95% CI: 26.92, 42.36) as NHIS costs. Total costs increased with age, high education and high household wealth.

Discussion

In this study, we examined the association between annual health service utilisation as well as annual direct healthcare costs and four BMI categories in the older adult population of Ghana. We found that people who were overweight or obese had increased annual health service utilisation and costs compared with those of normal weight, despite making up only 36% of the population. Being obese was associated with about 53% more outpatient visits and 159% more inpatient admissions compared to those with normal weight. Being diagnosed with at least one chronic disease was also associated with 38% additional outpatient visits. Similarly, overweight was associated with 73% more inpatient admissions compared with those of normal weight, but there was no significant association for outpatient visits. Despite that the prevalence of overweight and obesity was only about half of the normal weight, total healthcare costs burden was almost doubled. The total per person direct healthcare costs associated with overweight increased by 73% and for obesity, these costs were more than double in all cost domains compared to persons with normal weight.

Our findings are consistent with previous international studies which have shown that health service utilisation among the overweight and obese among older adults are higher compared with normal weight (Doherty et al., 2012; Hugh et al., 2015; Konig et al., 2015; Musich et al., 2016; Suehs et al., 2017). For example, a comparison of healthcare utilisation by weight status in the US found those with obesity to be more likely to have more inpatient admissions and orthopaedic procedures compared with those of normal weight (Musich et al., 2016). Similarly, in Ireland, Doherty et al found overweight and obesity to be associated with significantly higher outpatient visits and inpatient admissions (Doherty et al., 2012) which translated to higher healthcare costs in those who were overweight or obese compared with those of normal weight. Increased healthcare utilisation associated with overweight or obese in our study could be attributed to a possible increased burden in prevalence of NCDs (Adeboye

et al., 2012). This could be the case as we also found that one out of five in the overweight or obese population had at least one chronic disease; and having a chronic disease was associated with increased utilization.

Our findings that 20% (one out of five) of overweight or obese respondents had at least one chronic disease, and that having a chronic disease was associated with increased hospital utilisation may imply a substantial but avoidable burden on the health system. This result is consistent with previously published research, which has shown obesity increases the risk of developing chronic diseases(Global Burden of Disease 2015 Obesity Collaborators, 2017; Singh et al., 2013) and the presence of chronic disease is associated with increased health service utilization, especially among older populations (Brinda et al., 2015; Global Burden of Disease 2015 Obesity Collaborators, 2017; Oostrom et al., 2014; Suehs et al., 2017).

As obesity mediates the occurrence and exacerbation of chronic diseases, an increasing prevalence of overweight and obesity in the older adult population (Stella T. Lartey et al., 2019) would likely increase health service utilization. Like most low and middle income countries, Ghana is facing a rapidly increasing burden of NCDs, however the country's health systems are under-resourced and unprepared (Aikins et al., 2014; Baldwin, 2015; Ofori-Asenso et al., 2016). The Ministry of Health's NCDs management strategy aimed to reduce overweight and obesity prevalence by 2% for people aged 15-49 years (Ministry of Health, 2012), with no plans for those aged 50 years and above. It can be argued that this strategy that neglects the 20% of the adult population of Ghana aged 50+ years - in whom the prevalence of overweight and obesity are rapidly increasing - is mistaken and requires urgent attention. Our study highlights the increasing burden and associated costs of overweight and obesity amongst these older age groups. These findings can be used by clinicians to increase surveillance on

NCD markers and by decision-makers to develop evidence-based strategies for overweight and obesity in Ghana.

Another significant result was the finding of a positive association between overweight and obesity and a higher additional annualized healthcare cost. This finding agrees with previous international studies which also found that people who were overweight/obese relative to those with normal weight were associated significantly higher healthcare costs (Buchmueller & Johar, 2015; Dee et al., 2015; Musich et al., 2016; Sturm et al., 2013; Suehs et al., 2017; Y. Wang et al., 2011; Wilkins et al., 2012). Overweight and obesity have been associated with increased health care costs that ranged from 19- 95% that were in some instances more than doubled those of persons whose weights were normal (Buchmueller & Johar, 2015; Finkelstein et al., 2009; Konig et al., 2015; Suehs et al., 2017). We found that relative to normal weight, overweight was associated with 73% additional total cost, and obesity was associated with more than a doubling of the total cost. This finding is also consistent with reports that such costs are driven by increased inpatient and outpatient utilisation (Konig et al., 2015; Raebel et al., 2004; Suehs et al., 2017). Finally, our finding that the government covered 60% of the total direct healthcare costs per person in 2014/15, suggests that high prevalence of overweight and obesity in the population potentially poses a substantial burden on the health budget.

Our study has some limitations. First, we used mean costs estimated from five districts of Ghana to estimate the NHIS costs for medications. Although the WHO SAGE data is representative of the older adult population (Biritwum et al., 2013) and medication prices do not change by district, medication costs from five districts may not be fully representative of the whole of Ghana. However, only these five districts provided complete claims data. Additionally, unlike service-related costs that were estimated based on diagnoses, type of services and the level at which service was accessed, mean medication costs were assumed to

be the same for all purposes but only differentiated based on outpatient or inpatient services. This may result in overestimating the medication costs if majority who visited the facilities required medications with lower costs or underestimate the medication costs if majority of people used medications that had higher costs. However, medication costs based on diagnosis for each person were not available at the time of data collection.

Second, service utilisation and OOP costs in the WHO SAGE were self-reported hence may be subject to recall bias. Any over- or under-reporting of the utilisation and specific costs will likely introduce some degree of measurement error; although in WHO SAGE, these data were reasonably well-reported (Kowal et al., 2012) and this recall period may not have major effect (Dalziel et al., 2018; Kjellsson et al., 2014). Annual costs were estimated from costs incurred during the last health facility visit which was available from the WHO SAGE. However, due to factors such as the season of visit and level of facility last visited, costs may be over- or underestimated. To provide additional scenarios around the costs, sensitivity analyses on annual costs were conducted by varying the unit (OOP, NHIS and total) costs by ±20%. Findings from the sensitivity analyses show that costs burden may differ based on the dispersion around the average costs. However, the significantly high costs burden due overweight and obesity compared to normal weight would remain the same. Additionally, since this is population-based and not hospital data, our study may not have accounted for some specific healthcare costs directly associated with obesity from sections, such as physiotherapy and dietician services. Therefore, we propose that future health services utilisation and healthcare costs evaluations use hospital data that would most likely capture all costs.

Regarding costs, this study could not account for indirect costs including those associated with absenteeism or presenteeism as these were not captured in the WHO SAGE. Even though the data is representative of the population aged 50 years and above, the analysis omits observations with missing data and BIVs. Hence, there is a chance for selection bias to be

introduced that might have affected external validity. However, missing data formed less than 5% of the total sample, which is likely to have minimal effect on the analysis (Dong & Peng, 2013). Lastly, as this is a cross-sectional study the results are indicative of associations rather than causal relationships.

To the best of our knowledge, evidence of association between health service utilisation as well as costs and BMI have been predominantly conducted in developed economies (Buchmueller & Johar, 2015; Dee et al., 2015; Doherty et al., 2012; Hugh et al., 2015; Konig et al., 2015; Suehs et al., 2017) but are scarce especially, in sub-Saharan Africa. A major strength of this study is the effort made to extend such analyses to a sub-Sahara African setting where prevalence of overweight and obesity are reported to be on the increase.

Conclusion

This study provides evidence of the utilisation and cost burden of overweight and obesity in Ghana. The results demonstrate that overweight and obesity were associated with increased health service utilisation and direct healthcare costs. One in five respondents in the overweight or obese population had at least one chronic disease, and having chronic disease was associated with increased outpatient utilization. Additionally, our study showed that even though the combined prevalence of overweight and obesity was 36%, the total cost burden was almost double that of normal weight. This cost burden to the government was high since it may have to bear more than half the healthcare costs per person. The results provide a compelling evidence to include those 50+ years in the Ministry of Health NCDs strategy and thus suggest the need for cost-effective and sustainable preventative and weight management programs to mitigate the associated increased health service utilization and high cost burden of overweight and obesity.

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Table 1: Characteristics of older adult (50+ years) respondents, WHO SAGE Wave 2 (2014/15)

Characteristics		Weighted Prevalence (%)
Sample, n (%)		3350 (100)
Sex	Males	47.1
	Females	52.9
BMI		
	Underweight	10.1
	Normal	53.8
	Overweight	22.9
	Obesity	13.2
Educational Level	Low	70.3
	High	29.7
Marital Status	Single	2.7
	Married/Cohabiting	63.5
	Divorced/ separated /Widow	33.8
Location	Rural	51.7
	Urban	48.3
Employment status	Employed	69.5
	Unemployed	30.5
Household Wealth Status	Lowest	13.0
	Low	19.7
	Moderate	22.0
	High	22.0
	Highest	23.4
Health Insurance	Uninsured	28.3
	Insured	71.7
Has a chronic disease	No	83.3
	Yes	16.7

All estimates are weighted

Table 2. Health service usage, by weight status among older adult (50+ years) respondents in Ghana, WHO SAGE Wave 2 (2014/15)

		Utilization (mean number of visits per year)			
		Outpatient visits		Inpatient Services	
	Weight status	No.	Mean (95%CI)	No.	Mean (95%CI)
Full Sample	Underweight	429	0.8 (0.7, 1.0)	429	0.1 (0, 0.2)
	Normal	1854	1.0 (0.8, 1.2)	1854	0.1 (0, 0.2)
	Overweight	683	1.5 (1.3, 1.7)	683	0.1 (0, 0.3)
	Obese	384	2.2 (1.9, 2.4)	384	0.1 (0, 0.5)
Only those who visited health facility	Underweight	179	2.0 (1.7, 2.5)	19	1.9 (0.9, 2.3)
	Normal	874	2.0 (1.8, 2.2)	98	1.3 (1.0, 1.5)
	Overweight	360	2.8 (2.4, 3.2)	44	2.1 (1.8, 2.2)
	Obese	218	3.7 (3.4, 4.2)	21	2.5 (2.4, 2.6)

All estimates are weighted
CI mean confidence interval

Table 3. Factors associated with health service utilization among older adult population in Ghana, 2014/15

Characteristics		†Annual Outpatient Utilization				†Annual Inpatient Utilization			
		Univariable		Multivariable		Univariable		Multivariable	
		[1]IRR	95% CI	IRR	95%CI	IRR	95% CI	IRR	95% CI
Weight status (Ref: Normal)	Underweight	0.90	0.68, 1.18	0.83	0.66, 1.06	1.58	0.52, 4.76	1.66	0.71, 3.87
	Overweight	1.44**	1.14, 1.83	1.15	0.92, 1.42	2.20***	1.46, 3.32	1.75**	1.21, 2.53
	Obesity	2.17***	1.74, 2.70	1.53**	1.19, 1.98	2.70**	1.48, 4.93	2.59*	1.20, 5.51
Sex (Ref: Male)	Female	1.77***	1.50, 2.09	1.60***	1.33, 1.92	1.20	0.77, 1.87	1.08	0.72, 1.62
Age, years	Age	1.02***	1.01, 1.03	1.02**	1.01, 1.03	1.01	0.98, 1.03	1.01	0.99, 1.02
Educational level (Ref: Low)	High	1.26*	1.04, 1.53	1.35**	1.09, 1.68	1.56*	1.06, 2.29	1.20	0.84, 1.87
Marital status (Ref: Single)	Married/ Co-habiting	1.97*	1.10, 3.53	2.20*	1.19, 4.05	0.96	0.11, 3.40	1.17	0.20, 4.92
	Divorced/ separated/Widow	3.24***	1.82, 5.77	2.66**	1.47, 4.82	1.18	0.12, 4.36	1.06	0.18, 4.38
Location (Ref: Rural)	Urban	1.22	0.98, 1.51	0.82	0.66, 1.02	2.09**	1.30, 3.34	1.23	0.75, 2.02
Employment status (Ref: Employed)	Unemployed	1.70***	1.41, 2.06	1.40**	1.15, 1.69	1.91**	1.22, 2.99	1.53*	1.11, 2.44
Household wealth status (Ref: Lowest)	Low	1.97***	1.35, 2.87	1.81***	1.31, 2.50	1.87	0.74, 4.74	1.39	0.52, 3.70
	Moderate	2.26***	1.61, 3.20	2.07***	1.49, 2.87	3.52**	1.50, 5.25	2.34	0.90, 6.10
	High	2.44***	1.82, 3.31	2.14***	1.52, 3.01	5.40**	2.05, 6.18	2.82*	1.02, 6.89
	Highest	3.29***	2.39, 4.52	2.68***	1.86, 3.85	5.83***	2.36, 7.41	3.62*	1.25, 7.20
Health insured (Ref: Uninsured)	Insured	1.44**	1.15, 1.80	1.19	0.96, 1.48	1.95	0.96, 3.94	1.79*	1.09, 2.96
Having chronic disease (Ref: No)	Yes	1.84***	1.43, 2.37	1.38*	1.07, 1.78	1.79**	1.28, 2.50	1.17	0.81, 1.70
[2]Intercept		0.87***	0.76, 1.00	0.58***	0.10, 0.89	0.63***	0.51, 0.79	0.15	0.01, 1.61

†Annual mean utilization estimated as the sum of outpatient visits and inpatient stays 12months prior to data collection.
[2]Intercept for univariate pertains to only BMI categories.
[1]IRR = incident rate ratio
CI = confidence interval
*P <0.05
**P <0.01
***P <0.001

Table 4. Annualised direct healthcare cost per person by out-of-pocket (OOP) costs, National Health Insurance Scheme (NHIS) and Total by weight status among older adult (50+ years) respondents in Ghana, WHO SAGE Wave 2 (2014/15)

Sample used	Weight status	OOP cost per person [Mean (95%CI)]			NHIS cost per person [Mean (95%CI)]			Total Costs per person (OOP +NHIS) [Mean (95%CI)]
		Outpatient visits	**Inpatient services**	**Total OOP**	**Outpatient visits**	**Inpatient services**	**Total NHIS**	**Total Costs**
Full Sample	Underweight	8.6 (6.3, 10.8)	9.3 (1.7, 19.1)	17.9 (10.0, 28.0)	15.6 (13.8, 19.0)	5.1 (2.7, 7.7)	22.1 (18.7, 25.5)	41.1 (30.4, 51.9)
	Normal	13.9 (6.4, 20.3)	4.3 (1.8, 6.8)	14.5 (10.3, 18.6)	13.5 (12.2, 14.8)	4.5 (3.4, 5.6)	20.3 (18.8, 21.7)	34.8 (29.9, 39.5)
	Overweight	19.4 (13.0, 25.7)	10.9 (1.5, 20.2)	30.2 (18.9, 41.5)	27.0 (23.6, 30.4)	20.3 (12.6, 27.1)	47.3 (41.7, 53.0)	77.5 (55.6, 95.8)
	Obese	33.3 (25.1, 41.5)	14.9 (6.0, 36.2)	48.2 (25.6, 70.8)	50.9 (44.6, 57.2)	18.9 (9.6, 28.1)	83.6 (60.7, 96.40)	131.9 (107.7, 162.1)
Only those	Underweight	17.4 (15.2, 25.5)	223.1 (52.5, 417.6)	233.5 (63.5, 429.8)	40.2 (38.3, 42.8)	121.6 (94.7, 141.5)	146.1 (116.7, 170.5)	379.6 (213.3, 567.2)
who visited	Normal	18.1 (15.0, 21.2)	95.0 (48.7, 139.4)	116.4 (48.5, 196.6)	31.0 (29.7, 32.3)	99.0 (93.4, 110.3)	120.9 (111.6, 130.1)	234.0 (168.9, 317.9)
health	Overweight	42.8 (30.5, 43.1)	220.8 (60.2, 390.0)	245.9 (82.3, 418.6)	59.7 (57.7, 61.0)	225.6 (229.6, 277.6)	292.3 (263.4, 317.0)	538.2 (373.4, 707.9)
facility	Obese	65.3 (53.8, 75.8)	326.8(124.5, 657.0)	381.7 (98.3, 722.0)	99.8 (95.3, 106.4)	413.6 (386.5, 534.6)	486.9 (457.7, 616.1)	868.6 (510.1, 1224.2)

CI = confidence interval

Note: Government bore for each person approximately 60% share of the total direct healthcare costs in the older adult population in 2014/15.

Table 5. Prevalence-based NHIS and total direct healthcare costs (2014/15), by BMI categories among older adult population (50+ years) in Ghana. Population source: Ghana Statistical Service.

	Weight status			
	Underweight	**Normal**	**Overweight**	**Obesity**
Prevalence, %	10.1	53.8	22.9	13.2
2015 Total adult Population (aged 50+y) = 3,462,016.00, n	349,664	1,862,565	792,801	456,986
[1]Prevalence-based NHIS costs (95% CI)	7,727,565.91 (6,538,709.62, 8,916,422.21)	37,810,061.54 (35,016,214.63, 40,417,651.99)	37,499,518.71 (33,059,829.39, 42,018,488.19)	38,204,038.96 (27,739,057.00, 44,053,461.20)
[1]Prevalence-based total costs (95% CI), $	$14,371,175 (10,629,774, 18147542)	$64,817,248 (55,690,682, 73,571,302)	$61,442,129 (44,079,773, 75,950,399)	$60,276,468 (49,217,404, 74,077,449)

[1] Prevalence-based costs estimated from total costs by weight status categories for full sample
CI = confidence interval

Table 6. Factors associated with direct healthcare costs (annualised cost per person) among older adult population in Ghana, 2014/15

	Annualised total costs [Predicted incremental costs]				OOP Costs [Predicted incremental costs]				NHIS Costs [Predicted incremental costs]			
	Univariate		Multivariate		Univariate		Multivariate		Univariate		Multivariate	
	Cost	95% CI	Cost	95% CI	Cost	95% CI	Cost	95% CI	Cost	95% CI	Cost	95% CI
Weight status (Ref: Normal)												
Underweight	20	-4.66, 37.47	20.35	-7.19, 19.88	10.81	-5.00, 22.60	9.48	-6.38, 11.35	12.6	-1.30, 6.49	10.51	-1.51, 8.53
Overweight	39.57***	24.96, 54.18	37.86***	26.71, 49.02	18.00**	6.47, 29.53	17.68***	9.67, 25.68	21.57***	15.90, 27.24	20.13***	15.08, 25.18
Obesity	87.68***	59.55, 115.81	63.96***	48.71, 79.20	35.98***	13.16, 58.79	28.16***	18.83, 37.48	51.71***	40.04, 63.37	34.64***	26.92, 42.36
Sex (Ref: Male)												
Female	17.04**	7.16, 26.93	14.03	-1.52, 22.32	1.5	-7.61, 8.6	1.06	-5.57, 10.77	16.53***	12.59, 20.48	7.75***	3.60, 11.89
Age, years	3.4	-.09, 8.95	1.81**	0.91, 3.30	1.32	-0.15, 3.79	1.45**	1.30, 7.55	1.18	-2.02, 3.84	1.34**	0.13, 2.55
Educational level (Ref: Low)												
High	31.61***	16.05, 47.17	17.19**	7.23, 27.16	23.63***	10.71, 36.54	12.21***	5.76, 18.67	7.98**	2.68, 13.28	5.64	-0.99, 8.26
Marital status (Ref: Single)												
Married/Co-habiting	20	-9.31, 49.56	34.11*	0.27, 67.96	7.19	-10.20, 24.68	9.29	-6.03, 24.61	12.93*	0.35, 25.51	23.70**	5.91, 41.49
Divorced/ Separated/Widow	36.47*	6.92, 66.02	42.47*	9.80, 75.14	11.19	-6.00, 28.37	11.62	-2.55, 25.79	25.28***	12.06, 38.50	28.48**	10.53, 46.42
Location (Ref: Rural)												
Urban	16.11*	3.92, 28.31	10.97	-2.57, 24.37	5.70	-3.57, 15.00	6.16	-2.20, 17.11	10.41***	5.26, 15.56	7.91	-2.73, 12.92
Employment status (Ref: Unemployed)												
Employed	21.43**	6.68, 36.18	9.1	-0.59, 8.78	13.95	1.81, 26.08	5.94*	1.50, 11.37	7.48**	2.08, 12.89	3.17	-2.38, 6.71
Household wealth status (Ref: Lowest)												
Low	11.47**	4.37, 18.58	15.11*	1.63, 28.58	3.5	-0.05, 7.04	4.22	-3.55, 11.99	7.97**	3.46, 12.49	8.57*	1.95, 16.20
Moderate	23.07***	13.12, 33.01	28.72**	11.96, 45.47	9.31	2.82, 15.81	14.31*	3.06, 25.56	13.75***	8.67, 18.83	12.34**	4.70, 19.99
High	41.54***	30.38, 52.71	38.24***	22.73, 53.75	16.87	9.34, 24.41	18.86***	8.81, 28.91	24.67***	18.52, 30.82	18.30***	10.45, 26.16
Highest	65.97***	46.00, 85.94	45.73***	29.53, 61.93	34.24	18.27, 50.21	24.57***	13.74, 35.40	31.72***	23.93, 39.52	19.28***	10.84, 27.73
Health insured (Ref: Uninsured)												
Insured	13.19*	1.70, 28.07	7.34	-2.63, 17.31	-2.09	-8.97, 10.79	3.53	-10.00, 5.91	15.27***	10.91, 19.63	12.52***	8.23, 16.81
Having chronic disease (Ref: No)												
Yes	27.15*	5.73, 48.58	18.01	-1.09, 25.07	10.85*	2.11, 28.81	7.45	-8.08, 18.13	16.30***	7.80, 24.80	10.84	-3.78, 16.81
Intercept	51.54***	45.75, 57.32	51.79***	46.35, 57.22	21.47***	17.04, 25.91	21.16***	17.51, 25.84	30.06***	27.55, 32.58	30.24***	27.73, 32.75

CI = confidence interval
*P<0.05, **P<0.01, ***P<0.001

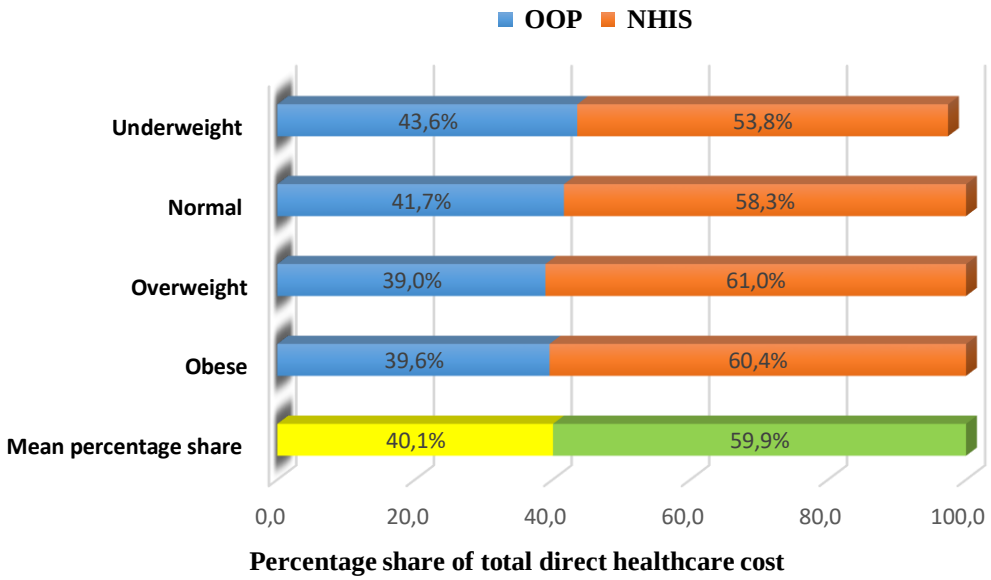

Figure 1. Percentage cost share per person between out-of-pocket (OOP) and the National Health Insurance scheme (NHIS) costs, among older adult population in Ghana WHO SAGE 2014/15. For each person, Government bore approximately 60% share of the total direct healthcare costs in the older adult population in 2014/15. Mean percentage cost share for OOP shown in yellow and that of NHIS shown in green.

Supplementary Tables

Appendix 1: Disease mapping from G-DRG to purpose (diagnosis) of hospital visit in WHO-SAGE

DRG Code	Disease on DRG	Disease in SAGE
MEDI28A	Malaria	Communicable disease (e.g. Malaria)
MEDI05A	Malnutrition	Nutritional deficiencies
MEDI23A	Diarrhoea	Acute conditions (e.g. diarrhoea)
MEDI02A	Simple Diabetes	Diabetes
MEDI32A	Hypertension	Hypertension
MEDI07A	Heart Disease	Heart Problems
MEDI14A	Cerebro-Vascular Accident/Stroke	Stroke
OBG34A	Spontaneous vaginal delivery	Maternal
ORTHO1A	Injury	Injury
ASUR30A	General Surgery	Surgery
ZOOM02A	Detention for Observation and Treatment - Adult	Unspecified inpatient disease
OPD06A	General [1]OPD - Adult	Unspecified OPD disease

Appendix 1 Legend: [1]OPD means outpatient department. Diseases identified in the WHO SAGE data as the main purpose for health facility attendance. Minimum service prices were obtained from the G-DRG, 2015 tariffs that is the current version and was used for reimbursement in 2017.

Appendix 2: Mean medication costs from NHIA District offices (based on 2017 figures)

	Secondary/Hospital Level		Other primary health Levels
Districts	**Outpatient**	**Inpatient**	**Outpatient**
Atiwa	30.2	64.9	14.8
Kwahu South	34.7	101.1	10.9
Affram Plains	14.4	58.2	10.9
Fanteakwa	29.6	88.4	10.9
*Osu Klottey	40.5	110.0	0.0
Mean Total costs **(GHS)**	29.9	84.5	9.5
Mean Total costs **(USD)**	6.9	19.4	2.2

Note: Mean medication costs received from East Gonja and Shai Osudoku Districts were not used because the costs of service and medication were not separated. *****Mainly, Ridge hospital

Appendix 3: Sensitivity analysis of annualised direct healthcare costs per person by out-of-pocket (OOP), National Health Insurance Scheme (NHIS) and total costs by weight status among older adult (50+ years) respondents in Ghana, WHO SAGE Wave 2 (2014/15).

Sample used	Weight status	OOP costs	NHIS costs	*Total Costs	OOP costs	NHIS costs	Total Costs	OOP costs	NHIS costs	Total Costs
		Mean (95% CI)			Mean (95% CI) varied by -20%			Mean (95% CI) varied by +20%		
Whole Full Sample	Underweight	17.9 (10.0, 28.0)	22.1 (18.7, 25.5)	41.1 (30.4, 51.9)	14.3 (8.0, 22.4)	17.7 (15.0, 20.4)	32.9 (24.3, 41.5)	21.5 (12, 33.6)	26.5 (22.4, 30.6)	49.3 (36.5, 62.3)
	Normal	14.5 (10.3, 18.6)	20.3 (18.8, 21.7)	34.8 (29.9, 39.5)	11.6 (8.2, 14.9)	16.2 (15.0, 17.4)	27.8 (23.9, 31.6)	17.4 (12.4, 22.4)	24.4 (22.7, 26.0)	41.8 (35.9, 47.4)
	Overweight	30.2 (18.9, 41.5)	47.3 (41.7, 53.0)	77.5 (55.6, 95.8)	24.2 (15.1, 33.2)	37.8 (33.6, 42.4)	62.0 (44.5, 76.6)	36.2 (22.7, 49.8)	56.8 (50.0, 63.6)	93.0 (66.7, 115.0)
	Obese	48.2 (25.6, 70.8)	83.6 (60.7, 96.40)	131.9 (107.7, 162.1)	38.6 (20.5, 56.6)	66.9 (48.6, 77.1)	105.5 (86.2, 129.7)	57.8 (30.7, 85.0)	10.3 (72.8, 115.7)	158.3 (129.2, 194.5)
Only those who visited health facility	Underweight	233.5 (63.5, 429.8)	146.1 (116.7, 170.5)	379.6 (213.3, 567.2)	186.8 (50.8, 343.8)	116.9 (93.4, 136.4)	303.7 (170.6, 453.8)	280.2 (76.2, 515.8)	175.3 (140.0, 204.6)	455.5 (256.0, 680.6)
	Normal	116.4 (48.5, 196.6)	120.9 (111.6, 130.1)	234.0 (168.9, 317.9)	93.1 (38.8, 157.3)	96.7 (89.3, 104.1)	187.2 (135.1, 254.3)	139.7 (58.2, 235.9)	145.1 (133.9, 156.1)	280.8 (202.7, 381.5)
	Overweight	245.9 (82.3, 418.6)	292.3 (263.4, 317.0)	538.2 (373.4, 707.9)	196.7 (65.8, 334.9)	292.3 (263.4, 317.0)	430.6 (298.7, 566.3)	295.1 (98.8, 502.3)	350.8 (316.1, 380.4)	645.8 (448.1, 849.5)
	Obese	381.7 (98.3, 722.0)	486.9 (457.7, 616.1)	868.6 (510.1, 1224.2)	305.4 (78.6, 577.6)	389.5 (366.2, 492.9)	694.9 (408.1, 979.4)	458.0 (118.0, 866.4)	584.3 (549.2, 739.3)	1042.3 (612.1, 1469.0)

*Total costs per person was estimated as the sum of the average OOP and NHIS costs per person.