ScienceDirect
Contents lists available at sciencedirect.com
Journal homepage: www.elsevier.com/locate/jval

Patient-Reported Outcomes

Evaluation of the Association Between Health State Utilities and Obesity in Sub-Saharan Africa: Evidence From World Health Organization Study on Global AGEing and Adult Health Wave 2

Stella T. Lartey, MPH, MA,[1] Lei Si, PhD,[2] Barbara de Graaff, PhD,[1] Costan G. Magnussen, PhD,[1,3] Hasnat Ahmad, MPhil,[1] Julie Campbell, PhD,[1] Richard Berko Biritwum, MBBS,[4] Nadia Minicuci, PhD,[5] Paul Kowal, PharmD,[6,7] Andrew J. Palmer, MBBS[1,*]

[1]Menzies Institute for Medical Research, University of Tasmania, Hobart, Australia; [2]The George Institute for Global Health, University of New South Wales, Kensington, Australia; [3]Research Centre of Applied and Preventive Cardiovascular Medicine, University of Turku, Turku, Finland; [4]Department of Community Health, University of Ghana, Accra, Ghana; [5]National Research Council, Neuroscience Institute, Padova, Italy; [6]World Health Organization, Geneva, Switzerland; [7]University of Newcastle Research Centre for Generational Health and Ageing, Newcastle, Australia

ABSTRACT

Background: Obesity is a major public health challenge and its prevalence has increased across the age spectrum from 1980 to date in most parts of the world including sub-Saharan Africa. Studies that derive health state utilities (HSUs) stratified by weight status to support the conduct of economic evaluations and prioritization of cost-effective weight management interventions are lacking in sub-Saharan Africa.

Objectives: To estimate age- and sex-specific HSUs for Ghana, along with HSUs by weight status. Associations between HSUs and overweight and obesity will be examined.

Study Design: Cross-sectional survey of the Ghanaian population.

Methods: Data were sourced from the World Health Organization Study of Global AGEing and Adult Health (WHO SAGE), 2014 to 2015. Using a "judgment-based mapping" method, responses to items from the World Health Organization Quality-of-Life (WHOQOL-100) used in the WHO SAGE were mapped to EQ-5D-5L profiles, and the Zimbabwe value set was applied to calculate HSUs. Poststratified sampling weights were applied to estimate mean HSUs, and a multivariable linear regression model was used to examine associations between HSUs and overweight or obesity.

Results: Responses from 3966 adults aged 18 to 110 years were analyzed. The mean (95% confidence interval) HSU was 0.856 (95% CI: 0.850, 0.863) for the population, 0.866 (95% CI: 0.857, 0.875) for men, and 0.849 (95% CI: 0.841, 0.856) for women. Lower mean HSUs were observed for obese individuals and with older ages. Multivariable regression analysis showed that HSUs were negatively associated with obesity (−0.024; 95% CI: −0.037, −0.011), female sex (−0.011; 95% CI: −0.020, −0.003), and older age groups in the population.

Conclusions: The study provides HSUs by sex, age, and body mass index (BMI) categories for the Ghanaian population and examines associations between HSU and high BMI. Obesity was negatively associated with health state utility in the population. These data can be used in future economic evaluations for Ghana and sub-Saharan African populations.

Keywords: health economic evaluations, health state utilities, obesity, sub-Saharan Africa, WHO SAGE Wave 2.

VALUE HEALTH. 2019; 22(9):1042–1049

Introduction

Overweight and obesity, hereafter referred to as high body mass index (BMI), has become a major public health challenge with increasing prevalence reported among adults aged 18 years and older in most parts of the world, including sub-Saharan Africa, between 1980 and 2014.[1] In particular, the prevalence of obesity among adults in urban West African populations has doubled over a period of 15 years since 1990,[2,3] an indication for the need to institute sustainable prevention and management measures. BMI is widely used to determine whether someone is in a healthy weight range for a given height. It is calculated as body mass (measured in kilograms) divided by the square of body height (measured in meters). The World Health Organization (WHO)

Conflict of interest: The authors declare that no competing interests exist.

* Address correspondence to: Andrew J. Palmer, MBBS, Health Economics, Menzies Institute for Medical Research, University of Tasmania, Medical Sciences 2 Building, 17 Liverpool St Hobart 7000, Tasmania, Australia. Email: andrew.palmer@utas.edu.au

https://doi.org/10.1016/j.jval.2019.04.1925

Table 1. Summary statistics of study participants in WHO-SAGE Wave 2 (2014-2015).

Number of participants	3966
BMI (kg/m^2)	25.1 (5.1)
BMI categories	
Normal BMI	59.5
Overweight	26.6
Obese	13.9
Age, years	40.2 (14.9)
Sex	
Males	44.8
Females	55.2
Age group	
18-49 years	77.8
50-64 years	15.0
65+ years	7.2
Education status	
Low	60.1
High	39.9
Marital status	
Married/cohabiting	59.5
Divorced/separated	15.5
Single	25.0
Place of residence	
Rural	47.9
Urban	52.1
Household wealth quintile	
Lowest	10.6
Low	17.0
Moderate	19.0
High	25.0
Highest	28.4
Smoking	
Never smoked	94.7
Quitted smoking	2.0
Currently smokes	3.3
Found to have chronic disease	
No	91.9
Yes	8.1

Note. All values are weighted. Data are mean (standard deviation) for continuous variables and percentages for categorical variables. BMI denotes body mass index calculated as weight in kilograms divided by squared height in meters.

Table 2. EQ-5D-5L dimensions (%) stratified by body mass index categories in the Ghanaian adult population (2014-2015).

EQ-5D-5L profiles	Normal weight	Over weight	Obese	Total
N	2468	960	538	3966
Mobility				
No problem	80.5	85.0	78.4	81.4
Slight problem	14.0	10.7	14.0	13.1
Moderate problem	4.2	3.4	5.5	4.2
Severe problem	1.2	1.0	2.1	1.3
Unable to do	0.2	0.0	0.2	0.1
Self-care				
No problem	88.3	93.8	93.8	90.2
Slight problem	9.5	5.2	5.2	8.0
Moderate problem	1.9	0.7	0.7	1.5
Severe problem	0.1	0.1	0.1	0.2
Unable to do	0.1	0.1	0.1	0.1
Usual activity				
No problem	79.0	83.7	81.5	80.6
Slight problem	14.5	9.8	9.4	12.5
Moderate problem	4.9	4.5	6.8	5.1
Severe problem	0.7	0.5	0.7	0.6
Unable to do	1.0	1.4	1.7	1.2
Pain/discomfort				
No problem	67.8	71.1	59.0	67.4
Slight problem	22.7	19.5	22.9	21.9
Moderate problem	7.7	6.9	14.4	8.4
Severe problem	1.4	2.2	3.6	1.9
Unable to do	0.3	0.3	0.2	0.3
Anxiety/depression				
No problem	72.5	78.6	77.1	74.8
Slight problem	19.8	14.3	15.5	17.7
Moderate problem	6.7	6.4	4.6	6.3
Severe problem	0.9	0.7	4.6	1.1
Unable to do	0.2	0.0	0.2	0.1

Note. All are weighted estimates.

defines overweight as a BMI $\geq$ 25.00 and $<$ 30.00 kg/m^2 and obesity as a BMI $\geq$ 30.00 kg/m^2.[4] Although high BMI is often regarded culturally as a source of beauty and a sign of affluence in some developing countries,[2,5] it is associated with many chronic diseases, including type 2 diabetes mellitus, hypertension, lipid disorders, osteoarthritis, gallbladder disease, strokes, some cancers, heart disease, and obstructive sleep apnoea in addition to reduced life expectancy.[6,7] Internationally, several studies have reported that high BMI has further been associated with a reduction in quality-adjusted life-years (QALYs) and a high economic burden owing to the associated medical and treatment costs.[8–10]

Health state utilities (HSUs) indicate the numerical strength of preference for a health state and are globally accepted as health-related quality of life weights.[11,12] Age- and sex-specific HSUs for a population can be used to calculate QALYs, a common measure of effectiveness used in cost-utility analyses (CUA).[13] CUA is a common approach used in health economic evaluations to inform and support decision making.[14] CUA is preferred over cost-effectiveness analysis (CEA) by many health economic evaluation entities because CUA allows for comparisons across different health interventions and diseases and incorporates more aspects of health and well-being.[14,15]

Several outcome measures can be used in CUA, including disability-adjusted life-years, health-adjusted life-years, healthy years equivalent, and QALYs.[13] QALYs, one of the most commonly used outcomes, combines HSUs with survival time. The HSU scale ranges from 0 (corresponding to death) to 1 (corresponding to perfect health), with negative values representing states worse than death.[13]

Preference-based measures for health outcomes are used to estimate HSUs with a prescored multi-attribute health status classifications system.[13,16,17] Nevertheless, generic preference-based measures are not often used in clinical trials of new therapies, and it is more common that a non–preference-based measure is adopted to measure the health status of interest. In this case, mapping or cross-walking from non–preference-based measure to preference-based measure can be used to statistically estimate the HSUs.[13,17–20] In recent times, many mapping models have been developed to estimate HSUs. These models use a range of statistical methods, including ordinary least squares, 2-part models, ordinal logit or multinomial logit regression models, cart analysis, and the censored least absolute deviation model.[17]

Table 3. Age- and sex-specific health state utilities (HSUs) using EQ-5D-5L in the adult population of Ghana.

Age group (years)	Males HSU (SD) (95% CI)				Females HSU (SD) (95% CI)
	Normal weight	**Overweight**	**Obese**	**Total**	**Normal weight**
Total	0.866 (0.089) (0.857, 0.875)	0.867 (0.081) (0.853, 0.881)	0.849 (0.099) (0.815, 0.941)	0.866 (0.088) (0.858-0.874)	0.852 (0.092) (0.841-0.861)
18-29	0.895 (0.064) (0.884-0.906)	0.904 (0.022) (0.895-0.913)	0.900* *	0.896 (0.059) (0.887-0.906)	0.881 (0.072) (0.864-0.898)
30-39	0.891 (0.062) (0.875-0.907)	0.879 (0.068) (0.841-0.918)	0.861 (0.061) (0.786-0.935)	0.886 (0.064) (0.872-0.901)	0.870 (0.067) (0.854-0.887)
40-49	0.857 (0.090) (0.839-0.875)	0.876 (0.065) (0.853-0.899)	0.875* *	0.863 (0.082) (0.849-0.878)	0.855 (0.083) (0.835-0.876)
50-59	0.837 (0.097) (0.821-0.852)	0.840 (0.094) (0.813-0.866)	0.797 (0.162) (0.722-0.871)	0.834 (0.102) (0.819-0.850)	0.807 (0.101) (0.792-0.823)
60-69	0.822 (0.101) (0.809-0.836)	0.815 (0.102) (0.783-0.847)	0.832 (0.130) (0.764-0.899)	0.821 (0.102) (0.807-0.834)	0.793 (0.107) (0.775-0.810)
70+	0.763 (0.134) (0.743-0.782)	0.729 (0.176) (0.669-0.789)	0.715* *	0.766 (0.142) (0.736-0.775)	0.737 (0.132) (0.719-0.756)

Note. All are weighted estimates.
*Data in this age group were not enough to estimate standard deviation and confidence intervals. The subsample for obese males in age group 18-29 years (n = 1), 40-49 years (n = 7), and ≥70 years (n = 13).

Although HSUs are essential for CUA, they are lacking in most low- and middle-income countries, including sub-Saharan Africa, largely because preference-based measures have not been included in data collections.[21] In addition, the absence of algorithms and value sets has been a further barrier.[21] In such situations, algorithms and value sets from similar populations have previously been adopted as proxies for more precise local utilities.[9,20,22,23]

To achieve the Universal Health Coverage and the Sustainable Development Goal 3 on health, Ghana has identified the need to improve the quality and efficiency in its healthcare services to provide fair and equitable access to health.[24,25] Nevertheless, the lack of parameters, including those to measure effectiveness, has been a major challenge hindering the course of conducting health economic evaluations in the population,[26] hence the need to develop these parameters. Our study aims to address one aspect of this by providing HSU estimates for both the general population of Ghana and for BMI categories. HSU data for the general population can be used across a broad range of health economic evaluations in Ghana and similar countries that lack such data. This can be particularly useful when evaluating new interventions for which short-term trial data are available. As many health economic evaluations adopt medium- to long-term time horizons, estimates of general population HSUs can be used for the period after the trial. For example, in a cost-effectiveness analysis of intensive versus standard blood pressure control,[27] long-term HSUs were based on general population HSUs from the Medical Expenditure Panel Survey. Also, in the cost-effectiveness analysis of screening for osteoporosis in Chinese women, the age-specific HSUs for the female general population were retrieved from the National Health Services Survey 2008—a population-wide survey for the comparator.[28] As such, the HSUs reported in this study will be critical to future health economic evaluations in the Ghanaian population. Thus, our estimated HSUs are intended for use in a range of health economic models, including those that will simulate progression through the BMI health states to assess the impact of changing prevalence on clinical and economic outcomes.

HSUs may differ based on factors such as age, sex, and BMI status.[9,29,30] Generating these HSUs could differentiate the quality of life of men and women across different ages and BMI categories and hence improve the accuracy of the cost-effectiveness results. Thus, our study aims to derive the first age- and sex-specific HSUs and HSUs stratified by weight status (ie, healthy weight, overweight, obese) for Ghanaian adults. In addition, we examine the extent to which HSUs are associated with overweight and obesity.

Methods

Study Population

Data for persons aged ≥18 years from Wave 2 of the World Health Organization's Study on global AGEing and adult health (WHO SAGE) in Ghana were used.[31,32] Details on data can be found at http://www.who.int/healthinfo/sage/cohorts/en/. We used the GhanaINDDataW2 and GhanaHHDataW2. Briefly, SAGE collected individual-level data from nationally representative households of adults using a stratified, multistage cluster design. The primary sampling units were stratified by region and location of residence (urban/rural) with samples selected from 250 enumeration areas. This study used responses from the individual questionnaire in the individual dataset. 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). Further information on WHO SAGE can be found at http://www.who.int/healthinfo/sage/cohorts/en/.

Of the 4735 survey respondents, 229 had missing data for height, 227 for weight, and 207 for one or more EQ-5D-5L dimensions. Also, biologically implausible values (height <100 cm

Table 3. Continued

Females HSU (SD) (95% CI)			Total Mean HSU (SD) (95% CI)			
Overweight	Obese	Total	Normal weight	Overweight	Obese	Total
0.857 (0.081) (0.849-0.866)	0.831 (0.096) (0.815-0.847)	0.849 (0.090) (0.841-0.856)	0.860 (0.091) (0.852-0.867)	0.861 (0.081) (0.853-0.869)	0.834 (0.097) (0.818-0.849)	0.856 (0.090) (0.850-0.863)
0.890 (0.040) (0.879-0.901)	0.892 (0.031) (0.881-0.903)	0.885 (0.096) (0.875-0.896)	0.889 (0.068) (0.878-0.899)	0.894 (0.036) (0.886-0.902)	0.893 (0.029) (0.883-0.903)	0.890 (0.060) (0.883-0.898)
0.875 (0.048) (0.862-0.889)	0.844 (0.094) (0.804-0.884)	0.866 (0.070) (0.853-0.879)	0.879 (0.066) (0.867-0.891)	0.877 (0.055) (0.862-0.892)	0.847 (0.090) (0.811-0.882)	0873 (0.068) (0.863-0.884)
0.856 (0.078) (0.837-0.876)	0.833 (0.072) (0.809-0.856)	0.848 (0.078) (0.835-0.862)	0.856 (0.087) (0.842-0.871)	0.865 (0.073) (0.849-0.881)	0.838 (0.070) (0.815-0.861)	0.856 (0.080) (0.845-0.867)
0.805 (0.103) (0.786-0.825)	0.795 (0.105) (0.772-0.818)	0.804 (0.103) (0.792-0.815)	0.824 (0.099) (0.812-0.836)	0.821 (0.100) (0.804-0.839)	0.796 (0.118) (0.772-0.819)	0.818 (0.104) (0.807-0.829)
0.802 (0.096) (0.782-0.823)	0.754 (0.132) (0.708-0.800)	0.786 (0.112) (0.769-0.803)	0.809 (0.1104) (0.797-0.821)	0.809 (0.099) (0.790-0.828)	0.764 (0.134) (0.721-0.808)	0.803 (0.109) (0.790-0.816)
0.733 (0.149) (0.701-0.765)	0.710 (0.187) (0.654-0.766)	0.733 (0.144) (0.716-0.750)	0.750 (0.133) (0.735-0.764)	0.732 (0.158) (0.702-0.761)	0.711 (0.218) (0.662-0.760)	0.743 (0.143) (0.729, 756)

or >250 cm, and weight <30.0 kg or >250.0 kg) were excluded using listwise deletion.[33,34] A total of 229 (4.8%) respondents who had missing data and 25 (0.005%) with biologically implausible values were excluded from the analyses. Because the focus of this study was on those with high BMI, those who were underweight (weighted proportion = 7%) were excluded from our analyses. In total, 16% of observations were excluded from the analyses. Consequently, 3966 (84%) participants who had complete responses were included in the final estimation sample for this study.

Variables

Outcome variable: health state utilities

Ideally, the collection of primary data using a preference-based measure is used to calculate HSUs. Nevertheless, preference-based measures have not been used in large population surveys in Ghana: the WHO SAGE employed the WHOQOL-100, a non–preference-based measure. The items on the WHOQOL-100 have been used in more than 100 studies worldwide to measure quality of life.[35] Nevertheless, WHOQOL-100 is a non–preference-based instrument, and HSUs cannot be directly calculated. To calculate HSUs, a 2-step approach was used. First, using a judgment-based method,[12,19,36] items from the WHOQOL-100 questionnaire in the WHO SAGE individual questionnaire were mapped onto the European Quality-of-Life (EQ-5D-5L), a preference-based measure (see Appendix I in Supplemental Materials found at https://doi.org/10.1016/j.jval.2019.04.1925). Second, according to the responses in the WHOQOL-100, we assigned a HSU for each individual using the EQ-5D-5L scoring algorithm.

A valid judgment-based mapping could be achieved in one of two ways[19]: first, the dimensions of the preference-based measure must be included in the source measure, for example, survey, and items must correspond to those of the preference-based measure. The mapping could be conducted using the dimensions or items. Another approach is to choose specific health states described in the source measure and assign them onto a generic health state descriptive system or the preference-based measure. Because of the subjectivity associated with this method,[19] and structural challenges especially, when response levels are condensed, empirical mapping methods[13] are preferred. Nevertheless, the judgment-based method of mapping is a useful alternative to generate HSUs where a non–preference-based measure is the only measure included in a study, as in the case of WHO SAGE. Despite the usefulness of the judgment-based mapping in such conditions, this method should not supersede the empirical methods of mapping when data are available from both preference and non–preference-based measure for the same population, and this weakness should be considered when interpreting our results.

The EQ-5D-5L instrument is a simple and widely used generic preference-based measure used to estimate HSUs. The EQ-5D-5L comprises 5 domains: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression, with 5 response options[37] (1 for no problems, 2 for slight problem, 3 for moderate problems, 4 for severe problems, and 5 for extreme problems/unable to perform activity). The WHOQOL-100 instrument is an international, cross-cultural comparable tool that covers 24 facets hierarchically organized within 6 domains: physical, psychological, level of independence, social relationships, environment, and spirituality, with an additional facet representing overall quality of life and health. For each item under the domains, 5 response options are available (1 for none or no problem, 2 for mild, 3 for moderate, 4 for severe, and 5 for extreme).[35] Under the domains, there are items that address mobility, self-care, usual activities, pain or discomfort, and anxiety or depression. Thus, the EQ-5D-5L and WHOQOL-100 have domains and response items that closely correspond to each other.

The EQ-5L-5L responses were mapped with 1 through 5 corresponding to 1 through 5 on the WHOQOL-100 item responses. We were then able to assign values and utility weights derived from the EQ-5D-5L value set. Judgment-based mapping of the WHOQOL-100 items to EQ-5D-5L was advantageous because each WHOQOL-100 item had 5-level responses that corresponded directly to the responses on the EQ-5D-5L. Furthermore, use of the

Table 4. Multivariable regression estimates (β) and 95% confidence intervals of association between health state utility and categories of body mass index and other covariates in Ghanaian adults, 2014-2015.

	Univariable		Multivariable	
	β (95% CI)	P	β (95% CI)	P
BMI categories				
Normal BMI	Reference		Reference	
Overweight	0.002 (−0.008 to 0.011)	.720	0.003 (−0.006 to 0.012)	.479
Obese	−0.026 (−0.042 to −0.010)	.002	−0.024 (−0.037 to −0.011)	<.001
Sex				
Males	Reference		Reference	
Females	−0.017 (−0.026 to −0.008)	<.001	−0.011 (−0.020 to −0.003)	.009
Age group				
18-49 years	Reference		Reference	
50-64 years	−0.056 (−0.066 to −0.046)	<.001	−0.047 (−0.057 to −0.036)	<.001
65+ years	−0.113 (−0.124 to −0.100)	<.001	−0.101 (−0.114 to −0.087)	<.001
Education status				
Low	Reference		Reference	
High	0.026 (0.017-0.035)	<.001	0.007 (0.001-0.016)	.099
Marital status				
Married/cohabiting	Reference		Reference	
Divorced/separated	−0.019 (−0.032 to −0.006)	.004	0.006 (−0.004 to 0.016)	.261
Single	0.043 (0.034-0.053)	<.001	0.026 (0.016-0.036)	<.001
Place of residence				
Rural	Reference		Reference	
Urban	0.011 (−0.002 to 0.023)	.092	−0.001 (−0.014 to 0.012)	.878
Household wealth quintile				
Lowest	Reference		Reference	
Low	0.015 (−0.004 to 0.034)	.131	0.015 (−0.004 to 0.033)	.119
Moderate	0.021 (0.002-0.040)	.026	0.020 (−0.003 to 0.038)	.025
High	0.033 (0.014-0.053)	.001	0.028 (0.009-0.048)	.004
Highest	0.039 (0.019-0.059)	<.001	0.035 (0.015-0.057)	.001
Smoking				
Never smoked	Reference		Reference	
Quitted smoking	−0.008 (−0.036 to 0.019)	.543	0.010 (−0.016 to 0.035)	.462
Currently smokes	−0.014 (−0.049 to 0.020)	.416	−0.010 (−0.046 to 0.026)	.580
Found to have chronic disease				
No	Reference		Reference	
Yes	−0.043 (−0.062 to −0.023)	<.001	−0.015 (−0.032 to 0.001)	.068
Constant	—	—	0.847 (0.828-0.867)	

EQ-5D-5L instead of the EQ-5D-3L had the advantage of reducing the ceiling effect and improved the discriminatory effect.[38,39] In addition, aside from mapping closely corresponding questions from both instruments, directly mapping 5-level WHOQOL-100 to 5-level EQ-5D-5L rather than condensing the WHOQOL-100 5-level responses to match the EQ-5D-3L 3-level responses helps to overcome any structural and response rating challenges.[12,36] We used the Zimbabwe EQ-5Q-5L value set and the calculator from the EuroQol Group's crosswalk project[39] because Ghana currently does not have its own dataset.

Explanatory and other variables

The main explanatory variables were overweight and obesity with normal weight as the base category. In the WHO SAGE, anthropometric measurements of body weight and height of respondents were taken using standard protocols.[31] BMI were categorized according to WHO classifications as follows: normal BMI, BMI = 18.50 to ≤25.00 kg/m^2; overweight, BMI = 25.00 to ≤30.00 kg/m^2; obesity, BMI ≥30.00 kg/m^2.[4]

Covariates were included based on previous literature,[9,40] and these included age, sex, educational level, marital status, locality (rural/urban), household wealth status, smoking status, and having been found to have a chronic disease.

Statistical Analysis

Accounting for the poststratified person's weight, age-, sex-, and BMI-specific mean HSUs were generated using the Zimbabwe EQ-5D-5L value set. Sampling weights provided in the WHO SAGE data were used.[32] Univariable and multivariable survey linear regression models were used to examine the association between HSUs and high BMI using normal weight as the reference category.[41] A 2-tailed *P*-value <.05 was considered as statistically significant. All statistical analyses were conducted using STATA version 15.0 (Stata Corp, College Station, Texas, USA).

Ethics Approval and Consent to Participate

The WHO SAGE study was approved by the WHO's Ethical Review Board and the University of Ghana Medical School Ethics and Protocol Review Committee in Ghana.[32] Therefore, we were not required to obtain a separate ethics approval for this study. We used the GhanaINDDataW2 and the SAGE Individual Questionnaire. All files are available from the WHO database.

Results

The sample used in the analyses comprise 3966 adults aged 18 to 110 years (84% of the total sample). Sampling weights were applied throughout the analyses. HSUs could not be calculated for 207 respondents who had missing data for one or more EQ-5D-5L dimensions. Of the 207 respondents, 31% were female, 10% obese, 38% overweight, and 65% were aged below 50 years. In the final sample of 3966 adults, the mean (standard deviation) age was 40.2 (14.9) years, and BMI was 25.1 (5.1) kg/m^2. Most respondents resided in urban areas (52%), were female (55%), had normal BMI (59.5%), were with low education (60%), and were from households with the highest level of wealth (28.4%) (Table 1). Table 2 shows the proportion who reported problems for each level of the 5 EQ-5D-5L domains for the BMI categories. Around one-fifth of the sample, respectively, reported that they experienced slight pain or discomfort (21.9%) and slight anxiety or depression (17.7%). Few respondents reported any problems in the self-care domain. In all, 44% of males and 56% of females reported no problems across all EQ-5D-5L health domains.

Age- and BMI-specific mean HSUs stratified by sex and for the population are presented in Table 3. The mean HSU (95% confidence interval) for the population was 0.856 (95% CI: 0.850, 0.863), 0.866 (95% CI: 0.858, 0.874) for males, and 0.849 (95% CI: 0.841, 0.856) for women. In general, whereas HSUs were slightly higher for persons who were overweight compared with normal weight and higher as household wealth increased, HSUs were lower for women and obese participants and decreased with age. In univariable analysis, factors that were significantly associated with HSU were obesity, sex, age, marital status, household wealth, and being found to have a chronic disease (Table 4). These factors were then used in the multivariable regressions. Although the inclusion of these variables attenuated the coefficients for the obesity categories, they remained statistically significant. Other factors also remained significantly associated with HSU in the multivariable analysis. Being obese was associated with significantly lower HSU (β = −0.024; 95% CI: −0.037, −0.011), whereas overweight was associated with higher HSU; however, this was not statistically significant. HSUs for women were 0.011 (95% CI: 0.003, 0.020) lower than for men, and higher in those with moderate, high, or higher household wealth compared with those within the lowest income quintiles.

Discussion

For the Ghanaian population, few studies have focused on finding the effect of BMI on health-related quality of life, and to-date, no studies have generated age- and sex-specific HSUs and HSUs stratified by weight status or studied the extent to which HSUs are associated with high BMI.[2,42,43] Nevertheless, in most low- and middle-income countries, particularly in sub-Saharan Africa, increasing prevalence of obesity has been reported, which in turn is a major risk factor for non-communicable diseases.[44–46] The lack of HSUs for the population underscores the difficulties in conducting economic evaluations to support the effective prioritization of health programs or health technology assessments within the Ghanaian and other sub-Sahara African populations. This study bridges this gap by generating age- and sex-specific HSUs and HSUs by weight status and by examining the associations between HSUs and high BMI in a sub-Sahara African setting. Most importantly, the weighted age- and sex-specific HSUs can be used to calculate QALYs, which may be used for economic evaluations for the Ghanaian context. In addition, HSUs generated by weight status can be used to support cost-effectiveness evaluations of measures, policies, or interventions to address overweight or obesity in this setting.

In this study, around two-fifths of respondents reported slight problems with pain and discomfort or anxiety and depression, and the least problems were reported for self-care. We found that HSUs were significantly lower in persons who were obese compared with normal weight, women compared with men, and in older age groups compared with younger age groups. In addition, HSUs were significantly higher for respondents who were single compared with married and higher as household wealth increased. Although the association was not significant, the results showed that HSUs were positively associated with overweight in the population. HSUs were also not significantly associated with respondents' education, place of residence, smoking, or having a chronic disease.

In most countries where HSUs have been calculated, mean individual HSUs were slightly lower than our study reported.[9,29,30] We found a strong negative association between HSU and obesity; controlling for other factors made only a small difference. Our findings of lower HSUs for obese respondents and for older respondents are consistent with previous studies.[8,9,30,40,47,48] Nevertheless, contrary to findings in previous studies, we found that both the unadjusted and adjusted HSUs for overweight were higher compared with normal BMI, although this was not significant.[9,29,30]

The negative associations found between HSU and obesity but not overweight may be an effect of general awareness of the health consequences of obesity.[49] In most settings in low- and middle-income countries, such as Ghana, the recognition of high BMI as a public health problem is a more recent phenomenon[2]; however, the burden associated with this may have existed over a longer period. Just like in most developing countries, to some people in Ghana, high BMI may be considered as beautiful and as a sign of affluence,[2,5] despite the associations with many chronic diseases and reduced life expectancy. Although recent improvements in public health activities have likely increased awareness around the health problems associated with overweight and obesity, addressing these societal norms will be a critical aspect of future public health initiatives.

The key strength of this study is the attempt to generate age- and sex-specific HSUs and HSUs by weight status and to determine the associations between HSU and high BMI for the Ghanaian population. The set of age- and sex-specific HSUs that we have generated can be used to calculate QALYs for CUA in the general Ghanaian population and in similar sub-Saharan countries. Specifically, the BMI-specific HSUs can be used to calculate QALYs for economic evaluations that are required to guide decision making around policy and preventative and management measures for overweight and obesity in sub-Saharan Africa. Instead of condensing the WHOQOL-100 responses and mapping onto the EQ-5D-3L responses, we used judgment-based mapping for the WHOQOL-100 five-level responses to the EQ-5D-5L, an instrument that reduces ceiling and floor effects.[38,39] We also used objectively measured weights and heights rather than self-reported. Although we used the most current population-based data to calculate HSUs—rarely available in sub-Saharan Africa—

our study has several limitations. First, we used a non–preference-based instrument (WHOQOL-100) to indirectly estimate HSUs. Employing mapping models is the second-best method to obtain utility values. In the WHO SAGE, because only a non–preference-based instrument was implemented during data collection, we used the judgment-based method to map items and responses to the EQ-5D-5L; this may reduce the precision of the HSUs obtained. Our results only provide interim HSUs that will be useful in cost-utility analyses in the Ghanaian population. To provide more reliable HSUs, we recommend that future studies use direct HSU elicitation methods or preference-based measures to generate a better population HSUs in Ghana. The second limitation is the use of the Zimbabwe value set as the surrogate. The Zimbabwe EQ-5D-5L value set was derived from the existing EQ-5D-3L, which was based on data collected from 2488 high-density urban dwellers in 2000.[39,50] Because of the differences in economic and political environment between Ghana and Zimbabwe,[51] both of which may affect health outcomes in the populations, the preference weights might vary. Health states valued differently in the Ghanaian population will result in biased HSUs in our study. Nevertheless, this value set was used because the characteristics of this population are much closer to that of the Ghanaian population in comparison to other existing value sets. Finally, the WHO SAGE data are cross-sectional, and therefore we could not estimate the effect of changes in high BMI and subsequent HSUs. Although the data are representative of the older adult Ghanaian population, because we omitted participants with missing anthropometric or EQ-5D-5L dimensions data, we may have introduced selection bias. Nevertheless, missing data accounted for less than 5% of the total sample,[52] and our use of sampling weights in the analyses reduced the potential for selection bias.

Despite these limitations, we have used the most robust statistical methods available to generate HSUs for the population. QALYs, an important outcome measure recommended by national bodies such as National Institute for Health and Care Excellence (NICE), can be estimated by combining HSU and survival/life expectancy. In turn, these QALYs can be used in CUA. Until a population-based study is conducted to determine HSUs for the Ghanaian population, these estimates can provide baseline HSUs for use in future CUA for Ghana.

In conclusion, our study provides age- and sex-specific HSUs and HSUs by weight status, and investigates associations between HSU and high BMI. We found HSUs to be negatively associated with obesity, to be lower among women, and to be lower among those of older age. The age- and sex-specific HSU can be used to calculate QALYs, which may be used for a range of health economic evaluations for the population. The study also provides HSUs by weight status, which will be important in studies to evaluate the cost-effectiveness of preventative and management actions for overweight and obesity.

Acknowledgments

We appreciate access to a preliminary version of SAGE Ghana Wave 2 data used for the analyses in this article.

Source of Financial Support

The authors received no specific funding for this work. Prof. Andrew J. Palmer is funded by the Centre of Excellence in Population Ageing Research, Australian Research Council (CE170100005). The National Heart Foundation of Australia Future Leader Fellowship (100849) supports Dr. Costan G. Magnussen. Dr. Lei Si is supported by an NHMRC Early Career Fellowship (Grant number: GNT1139826). The Study on global AGEing and adult health (SAGE) Wave 2 was supported by WHO and the US National Institute on Aging's Division of Behavioural and Social Science Research (BSR) through Interagency Agreements (OGHA 04034785; YA1323-08-CN-0020; Y1-AG-1005-01) with the WHO. Financial and in-kind support has come from the University of Ghana's Department of Community Health.

Supplemental Materials

Supplementary data associated with this article can be found in the online version at https://doi.org/10.1016/j.jval.2019.04.1925.

REFERENCES

1. Mendis S, Armstrong T, Bettcher D, et al. *Global Status Report on Noncommunicable Diseases 2014: Attaining the Nine Global Noncommunicable Diseases Targets; A Shared Responsibility*. Geneva: World Health Organization; 2014.
2. Agyemang C, Boatemaa S, Frempong GA, Aikins Ad-G. Obesity in Sub-Saharan Africa. In: Ahima RS, ed. *Metabolic Syndrome*. Cham, Switzerland: Springer; 2016:41–53.
3. Abubakari A, Lauder W, Agyemang C, Jones M, Kirk A, Bhopal R. Prevalence and time trends in obesity among adult West African populations: a meta-analysis. *Obes Rev*. 2008;9:297–311.
4. World Health Organization. *Obesity: Preventing and Managing the Global Epidemic*. Geneva: World Health Organization; 2000.
5. Low S, Chin M, Deurenberg-Yap M. Review on epidemic of obesity. *Ann Acad Med Singapore*. 2009;38:57–65.
6. Peeters A, Barendregt J, Willekens F, et al. Obesity in adulthood and its consequences for life expectancy: a life table analysis. *Ann Intern Med*. 2003;138:24–32.
7. Prospective Studies Collaboration, Whitlock G, Lewington S, et al. Body-mass index and cause-specific mortality in 900 000 adults: collaborative analyses of 57 prospective studies. *Lancet*. 2009;373:1083–1096.
8. Slagter S, Vliet-Ostaptchouk J, Beek A, et al. Health-related quality of life in relation to obesity grade, type 2 diabetes, metabolic syndrome and inflammation. *PLoS One*. 2015;10(10):e0140599.
9. Kortt MA, Clarke PM. Estimating utility values for health states of overweight and obese individuals using the SF-36. *Qual Life Res*. 2005;14:2177–2185.
10. Lehnert T, Sonntag D, Konnopka A, Riedel-Heller S, König H-H. Economic costs of overweight and obesity. *Best Pract Res Clin Endocrinol Metab*. 2013;27:106–115.
11. Karimi M, Brazier J. Health, health-related quality of life, and quality of life: what is the difference? *PharmacoEconomics*. 2016;34(7):645–649.
12. Ahmad H, Taylor BV, van der Mei I, et al. The impact of multiple sclerosis severity on health state utility values: evidence from Australia. *Mult Scler*. 2017;23(8):1157–1166.
13. Drummond MF, Schulpher MJ, Claxton K, Stoddart GL, Torrance GW. *Methods for the Economic Evaluation of Health Care Programmes*. 4th ed. Oxford: Oxford University Press; 2015.
14. Jakubiak-Lasocka J, Jakubczyk M. Cost-effectiveness versus cost-utility analyses: what are the motives behind using each and how do their results differ?—a Polish example. *Value Health Reg Issues*. 2014;4:66–74.
15. National Information Center on Health Services Research and Health Care. Health Economics Information Resources: A Self-Study Course: Module 4 2016. https://www.nlm.nih.gov/nichsr/edu/healthecon/04_he_06.html. Accessed November 12, 2018.
16. Wailoo AJ, Hernandez-Alava M, Manca A, et al. Mapping to estimate health-state utility from non–preference-based outcome measures: an ISPOR Good Practices for Outcomes Research Task Force Report. *Value Health*. 2017;20:18–27.
17. Brazier J, Yang Y, Tsuchiya A, Rowen D. A review of studies mapping (or cross walking) non-preference based measures of health to generic preference-based measures. *Eur J Health Econ*. 2010;11(2):215–225.
18. Alava MH, Wailoo A, Wolfe F, Michaud K. A comparison of direct and indirect methods for the estimation of health utilities from clinical outcomes. *Med Decis Making*. 2014;34:919–930.
19. Brazier J, Ratcliffe J, Salomon J, Tsuchiya A. *Measuring and Valuing Health Benefits for Economic Evaluation*. 2nd ed. Oxford: Oxford University Press; 2016.
20. Wee HL, Yeo KK, Chong KJ, Khoo EYH, Cheung YB. Mean rank, equipercentile, and regression mapping of World Health Organization Quality of Life Brief (WHOQOL-BREF) to EuroQoL 5 Dimensions 5 Levels (EQ-5D-5L) utilities. *Med Decis Making*. 2018;38(3):319–333.
21. Kularatna S, Whitty JA, Johnson NW, Scuffham PA. Health state valuation in low- and middle-income countries: a systematic review of the literature. *Value Health*. 2013;16:1091–1099.
22. McCaffrey N, Kaambwa B, Currow DC, Ratcliffe J. Health-related quality of life measured using the EQ-5D–5L: South Australian population norms. *Health Qual Life Outcomes*. 2016;14(1):133.

23. Norman R, Church J, van den Berg B, Goodall S. Australian health-related quality of life population norms derived from the SF-6D. *Aust N Z J Public Health*. 2013;37(1):17–23.
24. Ministry of Health. In: Office of the Chief Director, ed. Ghana: Ministry of Health; 2016:7–28. *National Community-Based Health Planning and Services (CHPS) Policy*; Vol 1.
25. United Nations. *Transforming Our World: The 2030 Agenda for Sustainable Development*. New York: United Nations.
26. Chalkidou K, Lord J, Gad M. *Improving the Quality and Efficiency of Healthcare Services in Ghana Through HTA: Cost-Effective Care for Managing Hypertension in Ghana, May 2017*. London: Minstry of Health Ghana and International Decision Support Initiative Imperial College London; 2017. https://www.oxfordscholarship.com/view/10.1093/acprof:oso/9780199692125.001.0001/acprof-9780199692125-chapter-13.
27. Bress AP, Bellows BK, King JB, et al. Cost-effectiveness of intensive versus standard blood-pressure control. *N Engl J Med*. 2017;377(8):745–755.
28. Si L, Winzenberg TM, Jiang Q, Palmer AJ. Screening for and treatment of osteoporosis: construction and validation of a state-transition microsimulation cost-effectiveness model. *Osteoporos Int*. 2015;26:1477–1489.
29. Keating C, Peeters A, Swinburn B, Magliano D, Moodie M. Utility-based quality of life associated with overweight and obesity: the Australian Diabetes, Obesity, and Lifestyle Study. *Obes J*. 2013;21(3):652–655.
30. Lin VW, Wong ES, Wright A, et al. Association between health-related quality of life and body mass after adjustable gastric banding: a nonlinear approach. *Value Health*. 2013;16:823–829.
31. World Health Organization. *WHO SAGE Survey Manual*. Geneva: World Health Organization; 2006.
32. Kowal P, Chatterji S, Naidoo N, et al. Data resource profile: the World Health Organization Study on global AGEing and adult health (SAGE). *Int J Epidemiol*. 2012;41:1639–1649.
33. Subramanian SV, Ozaltin E, Finlay JE. Height of nations: a socioeconomic analysis of cohort differences and patterns among women in 54 low- to middle-income countries. *PLoS One*. 2011;6(4):1–13.
34. Cois A, Day C. Obesity trends and risk factors in the South African adult population. *BMC Obes*. 2015;2(42):1–10.
35. The WHOQOL Group. The World Health Organization Quality of Life Assessment (WHOQOL): development and general psychometric properties. *Soc Sci Med*. 1998;46(12):1569–1585.
36. Al-Ruzzeh S, Epstein D, George S, et al. Economic evaluation of coronary artery bypass grafting surgery with and without cardiopulmonary bypass: cost-effectiveness and quality-adjusted life years in a randomized controlled trial. *Artificial Organs*. 2008;32(11):891–897.
37. Kind P. *The EuroQol Instrument: An Index of Health-related Quality of Life*. 2nd ed. Philadelphia, PA: Lippincott Raven; 1996.
38. Janssen M, Birnie E, Haagsma J, Bonsel G. Comparing the standard EQ-5D three-level system with a five-level version. *Value Health*. 2008;11:275–284.
39. van Hout B, Janssen MF, Feng YS, et al. Interim scoring for the EQ-5D-5L: mapping the EQ-5D-5L to EQ-5D-3L value sets. *Value Health*. 2012;15(5):708–715.
40. Si L, Shi L, Chen M, Palmer AJ. Establishing benchmark EQ-5D-3L population health state utilities and identifying their correlates in Gansu Province, China. *Qual Life Res*. 2017;26(11):3049–3058.
41. Groves R. *Survey Methodology*. Hoboken, NJ: John Wiley & Sons; 2014.
42. Duda RB, Jumah NA, Hill AG, Seffah J, Biritwum R. Interest in healthy living outweighs presumed cultural norms for obesity for Ghanaian women. *Health Qual Life Outcomes*. 2006;4(44):1–7.
43. Ofori-Asenso R, Agyeman AA, Laar A, Boateng D. Overweight and obesity epidemic in Ghana—a systematic review and meta-analysis. *BMC Public Health*. 2016;16(1239):1–18.
44. Daniels Jr ME, Donilon TE, Bollyky TJ. *The Emerging Global Health Crisis Noncommunicable Diseases in Low- and Middle-Income Countries*. New York: Council on Foreign Relations; 2014.
45. Friedrich MJ. Global health: rates of noncommunicable diseases increasing in developing countries. *JAMA*. 2015;313:3.
46. Baldwin W. *The Burden of Non-communicable Diseases in the Developing World: A Role for Social and Behavioral Research*. Rockville, MD: Agency for Healthcare Research and Quality; 2015.
47. Lee AJ, Morgan CL, Morrissey M, Wittrup-Jensen KU, Kennedy-Martin T, Currie CJ. Evaluation of the association between the EQ-5D index (health-related utility) and body mass index (obesity) in hospital-treated people with type 1 diabetes, type 2 diabetes and with no diagnosed diabetes. *Diabetic Med*. 2005;22:1482–1486.
48. Dennett SL, Boye KS, Yurgin NR. The impact of body weight on patient utilities with or without type 2 diabetes: a review of the medical literature. *Value Health*. 2008;11:3.
49. World Health Organization. *Global Health Risks: Mortality and Burden of Disease Attributable to Selected Major Risks*. Geneva: World Health Organization; 2009.
50. Jelsma J, Hansen K, De Weerdt W, De Cock P, Kind P. How do Zimbabweans value health states? *Popul Health Metr*. 2003;1(1):11.
51. Bowden S, Mosley P. Four African case studies; Ghana, Uganda, Kenya, and Zimbabwe. In: *The Politics of Poverty Reduction*. Oxford: Oxford University Press; 2012.
52. Dong Y, Peng C-YJ. Principled missing data methods for researchers. *Springerplus*. 2013;2:222.