Public Health Nutrition: 24(14), 4522–4529 doi:10.1017/S1368980020003717

High BMI: an important health risk factor among older adults in Ghana

E Yorke[1,*], J Tetteh[2], Vincent Boima[1] and AE Yawson[2]

[1]Department of Medicine and Therapeutics, School of Medicine and Dentistry, College of Health Sciences, University of Ghana, PO Box GP 4236, Accra, Ghana: [2]Department of Community Health, School of Public Health, College of Health Sciences, University of Ghana, Accra, Ghana

Submitted 15 April 2020: Final revision received 11 August 2020: Accepted 17 September 2020: First published online 15 October 2020

Abstract

Objective: We examined BMI as a health risk factor for self-reported diabetes mellitus, angina, strokes and arthritis among older Ghanaians aged 50 years and above.
Design: We analysed the individual-level data from the World Health Organization Study on global AGEing and adult health Ghana Wave 2 (2014/2015). The influence of BMI on self-reported chronic conditions including diabetes, angina, stroke and arthritis was examined.
Setting: Households from all the administrative regions of Ghana.
Participants: Included 3350 adults aged 50 years and older.
Results: The prevalence of overweight and obesity among participants was 22·8 % (95 % CI 20·6, 25·2) and 13·2 %, respectively (95 % CI 11·5, 15·1). With respect to individual chronic conditions, arthritis emerged with the highest prevalence rate of 7·3 (95 % CI 5·3, 9·9), while the prevalence rate of diabetes, angina and stroke was 2·8 % (95 % CI 2·0, 3·9), 1·7 % (95 % CI 1·1, 2·6) and 1·3 % (95 % CI 1·0, 1·8), respectively. The risk of diabetes among overweight and obesity was over three and two times, respectively, higher compared with participants with normal weights. Overweight and obesity were significantly more than two and three times likely to experience angina, respectively, compared with participants with normal weight. Obesity significantly influences arthritis with approximately two times increased odds compared with normal weight participants.
Conclusion: Prevalence of obesity and overweight in Ghana is high and increasing, which poses a health risk at the individual and population levels. Inter-sectorial and multidisciplinary measures in line with the national non-communicable disease policies aimed at curbing this trend are imperative.

Keywords
Obesity
Overweight
BMI
Cardiometabolic diseases

The prevalence of obesity is on a steady rise globally as well in Africa[1–3]. Many parts of Africa, especially among northern and southern African countries, continue to have worsening BMI estimations over the past decades[4]. While many developing countries including Ghana are still battling with infectious diseases, non-communicable diseases related to obesity, dietary and lifestyle changes have been on the rise over the past few decades[5–7]. Generally, risk factors for high BMI (obesity and overweight) in Africa include the lack of physical activity, over nutrition and consumption of high-fat, energy-dense diets, alcohol abuse, urban dwelling, increasing age, being middle class or above and attainment of higher education[8,9].

In Ghana, a study by Amoah AG in 2003 found out that the overall crude prevalence of overweight and obesity among adults aged 25 years and older in both rural and urban Accra was 23·4 % and 14·1 % for females and males, respectively. The rates of overweight (27·1 % *v.* 17·5 %) and obesity (20·2 % *v.* 4·6 %) were both higher in women than in men[8]. Also in 2005, a nationwide WHO health survey of 5000 adults aged 18 years and older published by Biritwum and his colleagues found the prevalence of obesity to be 5·5 % and higher among females 7·4 % compared with males 2·8 %. The highest prevalence of 16·1 % was reported in the Greater Accra with the least affected regions being Upper East or Upper West regions[9].

The health, economic and social consequences of overweight and obesity are enormous[7,10–12]. Obesity and overweight are significant risk factors for many cardiovascular and metabolic conditions such as diabetes

*Corresponding author: Email pavlovium@yahoo.com

mellitus, hypertension, coronary artery disease, strokes, dyslipidaemia and fatty liver[11,13–15]. Being obese or overweight has also been highly associated with osteoarthritis (OA), obstructive sleep apnoea (OSA), altered sleep patterns, chronic lung disease and depression[11]. These conditions are associated with significant morbidity and mortality that overstretch health systems and budgets of many developing countries including Ghana[5,13].

We sought to examine BMI (obesity and overweight) as health risk factors for self-reported diabetes mellitus, angina, strokes and arthritis among older Ghanaians aged 50 years and above. As derived anthropometric measures (obesity and overweight), we ascertained how these measures were associated with (predicted) the stated chronic diseases above using the data from the Wave 2 of the WHO-SAGE (The World Health Organization Study on global AGEing and adult health) study.

Methods

Study setting

WHO Study on Global Ageing and Adult Health (SAGE) wave 2 (2014/2015) Ghana dataset was used. SAGE is a longitudinal study carried out on a wide range of health indicators, including health, disability and visual difficulties, subjective well-being and its determinants, health care utilisation relating to in-patient and outpatient care, anthropometric measurements health financing, human resources for health, health state and socio-economic conditions and other demographic characteristics were essentially captured in SAGE surveys[16,17]. This was implemented in six lower- to middle-income countries including China, Ghana, India, Mexico, Russian Federation and South Africa[18]. SAGE wave 0, 1 and 2 use the same sampling procedure[17,18].

Study participants

Two target populations were used in SAGE wave 2, which includes a large sample of persons aged 50 years and older (focus group for SAGE) and a smaller comparative sample of persons in reproductive age group (aged 18–49 years). Households were classified into mutually exclusive categories where one or more persons aged 50 years and older were selected from households classified as '50+ households' and one person aged 18–49 years from a household classified as an '18–49 household'. In the older households, all persons aged 50 years and older were invited to participate, while proxy respondents were identified for respondents who were unable to respond for themselves. Multistage cluster sampling design was used for Ghana wave 2 with 250 Primary Sample Unit and 20 strata[19,20]. Detailed study design and procedure for data collection adopted for the SAGE surveys have been published by Kowal *et al.* in 2012[21].

In all, about 4735 respondents were involved in the SAGE wave 2 with inclusion of both older adults and those in their reproductive age. Based on the objective of our study, those below the age of 50 years and missing responses were excluded leaving total sample size of 3350 older adults aged 50 years and above.

Dependent variables

Self-reported chronic conditions including diabetes, angina, stroke and arthritis were the main primary outcomes for the study. The reported condition was assessed by SAGE wave 2 asking question '*Has a health care professional/doctor ever told you that you have . . .?* Or *Have you ever been diagnosed with . . .?*'. The variables were coded as 1 'Yes' and 0 'No'.

Independent variables

Demographic variables

Sex differential, age group (< 59, 60–69, 70–79 and 80+), marital status (never married, married, separated/divorced and widowed), religion (None, Christian, Islam and Primal indigenous), place of residence (urban *v.* rural), region (the then ten administrative regions), ethnicity (Akan, Ewe, Ga-Adangbe, Gruma, Grusi, Guan, Mande-Busanga and Mole-Dagbon), alcohol intake (no or yes), smoking status (no or yes) and BMI. Anthropometric measurements involving height and weight were measured. Respondent's height measurement was done without any shoes with feet and heels close together, standing straight and looking forward with back and head and heels touching a wall with height measurement. The measurement was read in centimetres (cm), which was then converted into metres (m) due to the nature of the study objective. Weight was measured with shoes off with a step on a scale, which was measured in kg. BMI was calculated using the formula: BMI = Weight (kg)[Height(m)]^{222}. BMI classification was done as follows: 18·5–24·9 (normal weight), 25–29·9 (overweight) and 30+ (obesity)[22].

To assess alcohol intake, SAGE wave 2 asked participants '*Have you ever consumed a drink that contains alcohol (such as beer, wine, spirits)?*' Those who answered 'yes' were further asked, '*Have you consumed alcohol in the last 30 days?*' with responses 'yes or no'. Those who answered 'yes' were classified as current taking alcohol (yes) and otherwise (no). Also, for smoking status, participants were asked, '*Have you ever smoked tobacco or used smokeless tobacco?*' Those who answered 'yes' were further asked, '*Do you currently smoke any tobacco products (such as cigarettes, bidis, cigars, pipes)?*' with responses 'yes or no'. Those who answered 'yes' were classified as current smoking (yes) and otherwise (no).

https://doi.org/10.1017/S1368980020003717 Published online by Cambridge University Press

Data analysis

Two approaches of data analysis were carried out: descriptive statistics and inferential statistics. Descriptive statistics, which involved two-way observational weighted row percentage table involving independent variables, associated with BMI categories was done. The Rao–Scott χ^2 was implemented due to the complex design nature of SAGE wave 2. Before multivariate data analysis was performed, and multicollinearity data analysis was adopted to assess for any potential high correlation between outcome variables and the independent variables understudied. We adopted the Variance Inflation Factor Initial analyses which showed high collinearity for some variables, hence they were dropped. Final analysis showed no high potential collinearity between our outcome variables and independent variables (BMI, sex, age, place of residence, alcohol intake as smoking status) (mean Variance Inflation Factor < 3).

Inferential statistics involving logistics with a robust standard estimation (weighted estimation) was also carried out to assess the association of BMI and the primary outcomes adjusting for sex, age group, place of residence, alcohol intake and smoking as suggested in other studies. Stata 15 statistical software was used to perform the analysis, and the 'svy' command in Stata was taken into consideration for the estimations.

Results

The study involved 3350 participants aged 50 years and above with a mean (SD) age of 62·2 (9·9) years. The prevalence of overweight and obesity among participants was 22·8 % (95 % CI 20·6, 25·2) and 13·2 %, respectively (95 % CI 11·5, 15·1). With respect to individual chronic conditions among the understudied population, arthritis emerged with the higher prevalence rate of 7·3 (95 % CI 5·3, 9·9), while the prevalence rate of diabetes, angina and stroke was 2·8 % (95 % CI 2·0, 3·9), 1·7 % (95 % CI 1·1, 2·6) and 1·3 % (95 % CI 1·0, 1·8), respectively (see Table 1).

Descriptive prevalence of examined chronic conditions across BMI status shows that overweight and obesity participants suffer diabetes at a rate of 5·8 % and 4·4 %, respectively. Despite the fact that the obese population was fewer compared with participants with normal weight, obese patients had the highest prevalence rate of angina, stroke and arthritis (4·1 %, 2·1 % and 12 %, respectively). Surprisingly, underweight and normal weight participants encountered the second most prevalence rate of angina and arthritis, respectively (2·3 % and 7·2 %, respectively) (see Table 1).

The association between BMI and the chronic conditions understudied was assessed by adopting logistic regression, adjusting for sex differential, age groups, place of residence, alcohol intake and smoking status. The analysis shows that there was a significant association between BMI and the chronic conditions except stroke. The risk of diabetes among overweight and obesity was significantly over three and two times, respectively, higher compared with participants with normal weights (adjusted OR (95 % CI) *P*-value: 3·58 (1·74, 7·36) 0·001 and 2·73 (1·40, 5·31) 0·003, respectively). Meanwhile, overweight and obesity were significantly more than two and three times likely to experience angina, respectively, compared with participants with normal weight (adjusted OR (95 % CI) *P*-value = 2·08 (1·09, 3·97) 0·026 and 3·73 (1·47, 9·44) 0·006, respectively). Obesity significantly influences arthritis with approximately two times increased odds compared with normal weight participants (adjusted OR (95 % CI) *P* -value: 1·99 (1·09, 3·61) 0·025) (see Table 2).

Other adjusted covariates significantly influencing diabetes include age group > 80 years (and age 60–69 years) and being an urban dweller; age 70–79 years predicted stroke while age group (> 70)> 80 years and smoking history significantly influence arthritis (see Table 2).

Discussion

Our analysis revealed that the prevalence of overweight and obesity among older adults aged > 50 years in Ghana was 22·8 % and 13 .2 %, respectively, giving a combined prevalence of high BMI to be 36 %. This finding is similar to previous reports. Among Ghanaian adults, Commodore-Mensah *et al.* reported from their systematic review that overweight/obesity prevalence to be between 20 and 62 %[23]. Ofori-Asenso *et al.* also in a systematic review reported that 43 % of Ghanaian adults are either overweight or obese, with a national prevalence of overweight and obesity estimated to be 25·4 % (95 % CI 22·2, 28·7 %) and 17·1 % (95 % CI 14·7, 19·5 %), respectively. In this review, more urban than rural dwellers had a higher prevalence of overweight (27·2 % *v.* 16·7 %) and obesity (20·6 % *v.* 8·0 %)[7].

There appears to be a steady increase in the prevalence of obesity in Ghana and Africa in general[24,25]. The reason for this increase is manifold including the lack of physical activity, over nutrition and consumption of high-fat, energy-dense diets, alcohol abuse, urban dwelling, increasing age, being middle class or above and attainment of higher education[8,9]. A higher risk of overweight and obesity has been associated with Ghanaians who consume excess alcohol[25,26]. This rising trend of overweight and obesity has fuelled obesity-related chronic diseases[25].

Overweight and obesity are associated with cardiometabolic conditions such as diabetes mellitus, hypertension, coronary artery disease, strokes, dyslipidaemia and fatty liver[11,13–15] as well as osteoarthritis, (OA) obstructive sleep apnoea (OSA), altered sleep patterns, chronic lung disease and depression among others[11]. Our study found out that overweight and obesity were associated with highest prevalence of self-reported diabetes compared with participants with normal BMI or who were underweight.

https://doi.org/10.1017/S1368980020003717 Published online by Cambridge University Press

Table 1 Prevalence of diabetes, angina, stroke and arthritis by demographic characteristics among older adults

		Diabetes	Angina	Stroke	Arthritis
	Total	*n* 85 (2·8 %)	*n* 59 (1·7 %)	*n* 48 (1·3 %)	*n* 230 (7·3 %)
Demographic variable	*n*	Weighted %	Weighted %	Weighted %	Weighted %
Sex					
Male	1398	2·8	1·1	1·1	7·1
Female	1952	2·8	2·2	1·4	7·4
Age group					
<59	1248	1·9	1·5	0·9	4·9
60–69	1062	4·2	1·5	1·4	7·4
70–79	704	2·5	2·6	2	10·9
80+	336	3·8	1·6	1·8	15·2
Marital status					
Never married	109	1·7	2·6	1·6	6·5
Married	1915	2·5	1·4	0·8	6·2
Separated/Divorced	398	3·7	1·2	2·8	6·4
Widowed/Widower	928	3·2	2·4	1·9	10·9
Religion					
None	110	1·5	0	0	1·2
Christian	2399	3	2·1	1·6	8·2
Islam	628	2·8	0·6	0·1	5·6
Primal indigenous	213	0·9	0·8	1·2	4·1
Place of residence					
Urban	1289	4·4	2	1·6	9·3
Rural	2061	1·3	1·3	0·9	5·3
Region					
Ashanti	542	4·2	0·9	2·2	7·9
Brong Ahafo	363	1	2·1	1·1	5·6
Central	434	1·4	1·1	1·2	2·9
Eastern	259	1·5	1·2	0·9	6·5
GT. Accra	302	6·9	3·8	1	18·8
Northern	346	0·6	0·9	0·8	5·6
Upper East	193	1·2	0·3	0·3	1·9
Upper West	169	0·9	0·5	0·6	0·6
Volta	311	1·7	1·5	1·5	3·8
Western	431	3	2·6	1·5	6·2
Ethnicity					
Akan	1610	3·1	1·7	1·7	6·2
Ewe	191	6·8	5·4	0·7	22·5
Ga-Adangbe	418	2·7	1·6	1·9	4·1
Gruma	78	3·1	0	2·2	6·3
Grusi	32	1·7	2·8	0	5·6
Guan	135	1·5	1·9	0·4	5·4
Mande-Busanga	847	1	0·4	0·4	6·5
Mole-Dagbon	39	0	0	0	2·1
Alcohol intake					
No	2658	3·1	1·4	1·3	7·4
Yes	692	1·6	2·4	1	6·9
Smoking					
No	3202	2·9	1·8	1·2	6·6
Yes	148	0·4	0	1·8	20·4
BMI					
Underweight	429	0·8	2·3	1·2	6·1
Normal	1857	1·5	0·9	1·1	7·2
Overweight	680	5·8	1·9	1·1	5·3
Obesity	384	4·4	4·1	2·1	12

Obesity was also associated with highest prevalence of self-reported angina, stroke and arthritis compared with participants who were underweight, overweight or with normal BMI.

After adjusting for sex differential, age groups, place of residence, alcohol intake and smoking status, logistic regression revealed that the risk of diabetes among overweight and obesity was significantly over three and two times higher compared with participants with normal weights, respectively. Also, overweight and obese participants were significantly more than two and three times likely to experience angina, respectively, compared with participants with normal weight, whilst only obesity significantly influences arthritis with approximately two times increased odds compared with normal weight participants. Increasing weight significantly increases the risk of

https://doi.org/10.1017/S1368980020003717 Published online by Cambridge University Press

Table 2 Logistic regression showing BMI as a predictor of diabetes, angina, stroke and arthritis among older adults

	Chronic conditions											
	Diabetes			Angina			Stroke			Arthritis		
Demographic variable	aOR	95 % CI	*P* value	aOR	95 % CI	*P* value	aOR	95 % CI	*P* value	aOR	95 % CI	*P* value
BMI												
Normal		Ref			Ref			Ref			Ref	
Underweight	0·60	0·22, 1·61	0·305	2·51	1·08, 5·79	0·032*	0·99	0·33, 2·98	0·996	0·68	0·37, 1·23	0·207
Overweight	3·58	1·74, 7·36	0·001*	2·08	1·09, 3·97	0·026	0·97	0·41, 2·29	0·941	0·81	0·47, 1·40	0·459
Obesity	2·73	1·40, 5·31	0·003*	3·73	1·47, 9·44	0·006*	1·72	0·67, 4·43	0·261	1·99	1·09, 3·61	0·025*
Sex												
Male		Ref			Ref			Ref			Ref	
Female	0·74	0·36, 1·54	0·427	1·95	0·77, 4·93	0·157	1·13	0·52, 2·46	0·764	1·07	0·59, 1·90	0·826
Age group												
<59		Ref			Ref			Ref			Ref	
60–69	2·37	1·07, 5·24	0·033*	1·05	0·39, 2·77	0·919	1·69	0·73, 3·90	0·220	1·67	0·64, 4·34	0·289
70–79	1·66	0·69, 4·01	0·253	2·06	0·90, 4·73	0·086	2·48	1·06, 5·81	0·036*	2·79	1·36, 5·71	0·005*
80+	2·86	1·17, 6·95	0·021*	1·27	0·46, 3·50	0·635	2·23	0·80, 6·24	0·123	4·26	2·05, 8·84	0·000*
Place of residence												
Urban	2·65	1·49, 4·71	0·001*	1·34	0·65, 2·75	0·421	1·75	0·86, 3·53	0·120	1·83	0·97, 3·44	0·059
Rural		Ref			Ref			Ref			Ref	
Alcohol intake												
No		Ref			Ref			Ref			Ref	
Yes	0·60	0·26, 1·41	0·247	2·54	0·64, 10·2	0·186	0·78	0·27, 2·23	0·120	0·84	0·47, 1·51	0·564
Smoking												
No		Ref						Ref			Ref	
Yes	0·24	0·03, 1·71	0·152		–		1·96	0·58, 6·60	0·274	5·21	1·05, 25·8	0·044

aOR, Adjusted OR.
*$P < 0·05$.

diabetes in the long term[11]. In 2014, the prevalence of type 2 diabetes was estimated to be 6 %[7], which is about fifteen times higher than the prevalence of 0·4 % reported in 1956[25], a trend linked strongly with the rising incidence of overweight and obesity[7,25]. In a large study of 114 281 middle-aged women from eleven states in the USA to assess the relationship between adult weight change and the risk for clinical diabetes mellitus over a 14-year follow-up, the authors discovered that body weight was a major risk factor for diabetes after adjusting for age[27]. Also the study revealed the odds of having diabetes increase with weight gain.

Several studies have shown that weight loss is associated with significant risk reduction for diabetes and CVD[25,27]. In the Nurses' Health Study, mentioned above[27], a 5 kg weight loss resulted in a 50 % reduction in the risk of diabetes. The landmark trial of the Diabetes Prevention Programme demonstrated that long-term weight loss was also associated with a reduction in the risk of type 2 diabetes[28]. Another large landmark randomised control trial involving over 5000 type 2 diabetes patients with BMI > 25 kg/m^2, the Look AHEAD (Action for Health in Diabetes) study[29], compared intensive lifestyle as the intervention with usual care and education as the control arm. There was a significant body weight reduction in favour of the intensive arm compared with the control arm (8·6 % *v.* 0·7 %, $P < 0·001$) with improved diabetes control and CVD risk factors such as central body fat distribution, subcutaneous fat and waist circumference at the end of year one.

As we found in our study, obesity has been linked with arthritis particularly OA of the knee[30,31] with a moderate association with hip OA[31]. The effects of OA include chronic pain, reduced mobility and loss of productivity that impact on the quality of life[30,32]. In the Rotterdam study, a BMI > 27 kg/m^2 was associated with a 3·3-fold greater risk of radiographically confirmed OA and progression of knee of the knee OA but not the hip[30]. Significantly, symptoms and signs of OA can be improved by losing weight leading to improvement in disability[33–35].

Obesity is a recognised independent risk factor for CVD such as CHD, myocardial infarction and angina pectoris[36,37]. The current study revealed that overweight and obesity were significantly more than two and three times likely to experience angina, respectively, compared with participants with normal weight. In the large Framingham Heart Study of 5209 participants who were followed up for 44 years, the effect of obesity (BMI ≥ 30 kg/m^2) was evaluated on the risk of CVD such as angina, MI, CHD and stroke. They reported that the age-adjusted relative risk for hypertension, which is a risk factor for angina, was higher among obese men (2·21) and women (2·75)[38]. There is ample evidence that weight loss leads to improvement in CVD[39,40].

The economic and social impact of obesity cannot be overemphasised. Direct costs that arise from preventive, diagnostic and treatment services are enormous, while indirect costs due to absenteeism from work and reduced productivity amongst others are quite high[41,42]. Absenteeism alone was reported to cost $4·3 billion in the USA[41], whilst both direct and indirect costs exceeded pounds sterling per year in the United Kingdom[42].

The overall physical, economic and social impact of overweight and obesity has policy implications. As the prevalence of overweight and obesity is expected to rise, it is also anticipated that non-communicable diseases will also rise in the coming decade in Africa[1,7]. Strategies to stem the tide of this raging epidemic of obesity and overweight must be urgently adopted. The public must be provided information on healthy food choices, avoiding excess alcohol consumption and increase physical activity. There is the need to train and deploy more nutritionists and dietherapists to improve dietary education. Individuals must be encouraged to increase their level of physical activity, whilst local government authorities are encouraged to provide and maintain physical spaces where people can undertake planned physical activities. There is an urgent need of a broad framework and policy agenda that seeks to prevent and manage overweight/obesity and its related effects[43].

Limitations

We recognise that the self-reported conditions measured (diabetes, angina, stroke and arthritis) may be associated with recall, and reporting biases may not reflect the true prevalence of these conditions. Although the methods adopted and randomisation were robust and have been validated over time, analysing a subset of the surveyed population may have introduced selection bias, which may possibly affect findings and subsequent inferences.

Conclusion

Our study found a high prevalence of overweight and obesity among older adult Ghanaians, consistent with a general trend in most developing parts of the world including Africa[1]. Obesity and overweight were associated with a high prevalence of diabetes, and obesity alone was associated with angina, stroke and arthritis. The epidemic of overweight and obesity poses a serious challenge to health and well-being and have negative impacts on the quality of life and survival of the population. Inter-sectorial and multidisciplinary measures in line with the national non-communicable disease policies aimed at curbing this trend are imperative.

Acknowledgements

Acknowledgements. The authors are grateful to all respondents and interviewers who made the SAGE survey in

Ghana possible. Financial support was provided by the US National Institute on Aging through Interagency Agreements (OGHA 04034785; YA1323-08-CN-0020; Y1-AG-1005-01) with the WHO and a Research Project Grant (R01 AG034479-64401A1). WHO contributed financial and human resources to SAGE. The Ministry of Health, Ghana, is supportive of SAGE. The University of Ghana's Department of Community Health contributed training facilities, data entry support and storage of materials. The Ghana Statistical Office provided the sampling information for the sampling frame and updates. *Financial support:* There was no funding available for current analysis. *Conflict of interest*: None. *Authorship:* E.Y. and A.E.Y. developed the concept. J.T. analysed the data. E.Y. wrote the first draft manuscript, J.T., V.B. and A.E.Y. contributed to the writing and reviewing of the various sections of the manuscript. All the authors reviewed the final version of the manuscript before submission. All authors read and approved the final manuscript. *Ethics of human subject participation:* The current study was conducted according to the guidelines laid down in the Declaration of Helsinki, and all procedures involving research study participants were approved by the SAGE was approved by the World Health Organization's Ethical Review Board (reference number RPC149) and the Ethical and Protocol Review Committee, College of Health Sciences, University of Ghana, Accra, Ghana. Written informed consent was obtained from all subjects/patients.

Availability of data and material

Data is freely available upon making official request to WHO-SAGE Team through the WHO website at http://www.who.int/healthinfo/sage/cohorts/en/.

References

1. Ng M, Fleming T, Robinson M *et al.* (2014) Global, regional, and national prevalence of overweight and obesity in children and adults during 1980–2013: a systematic analysis for the Global Burden of Disease Study 2013. *Lancet* **384**, 766–781.
2. Ramsay M, Crowther NJ, Agongo G *et al.* (2018) Regional and sex-specific variation in BMI distribution in four sub-Saharan African countries: the H3Africa AWI-Gen study. *Glob Health Action* **11**, Suppl. 2, 1556561.
3. Stevens GA, Singh GM, Lu Y *et al.* (2012) National, regional, and global trends in adult overweight and obesity prevalences. *Popul Health Metr* **10**, 22.
4. NCD Risk Factor Collaboration (NCD-RisC)–Africa Working Group (2017) Trends in obesity and diabetes across Africa from 1980 to 2014: an analysis of pooled population-based studies. *Int J Epidemiol* **46**, 1421–1432.
5. Boutayeb A (2006) The double burden of communicable and non-communicable diseases in developing countries. *Trans R Soc Trop Med Hyg* **100**, 191–199.
6. Kushitor MK & Boatemaa S (2018) The double burden of disease and the challenge of health access: evidence from access, bottlenecks, cost and equity facility survey in Ghana. *PLoS One* **13**, e0194677.
7. Ofori-Asenso R, Agyeman AA, Laar A *et al.* (2016) Overweight and obesity epidemic in Ghana – a systematic review and meta-analysis. *BMC Public Health* **16**, 1239.
8. Amoah AG (2003) Obesity in adult residents of Accra, Ghana. *Ethn Dis* **13**, S97–S101.
9. Biritwum RB, Gyapong J & Mensah G (2005) The epidemiology of obesity in Ghana. *GMJ* **39**, 82.
10. Pi-Sunyer X (2009) The medical risks of obesity. *Postgrad Med* **121**, 21–33.
11. Ofei F (2005) Obesity – a preventable disease. *GMJ* **39**, 98.
12. Wolf AM & Colditz GA (1998) Current estimates of the economic cost of obesity in the United States. *Obes Res* **6**, 97–106.
13. Wannamethee SG, Shaper AG & Walker M (2005) Overweight and obesity and weight change in middle aged men: impact on cardiovascular disease and diabetes. *J Epidemiol Community Health* **59**, 134–139.
14. Avenell A, Broom JI, Brown TJ *et al.* (2004) Systematic review of the long-term effects and economic consequences of treatments for obesity and implications for health improvement. *Health Technol Assess* **8**, 1–182.
15. Akosua Akortsu M & Aseweh Abor P (2011) Financing public healthcare institutions in Ghana. *J Health Organ Manag* **25**, 128–141.
16. Agrawal G, Patel SK & Agarwal AK (2016) Lifestyle health risk factors and multiple non-communicable diseases among the adult population in India: a cross-sectional study. *J Public Health* **24**, 317–324.
17. Minicuci N, Biritwum RB, Mensah G *et al.* (2014) Sociodemographic and socioeconomic patterns of chronic non-communicable disease among the older adult population in Ghana. *Glob Health Action* **7**, 21292.
18. World Health Organization – WHO (2019) WHO Study on Global Ageing and Adult Health (SAGE). Health statistics and information systems. http://www.who.int/healthinfo/sage/en/2005 (accessed March 2019).
19. Biritwum R, Mensah G & Yawson A (2013) *Study on Global AGEing and Adult Health (SAGE), Wave 1: The Ghana National Report*. Geneva: World Health Organization.
20. WHO (2013) SAGE Waves 0, 2 & 3. http://www.who.int/healthinfo/sage/cohorts/en/2013 (accessed March 2020).
21. Kowal P, Chatterji S, Naidoo N *et al.* (2012) Data resource profile: the World Health Organization Study on Global ageing and Adult Health (SAGE). *Int J Epidemiol* **41**, 1639–1649.
22. CDC (2019) About Adult BMI. https://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/index.html (accessed March 2020).
23. Commodore-Mensah Y, Samuel LJ, Dennison-Himmelfarb CR *et al.* (2014) Hypertension and overweight/obesity in Ghanaians and Nigerians living in West Africa and industrialized countries: a systematic review. *J Hypertens* **32**, 464–472.
24. Ghana Statistical Service (GSS), Demographic and Health Surveys Institute for Resource Development/Macro Systems Inc. Ghana Demographic and Health Survey (1988) Maryland USA: Ghana Statistical Service (GSS) and Demographic and Health Surveys Institute for Resource Development/Macro Systems Inc; 1989. Available at https://www2.statsghana.gov.gh/nada/index.php/catalog/38 (accessed March 2020).
25. Ghana Statistical Service (GSS) GHSG & ICF International (2014) Demographic and Health Survey. Rockville: GSS, GHS, and ICF International. Available at https://dhsprogram.com/pubs/pdf/fr307/fr307.pdf (accessed March 2020).

https://doi.org/10.1017/S1368980020003717 Published online by Cambridge University Press

26. Agbeko MP, Akwasi K-K, Andrews DA *et al.* (2013) Predictors of overweight and obesity among women in Ghana. *Op Obes J* **5**, 72–82.
27. Colditz GA, Willett WC, Rotnitzky A *et al.* (1995) Weight gain as a risk factor for clinical diabetes mellitus in women. *Ann Intern Med* **122**, 481–486.
28. Fujimoto WY, Jablonski KA, Bray GA *et al.* (2007) Body size and shape changes and the risk of diabetes in the diabetes prevention program. *Clin Diab* **8**, 386–395.
29. ADA (2007) Reduction in weight and cardiovascular disease risk factors in individuals with type 2 diabetes: one-year results of the look AHEAD trial. *Diabetes Care* **30**, 1374–1383.
30. Reijman M, Pols HAP, Bergink AP *et al.* (2007) Body mass index associated with onset and progression of osteoarthritis of the knee but not of the hip: the Rotterdam Study. *Ann Rheum Dis* **66**, 158–162.
31. Sharma L & Chang A (2007) Overweight: advancing our understanding of its impact on the knee and the hip. *Ann Rheum Dis* **66**(2), 141–142. doi: 10.1136/ard.2006.059931.
32. Lievense AM, Bierma-Zeinstra SMA, Verhagen AP *et al.* (2002) Influence of obesity on the development of osteoarthritis of the hip: a systematic review. *Rheumatology* **41**, 1155–1162.
33. Christensen R, Bartels EM, Astrup A *et al.* (2007) Effect of weight reduction in obese patients diagnosed with knee osteoarthritis: a systematic review and meta-analysis. *Ann Rheum Dis* **66**, 433–439.
34. Fransen M (2004) Dietary weight loss and exercise for obese adults with knee osteoarthritis: modest weight loss targets, mild exercise, modest effects. *Arthritis Rheum* **50**, 1366–1369.
35. Messier SP, Loeser RF, Miller GD *et al.* (2004) Exercise and dietary weight loss in overweight and obese older adults with knee osteoarthritis: the arthritis, diet, and activity promotion trial. *Arthritis Rheum* **50**, 1501–1510.
36. Must A, Spadano J, Coakley EH *et al.* (1999) The disease burden associated with overweight and obesity. *JAMA* **282**, 1523–1529.
37. Klein S, Burke LE, Bray GA *et al.* (2004) Clinical implications of obesity with specific focus on cardiovascular disease: a statement for professionals from the American Heart Association Council on Nutrition, Physical Activity, and Metabolism: endorsed by the American College of Cardiology Foundation. *Circulation* **110**, 2952–2967.
38. Wilson PWF, D'Agostino RB, Sullivan L *et al.* (2002) Overweight and obesity as determinants of cardiovascular risk: the Framingham experience. *Arch Intern Med* **162**, 1867–1872.
39. Zhao Y, Yu BY-M, Liu Y *et al.* (2018) Weight reduction and cardiovascular benefits: protocol for a systematic review and meta-analysis. *Medicine* **97**(50), e13246. doi: 10.1097/MD.0000000000013246.
40. Look AHEAD Research Group, Gregg EW, Jakicic JM *et al.* (2016) Association of the magnitude of weight loss and changes in physical fitness with long-term cardiovascular disease outcomes in overweight or obese people with type 2 diabetes: a post-hoc analysis of the Look AHEAD randomised clinical trial. *Lancet Diabetes Endocrinol* **4**, 913–921. doi: 10.1016/S2213-8587(16)30162-0.
41. Vlad I (2003) Obesity costs UK economy £2bn a year. *BMJ* **327**, 1308.
42. Cawley J, Rizzo JA & Haas K (2007) Occupation-specific absenteeism costs associated with obesity and morbid obesity. *J Occup* **49**, 1317–1324.
43. Mendis S (2010) The policy agenda for prevention and control of non-communicable diseases. *Br Med Bull* **96**, 23–43.

Public Health Nutrition