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Original Article

Demographic, Clinical, and Lifestyle-Related Factors Associated with Body Mass Index in Ghana: WHO STEPS Household Survey, 2014-2025

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Abstract

Introduction: Globally, several populations suffer from obesity, which is defined as a body mass index (BMI) of at least 30 kg/m², and it is up to 25% in some regions of Ghana. Factors such as lifestyle behaviours, dietary intake, and some chronic illnesses.

Objective: This study analysed data from a household survey to determine the predictors of high body mass index in Ghana, 2014-2025.

Methods: This is a secondary data analysis of a study conducted across Ghana, involving both rural and urban communities to ensure national representativeness. The population included 4,464 adults aged 18 years and older, with 2,643 from rural areas and 1,821 from urban areas. Socio-demographic characteristics, clinical diagnoses, and selected lifestyle behaviours were extracted to inform the design of an effective, age-appropriate intervention. Bivariate and multivariable regression analyses were estimated. Statistical significance was determined at $p < 0.05$, and CI was set at 95%. Results from the analysis were presented as text, tables, and figures.

Results: The median age is 58 years (IQR: 18.0). The median BMI is 22.94 kg/m² (IQR: 6.23). The median SBP is 124.33 mmHg (IQR: 27.33). The median SBP is 76.67 mmHg (IQR: 16.33). The prevalence of obesity in the study was 12.05% (95% CI: 11.13, 13.04). Most of the population were of normal weight, 2,468 (55.29%). High BMI (obesity) was higher among adults (14%) and middle-aged adults (16%), while underweight (low BMI) was higher among older adults (19%) and the oldest adults (28%). Increased age (β: -0.04, 95% CI: -0.04, -0.019) predicted lower BMI. Female sex (β: 1.91, 95% CI: 1.52, 2.25), urban dwelling (β: 1.98, 95% CI: 1.54, 2.23), and education (β: 0.96, CI: 0.59, 1.34) were all found to significantly increase BMI. However, alcohol, tobacco, and blood pressure were significant on bivariate tests ($P < 0.05$).

Conclusion: Obesity in the population varies with age. Education on lifestyle modification, screening of at-risk groups, and control of the identified factors are necessary interventions. Ongoing surveillance and longitudinal research are essential to clarify causal pathways and to inform the development of effective, culturally tailored prevention and management strategies for obesity and related chronic diseases.

Keywords: "body mass index”, "factors", “Ghana”, "obesity".

Introduction

The increase in non-communicable and chronic diseases in the developing world is an issue of major concern and can lead to reduced quality of life and premature deaths (Obirikorang et al., 2015a). Obesity is a classified risk factor for several of the world's leading causes of death. It represents the 5th and 6th major level two public health problem among women and men, respectively, leading to the toll of death and disability worldwide (L Murray et al., 2020). Obesity is an independent risk factor for cardiac diseases, some types of cancer, and type-2 diabetes and leads to a high mortality rate. Moreover, it aggravates chronic diseases such as cholelithiasis, hypertension, hypercholesterolemia, and arthritis (So & Seo, 2013a).

The prevalence of obesity has increased in pandemic dimensions over the past 50 years with 650 million adults, 340 million adolescents and 39 million children classified as obese. As the obesity pandemic continues, estimates indicate that approximately 167 million adults and children will become less healthy due to being overweight or obese by 2025 (Blüher, 2019). Especially in developing countries, the possible implications of obesity on current and future population health and healthcare spending are likely to be enormous (Obirikorang et al., 2024a). The prevalence of overweight and obesity has risen steadily in Ghana over the years and is reportedly more common in the capital city, Accra where urbanization is highest (Lartey et al., 2019).

The Body Mass Index (BMI) is the crude method of measure of overweight and obesity but there are other popular but simple measures of obesity employed in recent times, which include the waist-to hip ratio (WHR), waist-to-height ratio (WHtR) and the percentage body fat (BF%), whose validity has been supported. Estimates from the World Health Organization (WHO) in 2008 showed that more than 1.4 billion adults, 20 years and older, were overweight with an overall 10% of the world's population being obese (Obirikorang et al., 2018a). There are reports on the prevalence of obesity across countries in and outside Africa and in Ghana, suggesting that obesity is increasing in prevalence (Doku & Neupane, 2015a; Lartey et al., 2019). Obesity is mainly caused by a mismatch between caloric intake and energy expenditure. The factors related to the nature of energy imbalance are numerous and complex; they include the socioeconomic environment, smoking, drinking, mental stress, sleep duration, sedentary lifestyle, eating habits, and the interactions between these factors (So & Seo, 2013a). For this reason, many obese people attempt to balance energy intake and expenditure or promote energy expenditure through diverse efforts in order to reduce and control their obesity.

Furthermore, previous studies have provided evidence that lifestyle-related factors that promote health are associated with decreased obesity (Al-Hazzaa, Abahussain, et al., 2012a), Also, obesity is a multifactorial condition influenced by many variables, including genetic, demographic and lifestyle factors. Genetic and demographic variables such as family history of obesity, age, ethnicity and sex cannot be modified while obesity-associated lifestyle factors such as sedentary behaviours, physical inactivity and unhealthy dietary choices are often modifiable (Doku & Neupane, 2015a).

According to the Ghana Demographic and Health Survey of 2014, the percentage of Ghanaian overweight/obese women rose from 30% in 2008 to 40% in 2014 (Amugsi et al., 2017). These direct and indirect effects of obesity impose an economic burden on the healthcare budget of countries and individual citizens (Tremmel et al., 2017a). Lifestyle changes related to westernization and socio-economic improvement are responsible for this increasing phenomenon of obesity and overweight. Reduction in physical activity has been identified as a risk factor, which on the global level causes 3.2 million related deaths. Another major cause of obesity is a relatively higher amount of calories consumed compared to that which is expended. In Sub-Saharan Africa, increased body fat composition is regarded as beautiful and a sign of wealth, which is a cultural driver for the increasing prevalence of overweight and obesity in young adults (Muthuri et al., 2014; Agyei et al., 2022).

We have mainly relied on the routine use of the body mass index (BMI) as an obesity measure. However, BMI has a limitation in differentiating between body composition and body fat distribution (Obirikorang et al., 2018). Alternative measures, including the bioelectrical impedance analysis (BIA) and BIA-derived body fat indices, like the body adiposity index and relative fat mass (RFM), have been proposed (Freedman et al., 2012b). These measures aim to address the limitations of BMI and serve as cost-effective indices to accurately identify individuals, with accuracy close to that of underwater weighing and dual-energy X-ray absorptiometry. In particular, RFM and total percentage body fat (TPBF) have been validated as being a more accurate measure compared to BMI to estimate whole-body fat percentage, in addition to improving body fat-defined obesity misclassification among different population groups(Obirikorang et al., 2024b). Hence the need for this study and the knowledge will go a long way in informing strategies to combat the obesity epidemic and hopefully, related medical conditions among the general Ghanaian population.

This study assessed the association between demographic (age, sex, education, marriage), clinical (blood pressure, history of stroke, depression, angina, arthritis, asthma and chronic lung disease), and lifestyle-related factors (salt diet, physical activity, alcohol, tobacco) factors and body mass index (BMI) in a Nationally representative survey of Ghanaian adults, using age-standardized anthropometric methods.

Methodology

Study Setting

This study was conducted across Ghana, involving both rural and urban communities to ensure national representativeness. The study population included 4,464 adults aged 18 years and older, with 2,643 from rural areas and 1,821 from urban areas.

Study Design and Sampling

This cross-sectional analytical study was conducted over four months. The sample size was calculated using the formula for comparative quantitative outcomes, adjusted for a 10% non-response rate, resulting in a total of 4,464 participants, with 2,643 from rural areas and 1,821 from urban areas. Simple random sampling was employed, selecting participants from nationally representative community lists to ensure unbiased representation.

Study Variables

The independent variables in this survey include sociodemographic variables (age, sex, location, marital status, level of education and school), clinical variables (presence of arthritis, angina, stroke, asthma, depression, systolic blood pressure, diastolic blood pressure, chronic lung disease, and health status); and lifestyle-related variables (salt intake, physical activity, alcohol consumption, and tobacco use). The outcome variable is the body mass index (BMI), which was used to assess obesity.

Data Collection Instruments and Procedures

Data were extracted from the WHO STEPSwise household survey to collect information on the variables. The questionnaire was pre-tested for clarity and reliability before data collection. Anthropometric measurements were taken following age-standardised protocols to ensure consistency. Height was measured to the nearest 0.1 cm using a stadiometer, with participants wearing minimal clothing and no shoes. Weight was recorded to the nearest 0.1 kg using a calibrated scale. Systolic and Diastolic blood pressures were measured three times in a seated position using a mercury sphygmomanometer and stethoscope, following American Heart Association guidelines, with the average of the last two readings recorded. All measurements were performed by trained personnel to ensure accuracy and reliability.

Data Management

BMI was calculated as weight (kg) divided by height squared (m^2). BMI was categorised using the WHO standard defined as: underweight (<18.5 kg/m^2), normal weight (18.5-24.9 kg/m^2), overweight (25.0–29.9 kg/m^2), and obese (≥ 30.0 kg/m^2). Ages were categorized based on the WHO ageing distribution as: 18-24 years (young adults), 25-44 years (adults), 45-59 years (middle-aged adults), 60-74 years (young older adults), 75-84 years (middle older adults), and 85 years and above (oldest older adults) for age-sensitive interpretations and interventions.

Systolic Blood pressure was categorized according to the International Society on Hypertension (ISH) as: less than 90 mmHg (low SBP), 90-119 mmHg (normal SBP), 120-139 mmHg (pre-hypertension), 140 mmHg and above (Systolic Hypertension). Diastolic Blood pressure was graded as: less than 60 mmHg (low DBP), 60-79 mmHg (normal DBP), 80-89 mmHg (pre-hypertension), 90 mmHg and above (Diastolic Hypertension). For the purpose of analysis, both were further coded into binary as 1 (for hypertension) and 0 (for non-hypertensive). Marital status was further dichotomized into currently married (coded as 1) and not currently married (coded 0).

Statistical Analysis

Data were analysed using STATA version 18. Continuous variables (age and blood pressures) were assessed for normality using Jarque-Bera Skewness and Kurtosis (sktest). Being not normally distributed, they were summarised with median and interquartile range (IQR). The categorical variables were summarised with frequencies and proportions.

Bivariate analysis was conducted to determine any relationship between each of the independent variables and the dependent variable (BMI). BMI was tested for normality using the sktest. It was not normal, thus, non-parametric tests were employed. Hence, the relationship between the categorical variables (such as age, sex, salt intake, physical activity, and stroke) and BMI was assessed each using the Wilcoxon-Mann-Whitney test. However, the Kruskal-Wallis test was used for health status, which had more than two levels.

Spearman's rank test of correlation was used for the relationship between the continuous variables (age and Blood pressure) and Body Mass Index. Statistical significance was set at $p < 0.05$.

Multivariate ordinal least squares (linear) regression was used to test the extent of prediction of BMI by the significant factors above. The residual from the BMI was generated and tested for normality using the sktest and the Shapiro–Wilk normality test (swilk). It was not normally distributed. Hence, the quantile regression model was used. It was also tested for equality of variance using the Cook-Weisberg test for heteroscedasticity. The variances were not equal; thus the regression model was fitted with heteroskedasticity-robust standard errors (RSE) using a variance-covariance estimate (VCE). The endogeneity assumption was tested using the omitted variable test (OVT), which showed no omission. Multicollinearity was checked using the variable inflation factor (VIF) test, and school was found to be collinear (with education), thus not included in the model. Each factor was reported using the coefficient and confidence interval, adjusting for the others.

The dataset was extracted by the Department of Biostatistics after permission and provided for a term paper while other ethical considerations were followed as appropriate for a secondary data analysis.

Results

Sociodemographic Characteristics

The median age is 58 years (IQR: 18.0), median BMI is 22.94 kg/m^2 (IQR: 6.23), median SBP is 124.33mmHg (IQR: 27.33), and median DBP is 76.67mmHg (IQR: 16.33).

Table 1 presents the socio-demographic characteristics of the respondents. The largest age group was middle-aged adults (1,468; 32.89%) while older olds constituted the smallest (130; 2.91%) of the study population. About 2,521 (56.47%) were married, most living rurally (2,643; 59.21%), with a female: male ratio of about 3:2. Among the respondents who had received formal education, primary school education was the most common level attained (668; 25.69%), while tertiary education had the lowest representation (141; 5.42%).

Table 1: Sociodemographic Characteristics of the participants

Variable	N	Frequency	Percentage
Age group (yrs)	4464		
Young adults		218	4.88
Adults		676	15.14
Middle-aged		1.468	32.89
Young olds		1,440	32.26
Middle olds		532	11.92
Older olds		130	2.91
Marital status	4464		
Not married		1,943	43.53
Married		2,521	56.47
Location	4464		
Rural		2,643	59.21
Urban		1,821	40.79
Sex	4464		
Female		2,610	58.47
Male		1,854	41.53
Schooling	4,464		
Yes		2,600	58.24
No		1,864	41.76
Education	2,600		
Below primary		626	24.08
Primary		668	25.69
Junior Sec.		667	25.65
Senior Sec		498	19.15
Tertiary		141	5.42

N: Number of participants

Table 2 presents the clinical factors. A total of 3,011 respondents were assessed for arthritis, 236 (7.84%) reported having arthritis. Angina was reported by 61 (2.03%) participants. Similarly, stroke prevalence was low, with only 50 (1.66%) participants reporting a previous stroke. Asthma was reported by 97 (2.18%). Depression was the least reported condition, affecting only 27 (0.90%).

For systolic blood pressure (SBP), 31 (0.70%) participants had low SBP, 1,756 (39.47%) had normal SBP, 1,533 (34.46%) were classified as pre-hypertensive, and 1,129 (25.38%) had systolic hypertension. For diastolic blood pressure (DBP), only 234 (5.29%) had low DBP, while over a half (2,415, 54.64%) had normal DBP.

More than half of the participants, 2,389 (53.92%), rated their health as good, while 631 (14.24%) considered their health very good. Moderate health status was reported by 1,041 (23.49%) participants. Only a small proportion rated their health as bad (8.35%).

Body mass index (BMI) assessment showed that 2,468 (55.29%) participants had normal weight. However, 960 (21.51%) were overweight and 538 (12.05%) were obese, indicating that approximately one-third of the participants had excess body weight. In contrast, 498 (11.16%) participants were underweight.

Table 3 presents the lifestyle-related aspects of the participants. Tobacco use was relatively low, with only 273 (6.14%) participants reporting tobacco use, while the vast majority, 4,176 (93.86%), did not use tobacco. Alcohol consumption was more common, with 1,306 (29.35%) participants reporting alcohol use compared to 3,143 (70.65%) who did not consume alcohol. More than half of the participants, 2,600 (58.24%), had a history of formal schooling, whereas 1,864 (41.76%) had no schooling history. 1,658 (37.27%) participants reported high salt intake, while 2,791 (62.73%) did not. 2,448 (55.31%) participants were physically active, indicating a relatively good level of engagement in exercise. However, 1,978 (44.69%) reported no regular physical exercise.

Table 2: Clinical factors of the participants

Variable	Presence	Frequency	Percentage
Arthritis (N=3011)	Yes	236	7.84
	No	2,775	92.16
Angina (N=3,011)	Yes	61	2.03
	No	2,950	97.97
Stroke (N=3,012)	Yes	50	1.66
	No	2,962	98.34
Asthma (N=4,448)	Yes	97	2.18
	No	4,351	97.82
Depression (N=3,012)	Yes	27	0.90
	No	2,985	99.10
Lung disease (N=4,455)	Yes	20	0.45
	No	4,435	99.55
Systolic BP	Low SBP	31	0.70
(4,449)	Normal	1,756	39.47
	Pre-HTN	1,533	34.46
	Syst. HTN	1,129	25.38
Diastolic BP	Low DBP	234	5.29
(N=4,420)	Normal	2,415	54.64
	Pre-HTN	1,041	23.55
	Diast. HTN	730	16.52
Health Status	Very good	631	14.24
(N=4,431)	Good	2,389	53.92
	Moderate	1,041	23.49
	Bad	370	8.35
BMI Category	Underweight	498	11.16
	Normal wt	2,468	55.29
(N=4,464)	Overweight	960	21.51
	Obese	538	12.05

Table 3: Lifestyle-related of the participants

	N	Frequency	Percentage
Use of tobacco	4,449		
Yes		273	6.14
No		4,176	93.86
Use of alcohol	4,449		
Yes		1,306	29.35
No		3,143	70.65
Schooling History	4,464		
Yes		2,600	58.24
No		1,864	41.76
Salt intake	4,449		
Yes		1,658	37.27
No		2,791	62.73
Physical exercise	4,464		
Physically active		2,448	55.31
No Exercise		1,978	44.69

Prevalence of Obesity

Figure 1 shows the prevalence of Obesity in the study which was 12.05% (95% CI: 11.13, 13.04). Most of the population were of normal weight, 2,468 (55.29%).

Figure 2 is a stacked bar chart showing the BMI distribution by age-group. High BMI (obesity) was more in the adults (14%) and middle-aged adults (16%); while underweight (low BMI) was more among the older adults (19%) and the oldest adults (28%).

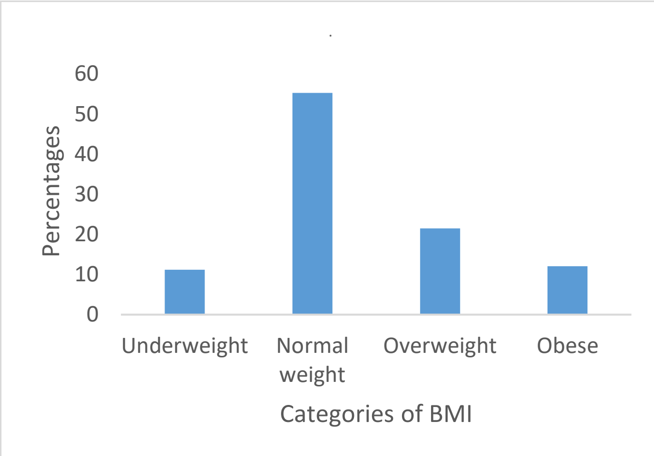

Figure 1: Prevalence of Obesity by BMI category

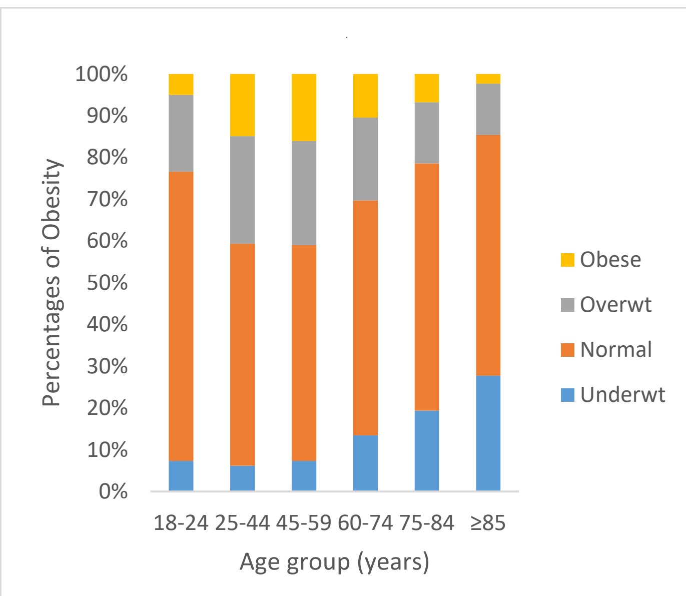

Figure 2: Distribution of Obesity by age group

Table 4 shows the Wilcoxon sign rank analysis of the relationship between the demographic, clinical and lifestyle factors and the BMI.

Sex, location, tobacco use, education, alcohol and health status had a significant relationship ($P < 0.05$)

Table 5 shows that all the continuous variables were statistically significantly related to BMI.

Age had a significant weak negative correlation with BMI (rho= -0.19, $p < 0.001$), while there are weak positive correlations with SBP (rho=0.098, $p<0.001$) and DBP (rho=0.088, $p<0.001$).

Table 6 shows the strength of the relationship using quantile linear regression model with robust estimates. Female sex, urban dwelling, and education were all found to significantly increase the BMI. The higher the age, the lower the BMI (Coefficient -0.04).

A unit rise in SBP increases the BMI by 0.03kg/m2 (β=0.03, 95% CI: 0.73-1.53). Females and urban residence significantly increase the BMI by aprox 2 (β=1.98, 95% CI: 1.54-2.2

Table 4: Association between Sociodemographic, Clinical, and lifestyle Characteristics and BMI

	N	Rank sum	Z	P
Sex				
Male	1854	3437004	-16.545	<0.001*
Female	2610	6528875		
Marital status				
Not married	1943	4335901	-0.043	0.966
Married	2521	5629978		
Location				
Urban	1821	4796341	17.273	<0.001*
Rural	2643	5169538		
Tobacco				
Yes	273	458616	-7.237	<0.001*
No	4176	9440409		
Alcohol				
No	3143	7174379	4.644	<0.001*
Yes	1306	2724646		
Education				
Yes	2600	6190547	9.091	<0.001*
No	1864	3775332		
Salt intake				
Previous	1658	3630423	1.415	0.157
Never	2791	6268602		
Physical act				
Yes	1978	4460509	0.052	1.945
No	2448	5336441		
Arthritis				
Yes	236	367805	0.966	0.334
No	2775	4166761		
Angina				
Yes	61	97209	0.795	0.427
No	2,950	4437356		
Stroke				
Yes	50	85159	1.613	0.107
No	2,962	4452419		
Asthma				
Yes	97	212985	-0.223	0.823
No	4,351	9681591		
Depression				
Yes	27	39439	-0.275	0.783
No	2,985	4498139		
Chronic lung disease				
Yes	20	37930	-1.155	0.248
No	4435	9887809		
Health status				
Very good	631	1500000	23.071 [h]	<0.001*
Good	2,389	5290000		
Moderate	1,041	2230000		
Bad	312	691930		
Very bad	58	99359		

*: significant P value: Z: Man Whitney's test. h: Kruskal Wallis test

Table 5: Spearman's test of Correlation

	Median	IQR	rho	*p* value
Age (years)	58.00	18.00	-0.192	<0.001*
SBP (mmHg)	124.33	27.33	0.098	<0.001*
DBP (mmHg)	76.67	16.33	0.088	<0.001*

*: significant P value: rho: Spearman rho.

Table 6: Independent Predictors of BMI

	β	RSE	P	Lower CI	Upper CI
Age (years**)**	-0.04	0.01	<0.001*	-0.04	-0.02
SBP (mmHg)	0.03	0.01	<0.001*	0.73	1.53
DBP (mmHg)	0.01	0.01	0.712	-0.02	0.03
Residence					
Rural	Ref				
Urban	1.98	0.19	<0.001*	1.54	2.23
Sex					
Male	Ref				
Female	1.91	0.16	<0.001*	1.52	2.25
Tobacco					
No	Ref				
Yes	-0.32	0.21	0.352	-1.08	0.38
Alcohol					
No	Ref				
Yes	0.16	0.16	0.408	-0.55	0.23
Education					
No	Ref				
Yes	0.96	0.16	<0.001*	0.59	1.34
Constant	25.06		<0.001	24.01	26.10

β: Coefficient; RSE: **Robust** Standard error; CI: Confidence interval. *: significant;

Discussion

This study examined the factors contributing to high BMI and Obesity in the Ghanaian population with interest in sociodemographic, clinical and lifestyle-related factors from a household survey conducted among Ghanaians.

The age distribution included all adults age groups from the young adults to the oldest old adults, with a median age of 58 years. Each of the middle-aged adults (45-65 years) and the young olds (60-75years) constitutes about a third of the population, thus both making two-thirds of the population. The sociodemographic profile shows the broader epidemiological transition occurring in many low- and middle-income countries (Muthuri et al., 2014b).

The shift toward older age, urbanization, and changing lifestyle factors is reflected in the rising, though still moderate, prevalence of overweight and obesity. The median BMI in the population is about 23kg/m2 which falls within the normal BMI range. However, about one-eight of the population are obese while one-fifth have above the normal BMI, both making up about a third of the population.

This study highlighted appropriate interventions for the population. This study found an inverse relationship between age and BMI, especially given the predominance of middle aged and young olds in the study. The trend in the study shows that while the obesity level tends to reduce with age group, the underweight level increases with age. Hence, the young and the middle-aged adults have more obesity while the underweight level is most among the oldest olds. This trend likely reflects a combination of physiological changes, survivorship bias, and possible undernutrition in the oldest age groups (Muthuri et al., 2014b; Ssentongo et al., 2021). Also, the RODAM study in Ghanaian adults also identified early-life factors (Danquah et al., 2019).

Other demographic factors contributing to obesity in Ghanaians include being female and urban residence. The significant influence of urban residence on BMI highlights the role of the built environment and lifestyle changes including increased sedentary behaviour and dietary shifts toward processed foods in driving weight gain (Yussif et al., 2024).

Similarly, the strong association between female sex and higher BMI may be attributable to biological differences in fat distribution, as well as gendered patterns of physical activity, nutrition, and health-seeking behaviours (Amoah, 2003).

High systolic and diastolic blood pressures and health status are the clinical states found to relate with BMI on bivariate test. Dwomoh and colleagues support that improving the quality of life can help the hypertensive patients in Ghana (Dwomoh et al., 2025a), which along with education and awareness in Ghana can control the BMI (Sanuade et al., 2018).

Thus, the lack of prediction by chronic diseases such as stroke, arthritis, and depression may suggest some protective factors at play in this cohort. However, as the population continues to age and urbanize, these factors may become more prominent, potentially driving up rates of obesity and associated non-communicable diseases (Vos et al., 2017).

Health status stands out as a robust correlate, those reporting “very good” health have significantly higher BMI rank sums, suggesting a nonlinear relationship between perceived health and BMI. This finding may reflect the “obesity paradox” where moderate BMI is associated with better outcomes in older populations (Amugsi et al., 2017; Doku & Neupane, 2015a; Freedman et al., 2012a).

Alcohol is the major lifestyle factor predicting a high BMI in this study, and with tobacco, they were both significant on bivariate did not significantly predict BMI on multivariable analysis. This may suggest confounding effects from other factors in the population. On the other hand, Physical activity was found in this survey to reduce BMI which supports the effect of exercise on BMI reduction as evidenced by the WHO STEPwise surveillance on non-communicable diseases and events such as obesity (Riley et al., 2016).

Limitations

The cross-sectional design limits the ability to establish causality between demographic, clinical, or lifestyle factors and BMI. Self-reported data on clinical history and lifestyle factors may introduce recall bias. Additionally, unmeasured confounders, such as dietary patterns beyond salt intake, were not fully explored. Also, the high proportion of rural and older participants may limit generalizability to younger or urban populations. The study is however strengthened by being a National survey, exploring several relevant sociodemographic, clinical and lifestyle-related factors.

Conclusion and Recommendation

This study shows that female gender, hypertension, alcohol intake, middle-age and urban residence are some factors predicting high BMI and obesity while physical activity among other factors predicts low BMI. The obesity level in this population is not exceptionally high compared with global trends, however given the established risks in this study, there is a need for attention.

The findings underscore the need for interventions targeted especially to the middle-aged adults towards preventing obesity, and conversely, nutrition-improving interventions at the older adults to address their underweight. To address the obesity, there is a need for primordial and primary prevention in the population and secondary and tertiary prevention in the affected which include screening, early diagnosis, public health education.

Also, epidemiological surveillance and longitudinal research are essential to clarify causal pathways and to inform the development of effective, culturally tailored prevention and management strategies for obesity and related chronic diseases.

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