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Levels, Trends, and Factors Associated With Obesity Among Women in Ghana, 2003–2022

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ABSTRACT

Background: Obesity in adults is defined as an individual with a body mass index (BMI) of 30 kg/m² or higher. The disease is one of the leading risk factors for noncommunicable diseases (NCDs), which accounts for 2.8 million deaths per year globally. Despite efforts to reduce obesity, the levels are still high, particularly in low- and middle-income countries. In Ghana, obesity has been on the rise over the past few decades, especially among women. The health and economic burden of obesity cannot be underestimated, and efforts must be made to identify factors that are associated with the condition. This study sought to determine the levels, trends, and factors associated with obesity among women in Ghana.

Methods: Data for the study came from four waves of the Ghana Demographic and Health Survey (GDHS) from 2003 to 2022. The analysis involved women aged 15–49 years. Their obesity status was categorized into a binary outcome of “1” for those who are obese (BMI = 30+ kg/m²) and “0” otherwise (BMI <30 kg/m²). Binary logistic regression was performed on the data to ascertain the factors that are associated with obesity among women for each of the years separately.

Results: In all, 15,467 women, aged 15–49 years, were included in the analysis. Out of this, 13.7% were obese (BMI = 30+ kg/m²). In terms of trends in obesity prevalence across the various years, the results showed an increase in obesity from 9.9% in 2003 to 23.0% in 2022. From the regression results, the common factors associated with obesity for each of the years included being an urban resident, having a tertiary education, and being in the richest household.

Conclusions: The results showed that being an urban dweller, having a tertiary level of education, being in the richest household, and being a resident of regions in the north of Ghana are associated with obesity. Therefore, policies aimed at reducing obesity in Ghana should intensify public health education, particularly among urban dwellers and wealthy individuals, to engage in healthy lifestyles. The less educated members of the population should also be educated to avoid behaviors that will put them at risk of obesity. Local authorities should create an environment, particularly in high-class neighborhoods, that offers easy access to healthy foods and places for physical activities.

1 | Background

Obesity is one of the leading risk factors for noncommunicable diseases (NCDs) and a major contributor to the global burden of disease [1]. Over the years, it has been revealed that the global prevalence of

overweight and obesity has doubled since 1980. As a result, nearly one-third of the world's population is either overweight or obese [2]. Notably, this increase has occurred more rapidly in low- and middle-income countries compared to developed countries [3, 4].

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Over the past few decades, Ghana has also experienced a continuous rise in the prevalence of overweight and obesity, especially among women [5]. For instance, findings from a previous systematic review revealed that about 43% of Ghanaian adults are overweight or obese [6]. According to the Ghana Demographic and Health Survey of 2014 (GDHS, 2014), the prevalence of overweight or obesity among women aged 15–49 was more than twice as likely as among men. In this age group, it was indicated that 40% of women and 16% of men were overweight or obese [7].

Studies have established that overweight/obesity is a major risk factor for other diseases, such as diabetes, cancer, hypertension, and coronary heart disease, among others. These diseases are also found to be associated with the high levels of mortality experienced in these settings [8, 9]. It is estimated that about 2.8 million people die every year as a result of being overweight or obese and their related health conditions [10].

With evolving lifestyles in many developing regions, this trend is likely to persist unless effective interventions are implemented to reverse or at least stop the progression. Implementing appropriate, effective, and context-specific interventions requires an understanding of factors that are associated with the phenomenon.

Several factors account for the rapid increase in obesity among women in low- and middle-income countries. This in turn has led to increases in NCDs in this part of the world, where the disease burden was mainly communicable in nature. According to the World Health Organization (WHO), risk factors of NCDs are classified into modifiable and nonmodifiable factors. The latter are avoidable lifestyles, which include alcohol intake, tobacco use, excessive intake of salt and fatty foods, as well as a lack of physical activity. Associated with the lifestyle risk factors are the metabolic risk factors, which include hypertension, overweight/obesity, hyperglycemia, and hyperlipidemia [11].

Analyzing the trends of obesity and the risk factors associated with the disease is vital for understanding the evolving public health landscape. This, in particular, allows for the implementation of context-specific interventions to address the problem. Therefore, this study aims to contribute to this understanding by examining the level, trends, and factors associated with obesity among women in Ghana, using four waves of data from the GDHSs, 2003–2022.

1.1 | Theoretical Model

The study is premised on the health belief model (HBM), as shown in Figure 1, which posits that individuals' health behavior is influenced by several factors, including what they believe about their health outcomes due to certain actions or inactions. The HBM is an appropriate theoretical framework for understanding issues relating to obesity and its prevention [12, 13]. The model has six elements, which include perceived vulnerability, perceived severity, perceived benefits, perceived barriers, cue to action, and self-efficacy [14, 15].

Concerning perceived vulnerability, it is believed that women who perceive themselves to be at risk of becoming obese would take the necessary precautions to avoid getting the condition. For

instance, an individual who does not think that he/she is at risk of being obese will not refrain from an unhealthy lifestyle.

In terms of severity, the individual who is aware of the severity of any disease is likely to take the necessary action to minimize the severity or avoid getting the condition. For instance, studies have shown that an individual who has a high perception of the severity of the disease burden can be influenced to change behavior to avoid or minimize the severity of the disease [16].

Any health behavior change is related to having the belief that there are benefits associated with that behavior change. Minimizing the risk of obesity requires a positive change in lifestyle, such as regular exercise and avoiding fatty and salty foods. For instance, findings from several studies revealed a positive health impact associated with the perception of the health benefits associated with certain changes in lifestyle [17].

Perceived barriers, which reflect obstacles to behavior change, pose some difficulty and reluctance for an individual to actually change behavior. For instance, barriers to behavior change to deal with obesity could include time and space for regular exercise and resources for healthy diets, among others. For instance, [18] clarified the barriers associated with weight loss and explained that so long as the individual perceived the health challenge to be severe and the benefits associated with behavior change are enormous, they will explore several means to overcome those barriers.

Self-efficacy is the individual's ability to perform a certain action effectively to achieve a certain health benefit. The individual's confidence will enable him/her to undertake behavior change in various forms, such as exercising effectively and regularly, as well as being disciplined and adhering to a healthy diet, to improve health and minimize the risk and severity of obesity. For instance, studies have shown a positive relationship between self-efficacy and positive behavioral change [19, 20].

Cues to action come about as the individual is motivated to change or maintain a certain health behavior to deal with a health problem. Specific cues from friends, relatives, health personnel, or through observation can influence the individual's understanding of the vulnerability and severity of the disease and the need to engage in appropriate behavior to minimize the risk or severity of the health problem [13, 21, 22].

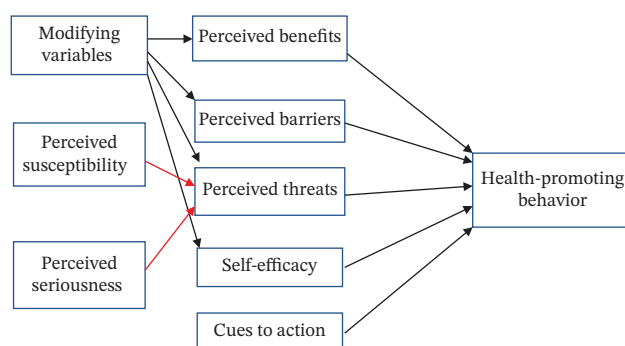


FIGURE 1 | The health belief.

The six elements espoused in this model reflect the possession of certain characteristics possessed by the individual to adhere to the appropriate behavior change to improve health. For instance, educational level, which is one of the variables of this study, is an important factor in determining how susceptible one can be to acquiring a particular illness, as well as how severe it can be, with dire consequences. The higher one's education, the more likely the person will know whether he/she is vulnerable and how severe the disease can be. Similarly, it is expected that urban dwellers who are better enlightened than their rural counterparts will have higher knowledge and a higher perception of their risk of acquiring a certain disease. More educated persons are also in a better position to know the benefits associated with certain behavior changes.

In terms of perceived barriers, more educated, urban dwellers and higher socioeconomic individuals are expected to have a higher capacity to overcome these barriers due to affordability issues and knowledge of the fact that the benefits associated with the behavior change outweigh the barriers. A cue to action reflects the need for some support from another person to change or sustain a certain behavior. This support, in the form of reminders and motivations, could come from a spouse or close friend. It is therefore expected that married women or women in some unions stand to benefit from this support to improve their health.

2 | Methods

2.1 | Study Site

The study utilized DHS data that were collected in Ghana, which is located on the West African coast of Africa, and has a total land area of 238,533 square kilometers, with a projected population of 34.9 million, where females constitute 50.7% of the population. The majority of Ghana's population (58.1%) is aged 15–59 years, 35.4% are aged 0–14 years, while 6.5% are aged 60 years and over. More than half (56.7%) of the population resides in urban areas. The country generally has a low-lying topography, with a few series of hills and mountains on the eastern border. Ghana currently has 16 administrative regions, with Greater Accra as the national capital. The country had 10 administrative regions until 2018, when six additional regions were created. Ghana is bounded by Burkina Faso to the north, the Gulf of Guinea to the south, Togo to the east, and Côte d'Ivoire to the west. The dominant economic activities include agriculture, service, and the industrial sectors.

2.2 | Study Population and Data Description

This study utilized a cross-sectional design, drawing data from the four waves of the GDHS of 2003, 2008, 2014, and 2022. Each of these is a nationally representative cross-sectional data set collected within specific periods in each year of data collection. A similar sampling method was used for the selection of study participants for all four waves. For each data collection period, a two-stage sampling method was used to select study participants, who were women aged 15–49 years. The first stage involved the selection of clusters (EAs), comprising both rural and urban areas of each of the regions. The second stage involved the systematic selection of households from which the study participants were

selected [23, 24]. The extracted GDHS data has a hierarchical structure where the sampled women are considered as lower-level units and are nested within predefined clusters as the higher level of the hierarchy. For this analysis, data from the various waves were analyzed separately to see the trend in the prevalence and associated factors over the years.

2.3 | Study Variables

The outcome (dependent) variable for this analysis is obesity, which is measured by the body mass index (BMI) of the individual. The BMI for each wave was measured by the weight of the person, in kilograms, divided by the square of the height, in meters (weight/H^2). A BMI value of $30 \text{ kg}/\text{m}^2$ or higher is considered obese [25]. Thus, obesity status was categorized into a binary outcome of "1" for those who are obese ($\text{BMI} = 30+ \text{ kg}/\text{m}^2$) and "0" for those who are not obese. The independent variables (risk factors) included in the analysis are age, educational status, household socioeconomic status (SES) (wealth quintiles), place of residence (rural or urban), marital status (married, never married, not married, divorced/widowed/separated), and region of residence (10 regions up to 2014 DHS and 16 regions for 2022 DHS). However, for purposes of cross-survey comparability, the 16 regions for the 2022 survey were reclassified to 10 regions, as pertained to the earlier surveys. Household SES was generated using the principal component analysis (PCA) method. The asset list used for the computation included household items such as TV sets, radios, fans, phones, fridges, motorbikes, vehicles, and cows. Also, household dwelling characteristics such as source of drinking water, sanitation facility, and roof type, among others, were included. Households were then categorized into quintiles of poorest, poorer, middle, richer, and richest. The dataset was weighted by applying the sampling weight command ("svy") during the analysis to address any potential sampling bias due to refusals and/or nonresponses.

2.4 | Ethical Approval

The ICF International Review Board (IRB), in conjunction with the Ghana Health Service Ethical Review Board, reviewed the protocols and approved the various waves of the GDHS to be collected [23]. In addition, informed consent was obtained from the study participants before the interviews were conducted. Access to the data for this analysis was free upon application for the use of the data through a registration process. The data for this analysis were anonymized with respect to the participants' identities.

2.5 | Analysis Method

The analysis involved 15,467 women aged 15–49 years, distributed among various years. With the use of tables and graphs, we show the levels and trends of obesity over the 20 years between 2003 and 2022. Descriptive analysis was done by performing a frequency test to summarize the data. Binary logistic regression was performed on the data to ascertain factors that are associated with obesity in Ghana. A test for multicollinearity was performed, and the results showed the absence of multicollinearity. Results are presented in tables and a line graph, which show trends in obesity across 4 years. A statistical test was also

conducted to ascertain any statistical difference in obesity levels across the various years. STATA Version 17.0 was used to perform the analysis.

3 | Results

3.1 | Distribution and Characteristics of Study Participants

In all, 15,467 women, aged 15–49 years, were included in the analysis (2003 = 3775; 2008 = 3243; 2014 = 3,245; and 2022 = 5,204), with a survey response rate of 95.7%, 96.5%, 97.3%, and 98.0% for 2003, 2008, 2014, and 2022, respectively. The nonresponses were due to the absence of the selected participants upon several visits. The result shows an overall obesity rate of 13.7%. There was also a consistent increase in obesity (BMI = 30 kg/m²) over the years, from 9.9% in 2003 to 23.0% in 2022. In terms of place of residence, 40.4% of the women resided in urban areas in 2003, 43.4% in 2008, 51.2% in 2014, and 54.6% in 2022. In terms of age distribution for 2003, the majority of the women were aged 25–29 (20.0%), followed by those aged 30–34 (19.2%), and the least group was aged 45–49 (12.0%). In 2008, those in the age group 25–29 were the majority (20.0%), while the least group (45–49) formed 12.9%. However, in 2014 and 2022, the largest age groups were those aged 30–34, constituting 20.0% and 19.5%, respectively (Table 1). In terms of education, the majority (40.8%) of the women in 2003 had secondary education, followed by those without education (35.9%), and the least were those with higher educational levels (1.9%). In 2008, 28.7% had no education, 45.9% had secondary education, while only 2.5% had higher education. In 2014, the majority (49.9%) of the women had secondary education, followed by those with no education (26.4%), and the least of 3.8% of the women, had higher education. In 2022, 54.0% had secondary education, 22.1% had no education, and the least of 7.7% of the women had higher education. The rest of the variable distribution is as given in Table 1.

3.2 | Level and Trends of Obesity, 2003–2022

Figure 2 below shows the levels and trends of obesity among women by year of the survey. The graph indicates a steady upward trend in the prevalence of obesity over the years, showing a notable increase from 9.9% in 2003 to 23.0% in 2022. The prevalence almost doubled over 20 years, as depicted in Figure 2.

To check for any statistical difference in obesity prevalence, a logistic regression test was conducted, and the results showed the existence of a statistically significant difference in the level of obesity between each pair of years except between 2014 and 2022, as given in Table 2.

3.3 | Multivariate Results

This section presents the results of the multivariate regression analysis, which shows the adjusted odds ratios (aOR) of the various years and variables. This considers all the variables together to see the net effect of each of them on the outcome variable (obesity status).

We start to examine the place of residence with respect to the obesity status of the women. The result showed no statistically

significant difference in obesity between rural and urban women except in 2022, where women from rural areas are 29% less likely to be obese compared with their counterparts residing in urban areas (aOR = 0.71; $p = 0.003$; CI [0.57–0.89]), as given in Table 3.

In terms of age groups, the results showed that the probability of becoming obese increases with age. Specifically, in 2003, women in the 25–29 age group were 2.4 times more likely to be obese compared with their counterparts in the age 15–24 (aOR = 2.37; $p = 0.013$; CI [1.20–4.64]). Also, women in the 30–34-year group were also 4.4 times more likely to be obese compared with their counterparts in the 15–24 age group (aOR = 4.39; $p = <0.001$; CI [2.17–8.89]). Similarly, women in the 45–49 years age group were 6.6 times more likely to become obese compared with their counterparts in the 15–24 years age group (aOR = 6.58; $p = <0.001$; CI [3.37–12.85]). Similar results (patterns) are observed in the other years where women in age 45–49 are the highest risk group of becoming obese, except in 2014 where those in age 40–44 years were the highest risk group (10.8 times) of becoming obese compared with their counterparts in the age group 15–24 years (aOR = 10.78; $p = <0.001$ CI [5.58–20.84]) (Table 3).

In terms of women's education, the results showed no association between education and obesity status for all the years, except in 2022, where individuals with secondary education were 48% more likely to become obese compared to their counterparts with no education (aOR = 1.48; $p = 0.021$; CI [1.05–2.42]). In terms of regional levels of obesity status, we observed that women from the three Northern Regions have a lower risk of becoming obese. Specifically, in 2003, women in the Northern, Upper West, and Upper East Regions were 85%, 79%, and 90% less likely to become obese compared with their counterparts in the Western Region, respectively. On the other hand, women in the Greater Accra Region have a higher chance (49%) of becoming obese compared with women in the Western Region. In 2008, there was no significant association among the women in the regions in terms of obesity. However, in 2014, results indicated that women from the Greater Region were 74% more likely to be obese compared to those in the Western Region (aOR = 1.74; p -value = 0.010: CI [1.14–2.64]). In 2022, the results revealed that women in the Northern Region had a 51% probability of being obese compared with women in the Western Region (aOR = 0.49; p -value = 0.001: CI [0.32–0.76]).

In terms of household wealth, the results show that in 2003, there was no statistically significant difference between women from the poorer and the women from the poorest households, as well as between women from the middle and the poorest households, in terms of obesity. However, the results showed that women in the richer households are about 3.4 times more likely to be obese compared with women in the poorest households (aOR = 3.42; $p = 0.002$; CI [1.56–7.51]). Also, women in the richest household were found to be 7.2 times more likely to be obese compared with those in the poorest households (aOR = 7.18; $p = <0.001$; CI [3.17–16.25]). A similar pattern is observed in 2008, where there was no significant difference among women in the first three household groupings (Table 3). For 2014, the results showed that obesity consistently increased with increasing household wealth. In 2022, it was observed that women in poorer households did not differ statistically from those in the poorest households. However, women in the middle-class quintile were found to be about

TABLE 1 | Characteristics of study respondents.

Variable	2003 Number (3775) (%)	2008 Number (3243) (%)	2014 Number (3245) (%)	2022 Number (5204) (%)
Obesity (overall = 13.7%)				
No	3401 (90.1)	2864 (88.3)	2615 (80.6)	4007 (77.0)
Yes	374 (9.9)	379 (11.7)	630 (19.4)	1197 (23.0)
Place of residence				
Rural	2250 (59.6)	1836 (56.6)	1584 (48.8)	2363 (45.4)
Urban	1525 (40.4)	1407 (43.4)	1661 (51.2)	2841 (54.6)
Age group				
15–24	634 (16.8)	535 (16.5)	471 (14.5)	786 (15.1)
25–29	755 (20.0)	649 (20.0)	579 (17.8)	900 (17.3)
30–34	725 (19.2)	590 (18.2)	649 (20.0)	1015 (19.5)
35–39	668 (17.7)	600 (18.5)	620 (19.1)	1010 (19.4)
40–44	540 (14.3)	451 (13.9)	503 (15.5)	848 (16.3)
45–49	453 (12.0)	418 (12.9)	423 (13.1)	645 (12.4)
Education				
No education	1355 (35.9)	931 (28.7)	857 (26.4)	1150 (22.1)
Primary	808 (21.4)	743 (29.9)	646 (19.9)	843 (16.2)
Secondary	1540 (40.8)	1488 (45.9)	1619 (49.9)	2810 (54.0)
Higher	72 (1.9)	81 (2.5)	123 (3.8)	401 (7.7)
Region				
Western	374 (9.9)	308 (9.5)	360 (11.1)	458 (8.8)
Central	306 (8.1)	315 (9.1)	341 (10.5)	567 (10.9)
Greater Accra	529 (14.0)	461 (14.2)	607 (18.7)	804 (15.4)
Volta	344 (9.1)	298 (9.2)	256 (7.9)	375 (7.2)
Eastern	408 (10.8)	321 (9.9)	305 (9.4)	427 (8.2)
Ashanti	713 (18.9)	645 (19.9)	574 (17.7)	1009 (19.3)
Brong Ahafo	396 (10.5)	295 (9.6)	286 (8.8)	531 (10.2)
Northern	385 (10.2)	344 (10.6)	314 (9.7)	661 (12.7)
Upper West	109 (2.9)	175 (5.4)	77 (2.4)	141 (2.7)
Upper East	211 (5.6)	81 (2.5)	125 (3.8)	231 (4.6)
Wealth index				
Poorest	778 (20.6)	610 (18.8)	580 (17.9)	926 (17.8)
Poorer	729 (19.3)	662 (20.4)	588 (18.1)	999 (19.2)
Middle	788 (20.9)	665 (20.5)	724 (22.3)	1046 (20.2)
Richer	744 (19.7)	716 (22.1)	688 (21.2)	1187 (22.7)
Richest	736 (19.5)	590 (18.2)	665 (20.5)	1046 (20.1)
Marital status				
Not married	581 (15.4)	600 (18.5)	721 (22.2)	1275 (24.5)
Married	2854 (75.6)	2098 (64.7)	1885 (58.1)	2924 (56.2)
Cohabiting	340 (9.0)	545 (16.8)	639 (19.7)	1005 (19.3)

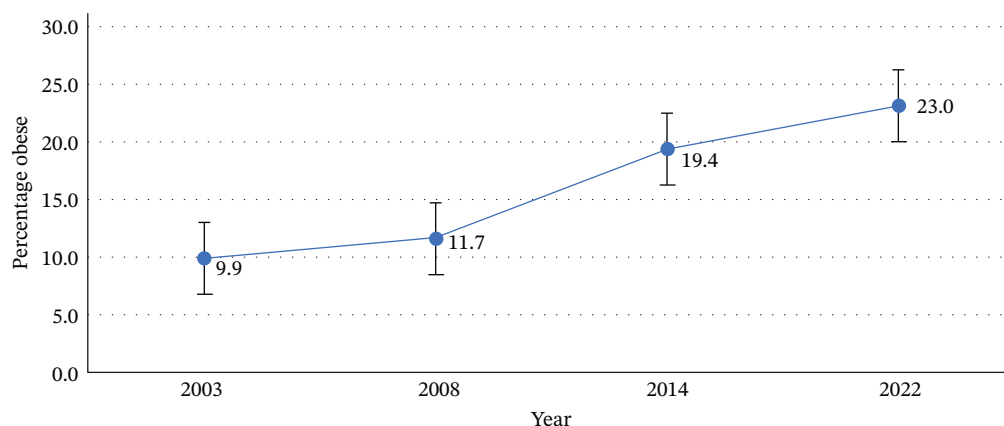


FIGURE 2 | Levels and trends of obesity among women, 2003–2022.

TABLE 2 | Regression output showing statistical differences in obesity levels by year.

Obesity	Odds ratio	Std. err.	z	P > z	[95% conf. interval]	
Year						
2022	—	—	—	—	—	—
2003	0.443678	0.0302886	−11.9	<0.001	0.3881135	0.507197
2008	0.5622924	0.0378552	−8.55	<0.001	0.4927842	0.641605
2014	0.8917969	0.0535673	−1.91	0.057	0.7927515	1.003217

3 times more likely to be obese compared with those in the poorest household (aOR = 2.95; $p < 0.001$; CI [1.82–4.78]). Similarly, women in the richer quintile households are about 5 times more likely to be obese compared with their counterparts in the poorest quintile. Last, the richest women in 2022 were 7.4 times more likely to be obese compared with their counterparts in the poorest households.

In terms of marital status, the 2003 result showed that women who are married are 91% more likely to become obese compared with those who are not married (aOR = 1.91; $p = 0.002$; CI [1.28–2.85]). For the other years (2008, 2014, and 2022), there was no statistically significant association found between marital status and women's obesity status (Table 3).

4 | Discussion and Policy Implications

This study examined the level, trends, and factors associated with obesity among women in Ghana using four waves of the Ghana DHS data, spanning from 2003 to 2022. The results showed that overall, 13.7% of the women were obese. This result is similar to that of Okyere [26], who reported an overall obesity prevalence of 15.2% in his study using three waves of Ghana DHS data from 2008 to 2022. In terms of trends, obesity increased consistently over the period, with the prevalence more than doubling between 2003 and 2022. This finding aligns with other studies where obesity prevalence in some countries in Africa has more than doubled over the past 20 years or more [27, 28]. The result also aligns with global estimates, where [29] have reported that obesity prevalence has been on the increase over the past few decades [30]. Improvements in the socioeconomic well-being of individuals

and households have been one of the factors driving these increases. These improvements tend to take people away from consuming healthy traditional foods and towards eating expensive but unhealthy diets. People also become inactive as they can afford basic means of transport to places instead of walking, all of which leads to an increase in obesity. To address the high and increasing levels of obesity, public health education is required that will enable people to change their behavior and lead a healthy lifestyle.

The results of the multivariate analysis showed that age, education, household wealth, and rural/urban place of residence were associated with obesity. Specifically, the results showed that women in rural areas were less likely to be obese compared to those in urban areas, particularly in 2022. This finding aligns with Asosega's spatial analysis of the prevalence of obesity and overweight among women in Ghana, which revealed that overweight/obesity clusters were predominantly in urban areas [31].

In terms of age groups, results showed that the probability of becoming obese increases with age. Findings from earlier studies in Ghana are in sync with this finding [5, 29]. As women age, they become more sedentary, and coupled with a poor diet, they are more likely to be obese compared to their younger counterparts. Health education needs to be strengthened on a healthy lifestyle, targeting older women. Also, women must be encouraged to engage in some physical activities to reduce their risk of becoming obese.

In terms of women's education, the results showed that, generally, higher levels of education are associated with obesity. This finding is similar to those of [30, 32], all in Ghana, where they

TABLE 3 | Odds Ratios from the logistic regression of the effect of risk factors on obesity among women.

Variable	2003		2008		2014		2022	
	aOR (95% CI)	P-Value	aOR (95% CI)	P-Value	aOR (95% CI)	P-Value	aOR (95% CI)	P-Value
PoR								
Urban	*****		*****		*****		*****	
Rural	0.69 (0.42–1.13)	0.138	0.72 (0.50–1.04)	0.082	1.21 (0.87–1.69)	0.254	0.71 (0.57–0.89)	0.003
Age group								
15–24	*****		*****		*****		*****	
25–29	2.37 (1.20–4.64)	0.013	3.21 (1.48–6.96)	0.003	3.21 (1.67–6.19)	0.001	2.23 (1.33–3.73)	<0.002
30–34	4.39 (2.17–8.89)	<0.001	4.76 (2.18–10.35)	<0.001	5.214.61 (2.77–9.80)	<0.001	3.34 (2.40–6.16)	<0.001
35–39	5.26 (2.75–10.05)	<0.001	8.09 (3.72–17.26)	<0.001	6.56 (3.40–12.66)	<0.001	4.93 (2.93–8.31)	<0.001
40–44	6.22 (3.18–12.14)	<0.001	11.23 (5.23–24.11)	<0.001	10.78 (5.58–20.84)	<0.001	5.10 (3.00–8.67)	<0.001
45–49	6.58 (3.37–12.85)	<0.001	9.03 (4.08–19.98)	<0.001	8.42 (4.16–17.05)	<0.001	5.39 (3.36–8.64)	<0.001
Education								
No education	*****		*****		*****		*****	
Primary	1.22 (0.77–1.93)	0.397	1.51 (0.96–2.38)	0.071	1.47 (0.97–2.21)	0.067	1.41 (0.97–2.04)	0.067
Secondary	1.17 (0.77–1.76)	0.457	1.34 (0.91–1.98)	0.136	1.28 (0.90–1.81)	0.171	1.48 (1.06–2.06)	0.021
Higher	1.45 (0.78–2.70)	0.231	1.85 (0.93–3.68)	0.079	1.37 (0.73–2.55)	0.323	1.13 (0.74–1.74)	0.566
Region								
Western	*****		*****		*****		*****	
Central	1.06 (0.57–1.95)	0.855	1.09 (0.57–2.06)	0.797	1.42 (0.98–2.07)	0.066	1.37 (0.88–2.15)	0.165
Greater Accra	1.49 (1.01–2.19)	0.045	1.53 (0.95–2.47)	0.078	1.74 (1.14–2.64)	0.010	1.41 (0.92–2.16)	0.109
Volta	1.17 (0.61–2.56)	0.636	1.66 (0.89–3.14)	0.113	1.09 (0.67–1.77)	0.734	1.04 (0.69–1.56)	0.853
Eastern	1.30 (0.77–2.18)	0.322	1.29 (0.73–2.29)	0.383	1.24 (0.85–1.82)	0.262	1.24(0.80–1.92)	0.337
Ashanti	1.19 (0.77–1.83)	0.427	1.04 (0.62–1.72)	0.887	1.25 (0.84–1.84)	0.270	1.07 (0.71–1.60)	0.753
Brong Ahafo	1.25 (0.62–1.69)	0.920	0.72 (0.35–1.47)	0.370	0.60 (0.34–1.05)	0.073	0.96 (0.77–1.38)	0.811
Northern	0.15 (0.03–0.73)	0.019	0.66 (0.34–1.29)	0.225	0.80 (0.43–1.50)	0.482	0.49 (0.32–0.76)	0.001
Upper West	0.21 (0.05–0.78)	0.021	0.59 (0.27–1.30)	0.192	1.12 (0.58–2.18)	0.726	0.69 (0.40–1.89)	0.179
Upper East	0.10 (0.01–0.93)	0.043	1.83 (0.38–1.84)	0.651	1.08 (0.60–1.95)	0.799	0.91 (0.55–1.50)	0.171
Wealth index								
Poorest	*****		*****		*****		*****	
Poorer	0.80 (0.32–1.98)	0.625	1.37 (0.64–2.94)	0.421	3.17 (1.59–6.32)	0.001	1.61 (0.99–2.60)	0.053
Middle	1.47 (0.66–3.28)	0.339	1.93 (0.89–4.23)	0.097	7.81 (4.00–15.21)	<0.001	2.95(1.82–4.78)	<0.001
Richer	3.42 (1.56–7.51)	0.002	4.94 (1.88–8.93)	<0.001	12.93 (6.24–26.80)	<0.001	4.96 (3.09–7.95)	<0.001
Richest	7.18 (3.17–16.25)	<0.001	7.82 (3.46–17.66)	<0.001	24.76 (11.63–52.68)	<0.001	7.36 (4.47–12.10)	<0.001
Marital status								
Not married	*****		*****		*****		*****	
Married	1.91 (1.28–2.85)	0.002	1.21 (0.85–1.72)	0.294	0.95 (0.67–1.32)	0.774	1.17 (0.82–1.39)	0.619
Cohabiting	1.27 (0.66–2.45)	0.464	0.98 (0.57–1.67)	0.930	0.80 (0.57–1.38)	0.604	1.07 (0.76–1.51)	0.682

found a positive association between maternal age and obesity. Factors that may contribute to these findings include the fact that more educated people reside in urban areas, are more wealthy,

and are in managerial occupations, which are associated with a sedentary lifestyle [4, 31]. Addressing this issue requires health education, which encourages physical activity and promotes

healthy eating among educated women, particularly those whose work does not allow them to engage in any meaningful physical activity.

In terms of regional performance in obesity status, we found no association between the region and outcome variable in 2008. For the other years, we observed that, generally, women from the three Northern Regions were significantly less likely to become obese. This finding aligns with a study conducted in Ghana by Yussif et al. [30], which showed higher obesity rates in southern and coastal regions than the Northern part of Ghana. The differences may be attributed to differences in wealth status, educational level, and sedentary lifestyle, which are more prevalent in the southern regions, which are more urbanized than regions in the north of Ghana [8]. To address the high level of obesity in the regions, the Health Promotion Units of the Ghana Health Service and all relevant agencies should apply context-specific interventions to address the local challenges of the population to help reduce obesity levels in these regions.

In terms of household wealth, the results show that a higher SES is associated with a higher risk of obesity. Specifically, women in higher socioeconomic households are at a higher risk of obesity. The findings support the general body of knowledge that wealthier women have a greater risk of becoming obese than poor women [33, 34]. Wealthy women typically can afford all food types, some of which are unhealthy and a risk factor for obesity. Such women also tend to live a sedentary lifestyle, which is one of the major risk factors of obesity. Specific policy interventions, by way of health education, may be necessary to address the increasing obesity prevalence among individuals in relatively higher socioeconomic brackets [8].

Marital status did not show much significant association with obesity, except in 2003, when married women are 91% more likely to become obese compared with those who were not married. This finding aligns with other studies conducted in Ghana and elsewhere [31]. Specifically, their systematic review and meta-analysis [4] concluded that married women were more at risk of obesity compared to unmarried women [14, 20, 22, 27, 28]. In another study [35], found that cohabitating women in Ghana are less likely to be obese compared to unmarried women. Several reasons can be adduced to explain this phenomenon. In the first place, when women get into a relationship, their lifestyle may change from an active to a more sedentary lifestyle, which is a key risk factor of obesity. Another factor may relate to changes in eating habits after marriage as couples may resort to unhealthy eating habits.

This study was guided by the Health Belief Model, which specified six elements based on which individuals may change behavior to improve their health. However, it is worthy of note that these factors (model elements) do not operate in isolation but in some combinations. Therefore, the force and direction of each element will determine the direction of the behavior change. Also, other factors not considered in the model may play a key role in behavior change. For instance, if an individual faces the problem of addiction, behavior change could be difficult to achieve even if the individual knows about the susceptibility, severity, and benefits associated with behavior change. Religious and cultural factors could play a similar role to prevent one from behavior change,

other than the six elements espoused by the model. Therefore, in applying this model to induce behavior change, there is a need to incorporate other local contextual factors, such as religious and cultural beliefs, to achieve the desired behavioral change to improve health.

5 | Study Strengths and Limitations

The use of DHS data has both strengths and weaknesses, and this analysis is no exception. For the strength, the conduct of DHS surveys requires following stringent standardized procedures for data collection and analysis, including the use of validated questionnaires, in order to assure both internal and external validity of the results. Despite these strengths, there are also several limitations worth discussing. In the first place, the selected study participants used in the analysis may not be a true representative of the entire female population due to some selection biases. As a result, the findings may not reflect the true outcomes of the whole population. It is also worth noting that the unavailability of other important predictors of the outcome variable, such as physical activity and nutritional history, could affect the findings. The problem of possible recall bias due to forgetfulness on the part of the respondents could also affect the results. Participants might also provide socially desirable responses to please the interviewer or conform to what society expects. Last, the data used for the analysis are cross-sectional, so it is not possible to establish causality, only associations. Despite these limitations, we think that the robustness with which the data were collected and the rigor with which the data analysis was undertaken, the results, and the findings can be generalized to represent the population from which the sample was drawn.

6 | Conclusion and Recommendations

This study examined the levels, trends, and factors associated with obesity among women in Ghana using four waves of GDHS data (2003, 2008, 2014, and 2022). From the results, we conclude that the prevalence of obesity among women has been on the ascendancy over the years, from 9.9% in 2003 through to 23.0% in 2022. In terms of factors associated with obesity, we found that age is an important factor, where older women are more likely to be obese compared with their younger counterparts. Also, higher levels of education are associated with a higher risk of being obese. Another important factor that was found to be associated with obesity is higher household wealth, where women in wealthy households have a higher risk of being obese. Other factors that showed some marginal association with obesity include those residing in the Greater Accra Region and women in urban places of residence. In view of this, we make the following recommendations:

1. In general, the Ministry of Health and the Ghana Health Service should enhance multisectoral coordination among stakeholders involved in the food and nutrition policy space to help provide health education to the general populace on the health implications of obesity as well as the effective implementation of obesity prevention programs.
2. Specifically, the Ghana Health Service, in collaboration with other relevant agencies, should implement context-

specific intervention programs such as the formation of keep fit clubs, targeting vulnerable populations, such as urban dwellers, those whose job type requires less physical activity, and those with higher SES.

3. Effective health education and promotion, targeting women, should consider indigenous cultural perceptions and norms relating to dietary and physical activity behaviors to address the rising prevalence of obesity among women in Ghana.
4. Local assemblies should be proactive in the provision of a conducive environment for people to facilitate behavior change, such as the construction of playgrounds and the creation of healthier food environments, among others.
5. National or at least local-level legislation should be enacted to regulate or minimize the sales and distribution of unhealthy foods, such as sweetened beverages and fatty foods, among others, which are now common in both urban and rural settings.
6. Longitudinal studies on people's lifestyle are required to understand the general lifestyle behaviors, such as dietary intake and physical activity, which lead people to obesity. Also, qualitative studies are needed to understand the sociocultural dynamics relating to traditional food systems that put people at risk of obesity.

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Ethics Statement

The Ghana Health Service Ethical Committee and the ICF International Institutional Review Board (IRB) reviewed and approved the protocol for the GDHS datasets.

Consent

Informed consent of eligible women was duly sought before the interviews and data collection.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

Data for this study came from the Ghana Health and Demographic Health Survey. Data are available online and can be accessed upon request from the Ghana Statistical Service through registration with the DHS Program. The registration can be done on the DHS website.

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