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Obesity burden by socioeconomic measures between 2000 and 2018 among women in sub-Saharan Africa: A cross-sectional analysis of demographic and health surveys

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Abstract

Background: The increasing global burden of obesity especially in low-and-middle-income countries (LMICs) accentuates the need for critical action. In the absence of evidence-based approaches to mitigate recent obesity trends, the likelihood of reaching global obesity targets will be almost zero.

Objective: This study examined the obesity prevalence in Sub-Sahara Africa and observed transitions on the burden of obesity prevalence over time.

Methods: Data from the Demographic and Health Survey which is based on cross sessional design was used. Most recent surveys carried out in 16 sub-Saharan Africa (SSA) between 2000 and 2018 were included in the analysis. Equiplot by the International Centre for Equity was used to display the inequities by the following socioeconomic measures: wealth index, education, and place of residence. Age-standardized prevalence was measured across these socioeconomic measures using the WHO standard population age distribution, examined changing trends and finally assessed transition in obesity prevalence by percentage point difference of highest and lowest prevalence within each of the three socioeconomic measures.

Results: A total of 496,482 women were included in the analysis. Obesity prevalence among women varied substantially, from 2% in Chad to 27% in Lesotho. Variation in obesity prevalence was observed across countries and by socioeconomic status measures. Among women in all the countries except Comoros, the burden was concentrated among the wealthiest. Out of the 16 countries included, the prevalence of obesity was concentrated among women with no education in eight countries (Benin, Burundi, Chad, Cote d'Ivoire, Guinea, Mali, Niger, Comoros) while it was concentrated in those with primary education in Congo and Lesotho and among those with secondary school education in DR Congo, Gabon, Namibia, Nigeria, and Zimbabwe. The burden of obesity was more concentrated in the urban across the 16 countries except in Comoros and Lesotho where they were higher in the rural (8.9 [7.2, 11.1] and 15.1 [13.0, 17.5] respectively) than in urban (6.6 [5.0, 8.8] and 6.8 [5.2, 8.8] respectively). Finally, the trend analysis with five countries

indicated that the prevalence and gap in obesity among women increased between previous and most recent surveys except in Zimbabwe where it reduces across the three socioeconomic measures between 2011 and 2018.

Conclusions: This study examined transition in obesity prevalence among women across three socioeconomic measures in selected sub-Saharan African countries. Increasing prevalence of obesity was found in SSA but transition to women in lower socioeconomic status is already taking place in some countries.

KEYWORDS
Age-standardized prevalence, Obesity, Socioeconomic measure, Sub-Saharan Africa

1 | INTRODUCTION

The increasing global burden of obesity especially in low-and-middle-income countries (LMICs) accentuates the need for critical action.[1,2] Globally, overweight and obesity were estimated to cause 3.4 million deaths, 3.9% of years of life lost, and 3.8% of disability-adjusted life years in 2010.[3] Between 1980 and 2014, worldwide obesity prevalence significantly doubled as 15% of women aged 18 and above were found to be with obesity.[4] By 2016, more than 650 million adults were considered as having obesity.[5] Furthermore, gender disparities exist in obesity prevalence as women are disproportionately affected across all socioeconomic levels and bear negative health and socioeconomic impacts.[5–7] Such negative impact of obesity on women heightens their risk of diabetes, cardiovascular diseases, hypertension, cancer, and a range of reproductive health issues. In the absence of evidence-based approaches to mitigate recent obesity trends, the likelihood of reaching global obesity targets will be almost zero,[8] and 57.8% (3.3 billion) of the global adult population especially women could have obesity or become overweight by 2030.[9]

Increasing globalization and its attendant urbanization are facilitating an epidemiological transition highlighted by a double burden of communicable and non-communicable diseases in sub-Saharan Africa (SSA).[6,10–12] Rapid urbanization due to socioeconomic changes has led to an unprecedented adoption of western-style diet including highly processed food and sedentary habits which are key drivers for obesity in the SSA region.[2,10] Concomitantly, obesity has been implicated in the rising prevalence of NCDs leading to a double burden of disease with a similarly high prevalence of communicable diseases such as malaria, tuberculosis, and HIV.[13] Public health interventions targeting obesity reduction are either inadequate or non-existent due to scarce human and material resources in SSA.[14] Hence, prioritizing the prevention of obesity will offer greater value in tackling the double burden of disease in an SSA region with limited resources when compared to the cost and challenges of weight reduction.[9,13]

Despite historical consideration of obesity as a problem of high-income countries and individuals with high socioeconomic status (SES), a transition in the burden of obesity has been witnessed across socioeconomic classes and settings.[16,17] For instance, LMICs in SSA with previously low obesity levels are facing a rising obesity burden, especially in urban areas and among women.[2,3] A four-stage conceptual model of obesity transition across socioeconomic groups is proposed by Jaacks et al[16] using data from 30 mega countries. In stage one, a higher prevalence of obesity is observed among individuals with higher SES compared to those with lower SES, and women bearing a greater burden (above 5% but not more than 20%). The second stage is highlighted by a large increase in adult obesity prevalence, a smaller increase in childhood obesity, and a reduction in gender and socioeconomic disparities among women. Stage three is characterized by higher obesity prevalence among individuals with lower SES compared to those with higher SES, and a "closing of the gender gap". Finally, a speculative fourth stage where obesity prevalence declines across all groups is predicted.[16]

Comprehensive data on obesity burden among women is critical in estimating their health effects, prioritizing public health actions, and evaluating progress where and when necessary.[3,15] Particularly, evidence-based knowledge of obesity trends across different settings in SSA can inform policy and program efforts leading to greater effectiveness of population-based interventions especially for women who bear the greater burden of obesity.[2,4] This study is aimed at describing the obesity distribution by socioeconomic measures among women in selected SSA countries and evaluating changing trends in obesity distribution and gaps by socioeconomic measures using data over time. The data source used does not contain height and weight data for men, therefore, men's prevalence and other analysis could not be explored.

2 | METHODS

2.1 | Study design

Cross-sectional series analysis of obesity prevalence in Africa was conducted by their socioeconomic status using datasets from nationally representative health surveys done in 16 sub-Sahara African countries. Publicly available dataset from Demographic and Health Surveys (DHS) done between 2010 and 2018 was used, following countries were involved, Benin, Burundi, Chad, Comoros, Congo, Cote d'Ivoire, DR Congo, Gabon, Guinea, Lesotho, Mali, Namibia, Niger, Nigeria, and Zimbabwe.

2.1.1 | Population, sample, and sampling

DHS is a multi-country survey that involves data collection every 5 years using similar multi-stratification cluster sampling approaches across all the countries. They are implemented in more than 90 low income and middle-income countries that provide information on standard global health and population indicators. As our study is focused on sub-Saharan Africa, all surveys in each country that collected anthropometric data were included. The surveys have a similar sampling design procedure used in data collection that has been published elsewhere.[17] The study population included women aged 18–49 years, analysis was restricted to women that were not pregnant to avoid false weight during pregnancy. Data from each survey were anonymized, therefore, there was no need for ethical approval as neither primary data was not collected nor used in this study.

2.2 | Measures

2.2.1 | Outcome variable

Our primary outcome of interest, obesity, was defined as having a body-mass index (BMI) of 30 kg/m or above. The DHS data on weight and height are collected during the survey period; reported values are not used, thus eliminating recall bias, and improving accuracy computation of BMI values.

2.2.2 | Socioeconomic measures

The following three socioeconomic index measures were used to assess and investigate the pattern of obesity: the place of residence, education index and wealth index. The choice of this socioeconomic measure was informed by previous studies in relevant field. Place of residence was measured as rural or urban using DHS criteria while education index was categorized as E1 to E4 with E1 as least educated (no education) and E4 as most educated (tertiary education). We used the existing categorical measure of education specified in the surveys. Wealth index was categorized as Q1–Q5, where Q1 and Q5 are the poorest and richest quintiles. The DHS has no information on household income; therefore, wealth index was used as a proxy indicator to measure the socioeconomic status of respondents. It was constructed using principal component analysis (PCA) based on the following household variables: number of rooms per house, ownership of a car, motorcycle, bicycle, fridge, television, and telephone as well as any kind of heating device.[17]

2.3 | Statistical analysis

All 16 countries were included in the analysis of obesity gaps, however, only five countries that had a minimum of two consecutive surveys and at least 4 years apart, were included in the trend analysis of obesity gaps. The gap in obesity prevalence is defined as the absolute difference in percentage points between the highest and lowest most extreme obesity prevalence estimates within each socioeconomic status measure (place of residence, education, and wealth index). Therefore, if the highest obesity prevalence by wealth was observed among the third quintile, and the lowest among the fifth quintile, the obesity gap by wealth was calculated as the arithmetic difference between the obesity estimate in the third and fifth quintile. With the five countries with consecutive surveys, trends in obesity gaps were assessed by socioeconomic status over two-time points. For the most recent surveys, the regional mean obesity prevalence within each socioeconomic status measure computed as the arithmetic average of all countries' estimates within each quintile were reported. The age-standardized obesity prevalence by each of the three socioeconomic status measures (wealth, education, and area of residence) using the WHO standard population age distribution was calculated and reported.[18] The "svy" command was used to account for complex survey sampling designs and the sampling weights across the surveys.[19] Due to the multi-stage sampling techniques approach used in DHS data, the svy command informs STATA that the dataset is from a survey by specifying the strata and primary sampling unit. Equiplots were generated to display inequalities in obesity by socioeconomic status using the equiplot.ado file. All the analyses were conducted, and graphs generated using Stata version 16. The findings were presented per the recommendation of the Strengthening Reporting of Observational studies in Epidemiology (STROBE) reporting guidelines (Supporting Information S1).

2.4 | Ethics

This study is based on a secondary dataset from the DHS; therefore, ethical approval is not required. Data used is available in public domains.

3 | RESULTS

3.1 | Population description

Data from 27 DHS from the 16 selected SSA countries were used for this analysis, a total of 292, 253 women were included in the analysis of the most recent obesity prevalence in Africa, and 496, 482 were included in the trend analysis of the change in prevalence over time. The most recent data available for the 16 African countries with available data corresponded to 2010–2018, and the age-standardized obesity prevalence among adult women varied greatly (Figure 1; Table 1). Overall, the highest obesity prevalence was found among the fourth richest quintile (3.4%), third education quintile (3.7%), and urban (5.3%) women (Table 1). Lesotho and Gabon had the highest obesity prevalence among women by all three socioeconomic measures (about 19%) whereas Chad had the lowest obesity prevalence (about 2%).

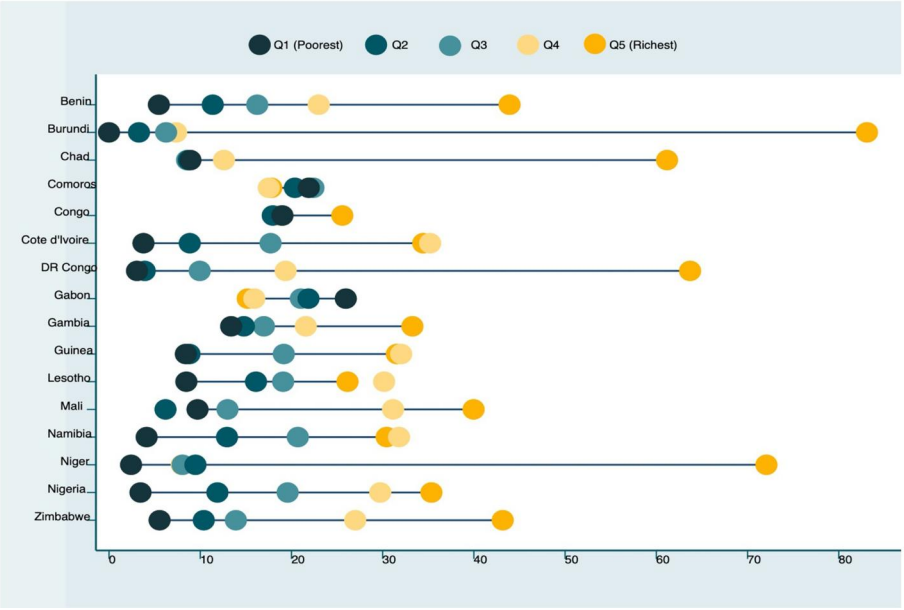

FIGURE 1 Most recent obesity prevalence in sub-Saharan Africa (SSA) by wealth index

TABLE 1 Most recent obesity prevalence in 16 sub-Saharan Africa (SSA)

	Obesity prevalence (women)	
Country	**Women with no obesity (%, 95% CI)**	**Women with obesity (%, 95% CI)**
Benin	88.16 [86.82, 89.37]	11.84 [10.63, 13.18]
Burundi	97.58 [96.84, 98.15]	2.421 [1.851, 3.162]
Chad	96.92 [96.26, 97.47]	3.076 [2.526, 3.741]
Comoros	80.57 [77.61, 83.22]	19.43 [16.78, 22.39]
Congo	88.43 [86.03, 90.46]	11.57 [9.541, 13.97]
Cote d'Ivoire	91.73 [90.04, 93.16]	8.265 [6.84, 9.955]
DR Congo	95.73 [94.3, 96.81]	4.272 [3.193, 5.696]
Gabon	73.26 [70.57, 75.79]	26.74 [24.21, 29.43]
Gambia	90.36 [88.58, 91.89]	9.64 [8.115, 11.42]
Guinea	89.28 [87.8, 90.61]	10.72 [9.392, 12.2]
Lesotho	72.33 [69.12, 75.33]	27.67 [24.67, 30.88]
Mali	90.0 [88.2, 91.56]	9.996 [8.44, 11.8]
Namibia	80.92 [78.59, 83.06]	19.08 [16.94, 21.41]
Niger	96.27 [95.52, 96.89]	3.735 [3.11, 4.478]
Nigeria	88.27 [87.28, 89.19]	11.73 [10.81, 12.72]
Zimbabwe	83.73 [82.25, 85.1]	16.27 [14.9, 17.75]
Total	89.98 [89.6, 90.34]	10.02 [9.657, 10.4]

3.2 | Obesity prevalence and transition in SSA

The obesity prevalence varied by socioeconomic status measure and by country. Among women in all the countries except Comoros, the burden was concentrated among the wealthiest. In Cote d'Ivoire, Lesotho and Namibia, obesity prevalence was more concentrated among women in the fourth wealth quintile. Of the 16 countries included, the prevalence of obesity was concentrated among women with no education in eight countries (Benin, Burundi, Chad, Cote d'Ivoire, Guinea, Mali, Niger, Comoros) while it was concentrated in those with primary education in Congo and Lesotho and among those with secondary school education in DR Congo, Gabon, Namibia, Nigeria, and Zimbabwe. Mapping this result also showed that countries where the prevalence of obesity was concentrated among those with low education also have a very low prevalence of obesity generally than others with exception to Comoros only. The burden of

obesity was more concentrated in the urban in most of the 16 countries except in Comoros and Lesotho where they were higher in the rural (8.9 [7.2, 11.1] and 15.1 [13.0, 17.5] respectively) than in urban (6.6 [95% CI 5.0, 8.8] and 6.8 [95% CI 5.2, 8.8]) respectively (Figure 2).

In the same pattern, among women in all the countries, obesity prevalence was least concentrated in the poorest quintile except in Comoros where obesity prevalence was most concentrated in the group. Also, obesity prevalence was least concentrated in the most educated group (more than secondary education) in all the countries. It was also least concentrated among women residing in the rural area except in Benin, Comoros, and Lesotho (Figure 3).

The largest obesity prevalence was observed in Lesotho with 27.7% [95% CI 24.7–30.9] in 2014 (Table 1), with 7.7 [95% CI 5.9, 10.1] among women in the fourth wealth quintile, 10.2 [95% CI 8.4, 12.3] among women with primary education and 15.1 [95% CI 13.0, 17.5] among women residing in the rural area (Table 2). Multiple obesity patterns emerge by socioeconomic status (Figure 1 and Table 2): Benin, Lesotho, Namibia, and Zimbabwe Bolivia had large inequalities in the distribution of obesity by wealth; Comoros, Gabon, Lesotho, Namibia by education level, and Congo, Gabon, and Lesotho by place of residence. The widest obesity gaps among the African women included in this analysis were observed in Gabon, with a 16.3 percentage point difference in obesity prevalence by place of residence, and a 10.9 percentage point difference by education level. By wealth quintile, the highest percentage point difference was observed in Zimbabwe (9.9) in 2010–2011 but reduced drastically by the next survey to 3.7. Therefore, going by the most recent survey, the highest percentage difference was observed in Benin (4.1%), which was mostly concentrated in the wealthiest quintile (4.2%).

Zimbabwe in 2010/2011 had an upper inequality pattern by wealth among women, in which large inequalities existed between the fourth and fifth poorest quintiles (3.8 [95% CI 3.2, 4.5] vs 11.5 [95% CI 10.5, 12.7]), with smaller differences between lower quintiles (Table 2). In Gabon, Lesotho, Benin, Namibia and Nigeria, the prevalence of obesity among women was similar in all wealth and education quintiles (Table 1). The smallest obesity gap by wealth status was in Comoros; by education level, the smallest was observed in Burundi and but place of residence, the smallest gap was observed in Burundi (Table 2).

3.3 | Trend analysis with five countries

The trend analysis with five countries (Benin, Burundi, Mali, Nigeria, and Zimbabwe) indicated that the prevalence and gap in obesity among women increased between the most recent and previous surveys except in Zimbabwe where it reduces across the three socioeconomic measures between 2010/2011 and 2018 (Table 2). In Benin between 2012 and 2018, the obesity gap increased from 1.1% to 4.1% points by wealth while the burden moved from women in the third quintile to fifth (wealthiest) quintile. By education, the obesity gap increased from 3.1% to 4.3% and the burden still concentrated among women with no education. By place of residence, the gap increased from 0.2% to 3%, substantial increase in urban area was observed from 2.5% [95% CI 2.1, 2.9] in 2012% to 5.9% [95% CI 4.8, 7.0] in 2018.

In Burundi between 2010 and 2017, the obesity gap increased from 0.5% to 1.9% by wealth status with a substantial increase in prevalence and burden more concentrated in the wealthiest quintile.

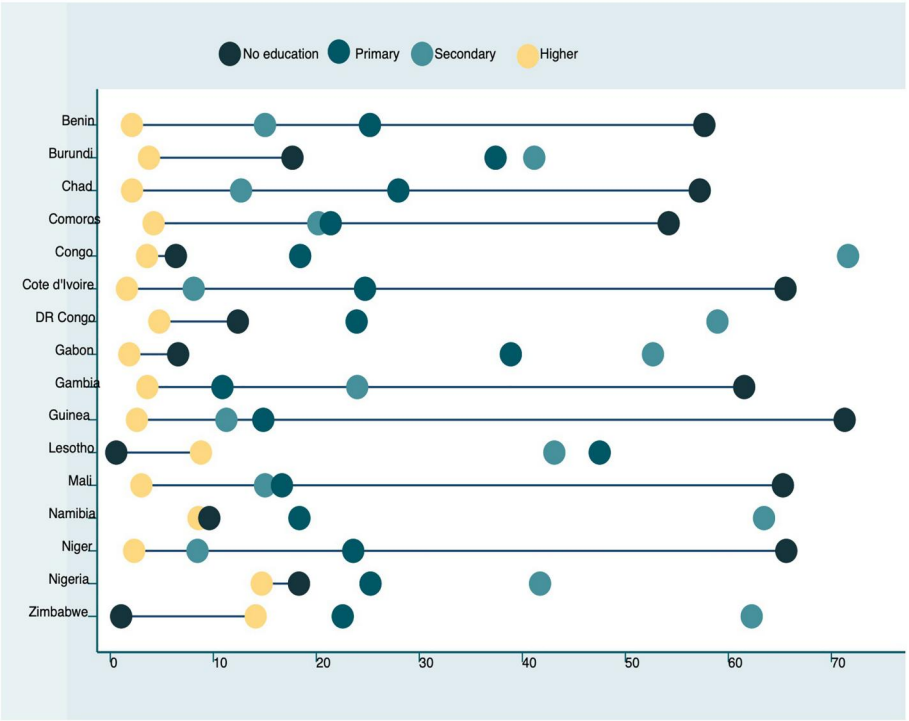

FIGURE 2 Most recent obesity prevalence in sub-Saharan Africa (SSA) by education

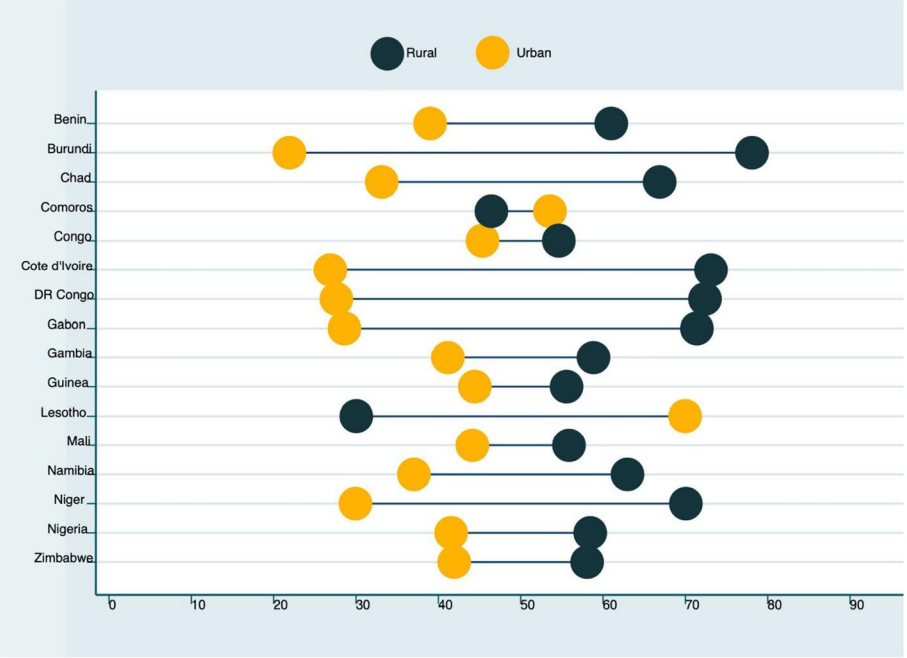

FIGURE 3 Most recent obesity prevalence in sub-Saharan Africa (SSA) by residence

By education level, 0.4%–1.1% but the burden of obesity prevalence shifted from women with no education (0.4 [95% CI 0.2, 1.1]) with those with primary school educations (1.2 [95% CI 0.4, 3.6]). We observed some exemption in socioeconomic measure by place of residence; the obesity gap reduced from 0.4% in 2010% to 0% gap in 2017. While this showed that no inequality was observed in the most recent survey, a substantial increase in the prevalence was observed among women residing in urban locations. In Mali between 2013 and 2018, the obesity gap increased from 2.4% to 2.9% by wealth status with the burden concentrated in the wealthiest quintile in both years. By education level, the obesity gap increased from 2.9% to 4.5% with more burden concentrated among women with no education. By place of residence, the obesity gap reduced from 1.2 in 2013% to 0.4% in 2018; we also observed a shift in the burden of obesity prevalence from women residing in the urban area (2.8 [95% CI 2.4, 3.3]) to women in rural areas (4.0 [95% CI 3.1, 5.2]).

In Nigeria, the obesity gap increased from 2.2% to 3.1% by wealth status; 1.3%–2.4% by education level and from 1.4 to 2.4 by place of residence. The burden of obesity was concentrated among women from the wealthiest quintile, those with primary education and those residing in urban locations. The most significant change in obesity gap and prevalence was observed in Zimbabwe by wealth status—a sharp reduction from 9.9 in 2011 to 3.7 in 2015.

4 | DISCUSSION

Data from the DHS was used to estimate the age-standardized prevalence of obesity in 16 SSA countries and to analyze the shift across three socioeconomic measures: wealth Index, education, and place of residence. Finally, percentage change as a measure for obesity shift or transition with data from five countries that have more than one survey with obesity data was computed. Overall, our estimates demonstrate the different patterns of obesity prevalence across countries in SSA with most countries in the first and second stage of obesity transition.

The recent conceptual model by Jaacks and colleagues[17] was used to map and discuss the findings from the prevalence analysis. They used economic development factors modified within the local context to design a conceptual model to explain stages in obesity transition among children, women, and men. They historically mapped and compared the transitions experienced by developed countries with developing countries. According to this conceptual model, only four countries in our study namely Burundi, Chad, DR Congo and Niger are not in the first stage of obesity transition as obesity prevalence among women in these countries is below 5%. This suggests that these countries are yet to enter obesity transition and these findings have been confirmed in previous studies.[19,20] Each of the four countries was reported to have an obesity prevalence among women that is lower than the regional (Africa) average although the prevalence reported in these studies were higher than our findings. The difference may emanate from methodological approach as this study used age-standardized prevalence compared to the use of normal descriptive prevalence in other studies. In Burundi, where there was two survey year data points, this study observed an increase in obesity prevalence, and this is consistent with a previous study also.[21]

Ten of the 16 SSA countries included in our analysis are in the first stage of obesity transition among women. The countries are Benin, Congo, Cote d'Ivoire, Gambia, Guinea, Mali, Namibia, Nigeria, and Zimbabwe; they all have obesity prevalence above 5% but not more than 20% according to the model by Jaacks et al model. Two of

TABLE 2 Age-standardized obesity prevalence (%) among women by country and year

Country	Sample size	Wealth index					Gap percentage points	Education				Gap percentage points	Area of residence		Gap percentage points
		Q1 (%, 95% CI)	Q2 (%, 95% CI)	Q3 (%, 95% CI)	Q4 (%, 95% CI)	Q5 (%, 95% CI)		E1 (%, 95% CI)	E2 (%, 95% CI)	E3 (%, 95% CI)	E4 (%, 95% CI)		Urban (%, 95% CI)	Rural (95% CI)	
Benin															
2018	10,814	0.1 [0.04, 0.4]	0.7 [0.40, 1.12]	1.1 [0.8, 1.6]	2.6 [1.9, 3.5]	4.2 [3.3, 5.2]	4.1	4.5 [3.7, 5.4]	2.5 [2, 3.15]	1.5 [1.1, 2.2]	0.2 [0.1, 0.4]	4.3	5.8 [4.8, 7.0]	2.9 [2.3, 3.7]	2.9
2012	39,063	0.5 [0.4, 0.7]	0.9 [0.7, 1.2]	0.1 [0.8, 1.3]	1.6 [1.3, 1.9]	1.2 [0.9, 1.5]	1.1	3.2 [2.8, 3.7]	1.3 [1.0, 1.6]	0.6 [0.5, 0.8]0	0.1 [0.02, 0.2]	3.1	2.5 [2.1, 2.9]	2.7 [2.3, 3.1]	
Burundi															
2016–2017	20,573	0.0	0.1 [0.0, 0.3]	0.2 [0.1, 0.4]	0.1 [0.1, 0.3]	2.0 [1.0, 4.0]	1.9	0.3 [0.2, 0.6]	1.2 [0.4, 3.6]	0.7 [0.5, 1.2]	0.1 [0.0, 0.2]	1.1	1.2 [0.9, 1.7]	1.2 [0.4, 3.6]	0.0
2010	9835	0.0	0.0	0.1 [0.0, 0.5]	0.2 [0.0, 0.9]	0.5 [0.3, 0.9]	0.5	0.4 [0.2, 1.1]	0.2 [0.1, 0.5]	0.2 [0.1, 0.5]	0.0 [0.0, 0.1]	0.4	0.2 [0.1, 0.3]	0.6 [0.3, 1.3]	0.4
Chad															
2014–2015	38,580	0.2 [0.1, 0.5]	0.2 [0.1, 0.3]	0.2 [0.1, 0.4]	0.3 [0.2, 0.7]	1.3 [1.1, 1.6]	1.1	1.0 [0.8, 1.3]	0.8 [0.5, 1.2]	0.3 [0.2, 0.5]	0.1 [0.0, 0.2]		1.5 [1.2, 1.9]	0.7 [0.5, 1.0]	0.8
Comoros															
2012	10,314	3.4 [2.1, 5.5]	3.2 [2.4, 4.2]	3.6 [2.8, 4.6]	2.6 [2.0, 3.4]	2.8 [1.9, 4.0]	1	8.1 [6.6, 9.9]	3.2 [2.3, 4.4]	3.6 [2.4, 5.5]	0.6 [0.4, 1.1]	7.6	6.6 [5.0, 8.8]	8.9 [7.2, 11.1]	2.3
Congo															
2011–2011	15,147	0.6 [0.4, 0.9]	1.3 [0.8, 2.3]	2.0 [1.3, 3.0]	2.2 [1.5, 3.2]	2.7 [2.0, 3.7]	2.1	0.3 [0.2, 0.6]	1.9 [1.2, 2.9]	6.3 [5.0, 7.8]	0.4 [0.2, 0.9]	6	7.2 [5.8, 8.9]	1.6 [1.1, 2.4]	5.6
Cote d'Ivoire															
	12,362	0.2 [0.1, 0.6]	0.6 [0.3, 1.2]	1.2 [0.8, 1.9]	2.2 [1.6, 3.0]	2.1 [1.5, 2.8]	1.5	4.2 [3.3, 5.3]	1.6 [1.2, 2.3]	0.5 [0.3, 0.7]	0.1 [0.0, 0.3]	4.1	4.9 [3.9, 6.0]	1.5 [1.0, 2.2]	3.4
DR Congo															0.0
	26,529	0.0 [0.0, 0.1]	0.1 [0.0, 0.1]	0.2 [0.1, 0.4]	0.9 [0.4, 2.0]	2.0 [1.5, 2.6]	2	0.6 [0.2, 1.4]	0.7 [0.5, 1.2]	1.8 [1.4, 2.3]	0.1 [0.1, 0.2]	1.7	2.2 [1.7, 2.9]	0.9 [0.4, 2.0]	1.3
Gabon															
2012	14,127	1.8 [1.4, 2.3]	3.6 [2.7, 4.7]	5.1 [3.7, 6.9]	4.5 [3.5, 5.8]	4.8 [3.6, 6.4]	3	1.7 [1.1, 2.6]	5.5 [4.4, 6.9]	11.7 [9.9, 13.7]	0.8 [0.5, 1.4]	10.9	18.0 [16.2, 20.0]	1.7 [1.3, 2.3]	16.3
Gambia															
	11,239	0.8 [0.4, 1.5]	1.0 [0.6, 1.7]	1.4 [0.9, 2.2]	2.5 [1.7, 3.6]	2.5 [1.7, 3.6]	1.7	3.9 [3.1, 5.0]	1.0 [0.6, 1.7]	2.7 [1.8, 3.9]	0.6 [0.2, 1.3]	3.6	5.6 [4.4, 7.0]	2.6 [1.9, 3.6]	3.0
Guinea															
2018	13,608	0.6 [0.4, 1.1]	0.8 [0.5, 1.2]	1.4 [1.0, 1.9]	2.6 [2.0, 3.4]	2.8 [2.3, 3.5]	2.2	5.5 [4.7, 6.5]	1.4 [1.0, 2.0]	1.1 [0.8, 1.5]	0.2 [0.1, 0.4]	5.3	4.6 [3.9, 5.5]	3.6 [2.9, 4.4]	1.0
2012	12,911	0.2 [0.1, 0.5]	0.2 [0.1, 0.4]	0.7 [0.4, 1.1]	1.3 [0.8, 2.1]	1.6 [1.1, 2.3]		2.4 [1.8, 3.2]	0.7 [0.5, 1.1]	0.8 [0.5, 1.3]	0.0 [0.0, 0.1]		2.4 [1.8, 3.3]	1.5 [1.0, 2.2]	0.0
Lesotho															
2014	5903	1.3 [0.9, 2.1]	3.5 [2.6, 4.7]	4.0 [2.9, 5.3]	7.7 [5.9, 10.1]	5.5 [4.5, 6.7]	4.2	0.2 [0.0, 0.7]	10.2 [8.4, 12.3]	9.8 [8.3, 11.6]	1.8 [1.3, 2.5]	8.2	6.8 [5.2, 8.8]	15.1 [13.0, 17.5]	8.3
Mali															
2018	15,057	0.6 [0.3, 1.1]	0.6 [0.3, 1.0]	0.9 [0.6, 1.4]	2.3 [1.5, 3.4]	3.5 [2.8, 4.3]	2.9	4.7 [3.8, 5.7]	1.4 [1.0, 2.1]	1.5 [1.1, 2.1]	0.2 [0.1, 0.4]	4.5	3.8 [3.1, 4.8]	4.0 [3.1, 5.2]	0.2
2012–2013	15,497	0.2 [0.1, 0.5]	0.4 [0.2, 0.7]	0.4 [0.2, 0.7]	0.9 [0.6, 1.3]	2.6 [2.1, 3.1]	0.2	2.9 [2.4, 3.6]	0.8 [0.6, 1.2]	0.7 [0.5, 1.0]	0.0 [0.0, 0.1]	2.9	2.8 [2.4, 3.3]	1.6 [1.2, 2.2]	1.2
Namibia															
2013	8178	0.7 [0.4, 1.2]	1.6 [1.1, 2.3]	2.9 [2.1, 3.9]	4.7 [3.7, 6.0]	4.8 [3.7, 6.2]	4.1	1.4 [0.8, 2.3]	2.3 [1.7, 3.1]	9.7 [8.2, 11.3]	1.4 [0.9, 1.9]	8.3	10.0 [8.5, 11.7]	4.7 [3.8, 5.9]	5.3

(Continues)

TABLE 2 (Continued)

Country	Sample size	Wealth index Q1 (%, 95% CI)	Q2 (%, 95% CI)	Q3 (%, 95% CI)	Q4 (%, 95% CI)	Q5 (%, 95% CI)	Gap percentage points	Education E1 (%, 95% CI)	E2 (%, 95% CI)	E3 (%, 95% CI)	E4 (%, 95% CI)	Gap percentage points	Area of residence Urban (%, 95% CI)	Rural (95% CI)	Gap percentage points
Niger															
2012	17,958	0.1 [0.0, 0.4]	0.4 [0.2, 0.7]	0.5 [0.2, 1.1]	0.3 [0.1, 0.4]	1.8 [1.4, 2.2]	1.7	2.0 [1.6, 2.5]	0.7 [0.4, 1.3]	0.2 [0.1, 0.4]	0.1 [0.0, 0.1]	1,8	1.6 [1.3, 2.0]	1.4 [0.9, 2.1]	0.2
Nigeria															
2018	42,146	0.2 [0.1, 0.4]	0.9 [0.7, 1.2]	1.4 [1.2, 1.7]	2.4 [2.0, 2.8]	3.3 [2.8, 3.8]	3.1	1.6 [1.3, 2.0]	1.8 [1.5, 2.1]	3.6 [3.2, 4.1]	1.2 [1.0, 1.5]	2.4	5.3 [4.7, 5.9]	2.9 [2.6, 3.3]	2.4
2013	104,580	0.4 [0.2, 0.8]	0.7 [0.5, 0.9]	1.0 [0.9, 1.2]	1.7 [1.5, 2.0]	2.6 [2.4, 3.0]	2.2	1.7 [1.3, 2.1]	1.6 [1.4, 1.8]	2.3 [2.1, 2.6]	1.0 [0.8, 1.1]	1.3	4.0 [3.6, 4.3]	2.6 [2.2, 3.0]	
Zimbabwe															
2015	19,118	0.9 [0.6, 1.3]	1.5 [1.2, 2.0]	2.2 [1.8, 2.7]	3.5 [2.9, 4.2]	4.6 [4.0, 5.4]	3.7	0.2 [0.1, 0.4]	3.1 [2.5, 3.7]	8.0 [7.1, 8.9]	1.4 [1.1, 1.8]	2.9	6.3 [5.6, 7.1]	6.4 [5.5, 7.3]	0.1
2010–2011	1.0 [0.7,1.4]	1.6 [1.2, 2.1]	2.1 [1.7, 2.7]	3.0 [2.5, 3.7]	3.8 [3.2, 4.5]	11.5 [10.5, 12.7]	9.9	0.4 [0.2, 0.8]	4.0 [3.4, 4.6]	6.3 [5.5, 7.2]	0.8 [0.6, 1.1]	5.9	5.4 [4.8, 6.2]	6.1 [5.3, 7.0]	0.7
Regional mean		0.7	1.2	1.7	2.4	3.4	2.8	2.3	2.4	3.7	0.5	3.2	5.3	3.6	1.7

Note: E1 to E4 with E1 = least educated, E2 = primary education; E3 = secondary education; E3 = Tertiary. Q1 = Poorest quintile; Q2 = Poorest quintile; Q3 = average quintile; Q4 = richer quintile; Q5 = richest quintile.

the 10 countries (Comoros and Namibia) have obesity prevalence close to 20%, this is suggesting that these two countries are likely to move into the second stage of obesity transition soon. This finding further strengthens evidence from previous studies and discussion about the increased prevalence of obesity in SSA countries, especially in women and children under 5 years.[22,23] Before now, obesity was termed a high-income public health problem, however, recent evidence shows that many low- and middle-income countries are experiencing a rapid shift in obesity prevalence than what the high-income countries experienced.[5] There are claims that obesity prevalence among women and children has doubled between 1990 and 2014[5,24,25]; this was also confirmed in our study except in Zimbabwe where obesity prevalence has reduced by about 50%. Although we could not find any previous studies to compare the unique finding from Zimbabwe, a recent cross-sectional study reported a 12.3% prevalence in obesity among women[26]; this is similar to the prevalence observed in our study (12.7).

Several factors ranging from rapid urbanization, changes in demography, lifestyle choices, nutritional shift, and biological factors have been identified as determinants of obesity in SSA.[2,11] Our observation that urban areas bear a greater burden of obesity among selected SSA countries is in consonance with the findings of Jiwani et al[16] which investigated 13 Latin American and Caribbean countries. As many parts of Africa are increasingly undergoing urbanization, significant change in diet from traditional to a western-style diet which is largely unhealthy with more sugar or fat is being witnessed.[27,28] This, in combination with an increasing sedentary lifestyle especially among women,[5] have been identified as dominant risk factors for metabolic syndrome and NCDs in LMICs. Similarly, Baker's theory has been used to explain the vulnerability of women from deprived socio-economic backgrounds to obesity.[29,30] The theory explains how fetal programming exposes people from poor households to non-communicable diseases later in life when suddenly exposed to surplus food or a diet with high sugar.

Also, this study observed the narrowing of socioeconomic differences in the prevalence of obesity across a few countries. From the results of five countries with two survey year data points, narrowing of socioeconomic difference in obesity prevalence was not observed among them except in Zimbabwe. The result from Zimbabwe showed narrowing across the three measures, wealth index, education, and place of residence. We observed narrowing of gap by place of residence in Burundi, Guinea, and Mali; increased obesity prevalence among rural women was the cause of narrowing for Guinea and Mali. This showed that these countries are somewhat characterized by the second and third stage of obesity transition according to Jaacks and colleagues' theory where the burden of obesity shifts to women from lower socioeconomic status.[17] Additionally, among the countries with single point surveys, obesity prevalence is concentrated in women with lower socioeconomic status as measured by education and wealth index. This finding is in line with the observation of Jiwani et al[16] that obesity is disproportionately moving toward individuals with lower socioeconomic status. Even though this finding could not be matched with previous

surveys, this probably shows that these countries are already in the second stage of obesity transition, to say the least.

The findings from this study have strong indications for policy and recommendations in tackling the rising prevalence of obesity especially among women in the region. Our findings strongly support the calls for effective policies to tackle obesity prevalence in developing countries especially in the face of rising prevalence of NCDs and its impact on the quality of life in SSA.[31,32] Population-wide interventions alongside specific policies to curtail the rising prevalence by socioeconomic status is key. For example, specific policies that will tackle obesity among rural women in Lesotho and Comoros and urban women in Gabon and Namibia will be key to reversing obesity prevalence in those countries. Also, specific policies targeted at least educated women (no education and primary education only) in Benin, Comoros, Congo Lesotho and educated women with secondary school education in Nigeria, Zimbabwe, Gabon, and DR Congo, can attenuate the rising obesity prevalence in these countries. It will be interesting to further study the huge reduction in obesity prevalence in Zimbabwe, as there may be lessons to be learned by other African countries especially if there were specific policies implemented. Another implication for research is the need for up-to-date data in SSA enough to study trends in obesity prevalence and possible transitions taking place in the region.

This study comes with some limitations, first is the cross-sectional design used in collecting obesity data; this means data was collected at specific points and not from longitudinal data. As the data were collected at different years, it is important to keep in mind the economic growth difference of these countries during interpretation. Also, inability to disaggregate by gender posed a challenge as the data source used does not collect information on men's height and weight. However, it's noteworthy to mention that previous studies have highlighted the increased burden of obesity among women when compared to men. The findings from the trend analysis could be stringer if data from more than 2 years were available, however, very few countries have this in the DHS dataset. This study also came with some strengths, one of which is the use of strategies to ensure the dataset is nationally representative. We also conducted age standardized prevalence which provides more accurate prevalence findings and stratified prevalence by socioeconomic measures. Finally, the use of dataset from the same source enhances the use of findings to support precise policy and practices.

5 | CONCLUSION

In conclusion, this study showed the variability and some levels of complexity in age-standardized obesity prevalence in SSA. The findings from our study showed that there is an increasing prevalence of obesity across all the three socioeconomic measures (wealth index, education, and place of residence) in SSA with the highest in Gabon and Lesotho. Also, socioeconomic differences by education and place of residence seem to be the main drivers among most of the 16 included SSA countries where varying transition stages of obesity are being witnessed.

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CONFLICT OF INTEREST

The authors declare that they have no competing interest.

AUTHOR CONTRIBUTIONS

Sanni Yaya contributed to the study design and conceptualization. Seun Anjorin performed the analyses, Seun Anjorin and Elvis Anyaehiechukwu Okolie drafted the first draft of this manuscript. Sanni Yaya provided technical support and critically reviewed the manuscript for its intellectual content. Sanni Yaya had final responsibility to submit for publication. All authors read and amended drafts of the paper and approved the final version.

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