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Double burden of malnutrition and associated factors among women of reproductive age in sub-Saharan Africa: a multilevel multinomial logistic regression analysis

Beminate Lemma Seifu ,[1] Kusse Urmale Mare,[2] Bruck Tesfaye Legesse ,[3] Tsion Mulat Tebeje [4]

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For numbered affiliations see end of article.

Correspondence to
Beminate Lemma Seifu;
beminetlemma1915@gmail.com

ABSTRACT

Background Globally, malnutrition among women of reproductive age is on the rise and significantly contributing to non-communicable disease, deaths and disability. Even though the double burden of malnutrition (DBM) is a common problem among women in sub-Saharan Africa (SSA), there are limited studies examining the factors contributing to underweight, overweight, and obesity at the SSA level.

Objective To determine the factors associated with the DBM, and their relative magnitude, among women of reproductive age in SSA.

Design Cross-sectional study design.

Setting 33 SSA countries.

Participants 240 414 women of reproductive age.

Primary and secondary outcome measures A multilevel multinomial logistic regression model was applied to identify factors associated with malnutrition. The adjusted relative risk ratio with 95% CI was used to declare the statistical significance of the association.

Results The pooled prevalence of underweight, overweight and obesity among women in SSA were 8.87%, 16.47% and 6.10%, respectively. Women who are from rural residence and smoke cigarettes were more likely to be underweight. Conversely, women between the age of 24–34 and 35–49, who have higher education, belong to a middle and rich household, are ever married, have high parity, use contraceptives, have media exposure and smoke cigarettes were more likely to be overweight and/or obese.

Conclusion The findings of our study suggest that certain factors such as residence, education status, wealth, marital status, occupation, cigarette smoking, and contraceptive use have a significant assocation with malnutrition among women. Therefore, it is important for public health programs aimed at preventing the double burden of malnutrition to focus on these factors through comprehensive public awareness and cost-effective operational health interventions.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ Large national datasets were examined for plausible comparisons for this study.
⇒ These findings are limited by the use of cross-sectional data that present difficulties in establishing a temporal association between the independent variables and the outcome measures.
⇒ Data on known risk factors of undernutrition and overnutrition including the dietary intake, physical activity, sedentary behaviour, visceral adiposity were not available in the Demographic and Health Survey dataset.
⇒ Another limitation is the use of body mass index (BMI) to classify people as underweight, overweight or obese, it is widely acknowledged that the BMI does not distinguish between excess fat, muscle and bone mass.
⇒ This survey does not cover the use of social media, which has the potential to significantly influence food and lifestyle choices.

BACKGROUND

Historically, undernutrition and overnutrition were thought to be separate public health concerns, but recent global evidence indicates their coexistence within the same community, families or individuals.[1] Because of the rapid global nutrition transition, an increasing proportion of individuals are exposed to various forms of malnutrition throughout their lives and directly bear the double burden of malnutrition (DBM).[2] WHO defines DBM as, 'the coexistence of undernutrition along with overweight, obesity-related or diet-related non-communicable diseases (NCDs), within individuals, households, and populations, and across the life course'.[3] In low-income and middle-income countries (LMICs) where undernutrition remains a major public health challenge, obesogenic factors that promote excessive body weight gain are increasing.[4] In addition to the DBM, sub-Saharan African nations also experience

a triple burden of malnutrition, which is the combination of undernutrition, overnutrition and deficiencies in certain micronutrients.[5]

Globally, nearly one-third of the population suffers from some form of malnutrition (underweight, overweight or obesity).[3 6] More than 600 million adults were underweight in 2016, while nearly two billion were overweight or obese.[7 8]

Women of reproductive age with DBM are predisposed to poor reproductive outcomes for the women themselves and their offspring during preconception, pregnancy and lactation.[9–11] Preconception maternal undernutrition results in an increased risk of fetal growth restriction, low birth weight, preterm birth and early childhood stunting.[12–14] On the other hand, overweight and obesity are associated with psychosocial problems due to menstrual irregularities, abnormal uterine bleeding and anovulation during the early pubertal period.[15–17] Furthermore, maternal overnutrition increases the risk of adverse antenatal, intrapartum and postpartum complications[18] such as gestational diabetes, pre-eclampsia,[19–22] maternal death, haemorrhage and caesarean delivery,[23 24] neonatal and infant deaths, neural tube and cardiac defects in newborns,[25] birth trauma, and macrocosmic infants.[26]

For several decades, high rates of underweight among women have been a major public health concern in LMICs. However, lifestyle and behavioural changes related to increased urbanisation and globalisation resulted in a significant nutritional transition from underweight to overweight in these settings.[27] Even though it is not uncommon to find the coexistence of undernutrition and overnutrition within the same country, community and household, these countries continue to deal with DBM, diet-related NCDs in addition to the infectious diseases burden.[7]

The prevalence of underweight in adult women has decreased in Africa since 1980 but remains higher than 10% in this region. However, existing evidence shows an increasing trend in overweight across LMICs.[28] National and subnational studies across African regions revealed that DBM affects 14% of childbearing women in Ghana, while the prevalence of undernutrition was 4% in Ghana,[29] 11% in Tanzania,[30] 16.9% in Kenya[31] and 25.5% in Ethiopia.[32] Moreover, about 27% of these women in Mali[33] and 63% in Ethiopia[34] suffer from overnutrition (overweight and obesity). It was also found that the magnitude of overweight and obesity, respectively, was 28.1% and 7.7% in Kenya,[31] 21% and 12% in Ghana.[29] Evidence has shown that women are more likely than men to be underweight and overweight, possibly due to the nature of their reproductive health, lower social status, poverty and a lack of education.[35 36]

Previous studies found that maternal undernutrition was associated with factors such as occupation, marital status, contraceptive use, region, residence and community-level wealth.[30 34 37] Likewise, women's and household socioeconomic status, place of residence, age, marital status, education, employment, substance use (alcohol and cigarette), use of hormonal contraceptives, breast feeding and exposure to mass media were reported to have a significant effect on maternal overweight or obesity.[38–43]

Globally, comprehensive double-duty interventions targeting health sectors, social safety nets, educational settings, agriculture, food systems and food environments were under implementation to end all forms of malnutrition.[44–47] In addition, preconception nutritional supplementation for menstruating girls and adult women was also considered as an additional women-specific intervention. Despite these interventions, none of the African countries are on the track to achieve the 2030 target of reducing malnutrition among reproductive-age women[1] due to weak policies regulating the quality of diets and limited resources for programme implementation.[48]

Although undernutrition and overweight or obesity among reproductive-age women is a common problem in sub-Saharan Africa (SSA), evidences on the DBM and its determinants at the sub-Saharan African level are scarce. One study conducted previously in this region only included five countries[1] and other studies were based on a single country[29 32 37] and subnational data.[30 31] Moreover, some of these studies do not employ appropriate statistical method (ie, multilevel multinomial analysis) that accounts for hierarchical nature of data and polytomous nature of the nutritional status to identify determinants for each type of malnutrition.[29–31] And other studies only focused either on overnutrition[33 34 49–51] or undernutrition[30] and did not assess the effect of some community-level factors (community-level poverty and community-level illiteracy).[29–31] Therefore, by taking into account the aforementioned methodological limitations, this study aimed to estimate the pooled burden and individual and community-level determinants of underweight, overweight and obesity among reproductive-age women in 33 sub-Saharan African countries.

METHODS

Data source, study setting and population

This study was based on the most recent Demographic and Health Survey (DHS) data of 33 SSA countries. DHS is a nationally representative survey routinely conducted every 5 years and collects data on basic health indicators such as mortality, morbidity, fertility and maternal and child health-related characteristics. The survey used a two-stage stratified sampling technique to select the study participants. In the first stage, Enumeration Areas (EAs) were randomly selected based on the country's recent population and using the housing census as a sampling frame, households were randomly selected in the second stage. Each country's survey consists of different datasets including men, women, children, birth and household datasets. For this study, the study population were reproductive-age women, thus, we used the individual (women's) Record dataset (IR file). In the current study, 240 414 women of reproductive age were considered for

final analysis (online supplemental table 1). Detailed information about DHS methodology can be found from the official database https://dhsprogram.com/Methodology/index.cfm.

Study variables and definitions

The outcome variable was women's nutritional status that was assessed by body mass index (BMI) measured based on the WHO adult BMI classification.[7] BMI was calculated by dividing a woman's weight in kilograms by the square of height in metres (kg/m^2). The survey measured weight with an electronic SECA 874 flat scale designed for mobile use and height with a shore measuring board. For the analysis purpose, women were grouped into four categories of nutritional status based on their BMI: underweight (BMI<18.5 kg/m^2), normal weight (BMI of 18.5–24.9 kg/m^2), overweight (BMI of 25.0–29.9 kg/m^2) and obesity (BMI≥30.0 kg/m^2).[52]

Explanatory variables were classified as individual and community-level factors. Socioeconomic, demographic, behavioural and community-level factors were selected based on previous studies conducted in LMICs[6 35–37 49 53–56] and their availability in the DHS dataset. The individual-level factors were age, marital status (labelled as not married, currently married and formerly married), women's occupation (working or not working), parity (nulliparous, 1–4 and >5 children), women's education (no education, primary education, secondary education and higher education), wealth index (poor, middle and rich), exposure to media (no and yes) and contraceptive use (yes and no).

The community-level factors included the sub-Saharan African region (East, West, Central and South African regions), place of residence (urban or rural), community level women's education, community-level poverty. The last two community-level variables were generated by aggregating the individual-level observations at the cluster level (ie, they are not directly found in the DHS dataset). The aggregates were computed using the average values of the proportions of women in each category of a given variable and median values were used to categorise the aggregated variables into groups (ie, low and high community level women's education and poverty).

Media exposure was created from three variables (frequency of listening to the radio, watching television and reading newspapers or magazines). In this study, women who listened to radio or watched television or read newspaper/magazine at least once in a week were considered as having exposure to media (coded 'yes') and otherwise labelled as not having media exposure (coded 'no').

Data management and statistical analysis

Data of 33 SSA countries were pooled, recoded and analysed using Stata V.17 software. Before analysis, data were weighted using sampling weight, primary sampling unit and strata to restore the survey's representativeness and obtain appropriate estimate. Descriptive results were presented using frequencies and percentages.

To account for the clustering effects of DHS data and the polytomous nature of the outcome variable, a multilevel multinomial logistic regression model was applied to determine the effects of each independent variable on women's nutritional status (underweight, overweight and obesity). Normal weight used as the reference category. Bivariable multilevel multinomial logistic regression analysis employed to identify variables eligible for the multivariable analysis. Variables with a p value less than 0.20 in this analysis and those found important in the literature were considered as candidates for the multivariable multilevel multinomial logistic regression analysis.

Model building

Likelihood ratio (LR) test, intraclass correlation coefficient (ICC) and median OR (MOR) were computed to measure the variation between clusters. The ICC quantifies the degree of heterogeneity between clusters (the proportion of the total observed individual variation in malnutrition among RAW).

$$\text{ICC} = \sigma^2 / (\sigma^2 + \pi^2/3).^{57}$$

The MOR quantifies the variation or heterogeneity in malnutrition between clusters in terms of the OR scale and is defined as the median value of the OR between the cluster with a high likelihood of malnutrition and the cluster at lower risk when randomly picking out individuals from two clusters (EAs)

$$\text{MOR} = \exp\sqrt{2 \times \partial^2 \times 0.6745} \sim \text{MOR} = \exp(0.95 \times \partial).^{58}$$

∂^2 indicates that cluster variance.

After selecting the variables for multivariable multinomial analysis, four models were fitted to identify the best-fitted model. Model I or null model (a model with only the outcome variable), model II (a model with only the individual-level explanatory variables), model III (a model with only the community-level explanatory variables) and model IV/full model (simultaneously examined the effect of both the individual and community-level predictors on the outcome variable) were fitted. Finally, log-LR (LLR) and deviance (ie, −2LLR) values were used for model selection and the model with the lowest deviance was considered as the best-fitted model. Finally, a p<0.05 and the adjusted relative risk ratio (aRRR) with the corresponding 95% CI were used to declare the statistical significance of the independent variables. Collinearity diagnostic was conducted and the variance inflation factor values for all variables included in the final model were less than 10, suggesting that there was no multicollinearity. In addition, ICC and MOR were computed to estimate the random variability in level of underweight, overweight and obesity between clusters.

Patient and public involvement

Patients and public were not involved in this study since we have conducted a secondary data analysis based on already available DHS data, which was collected to

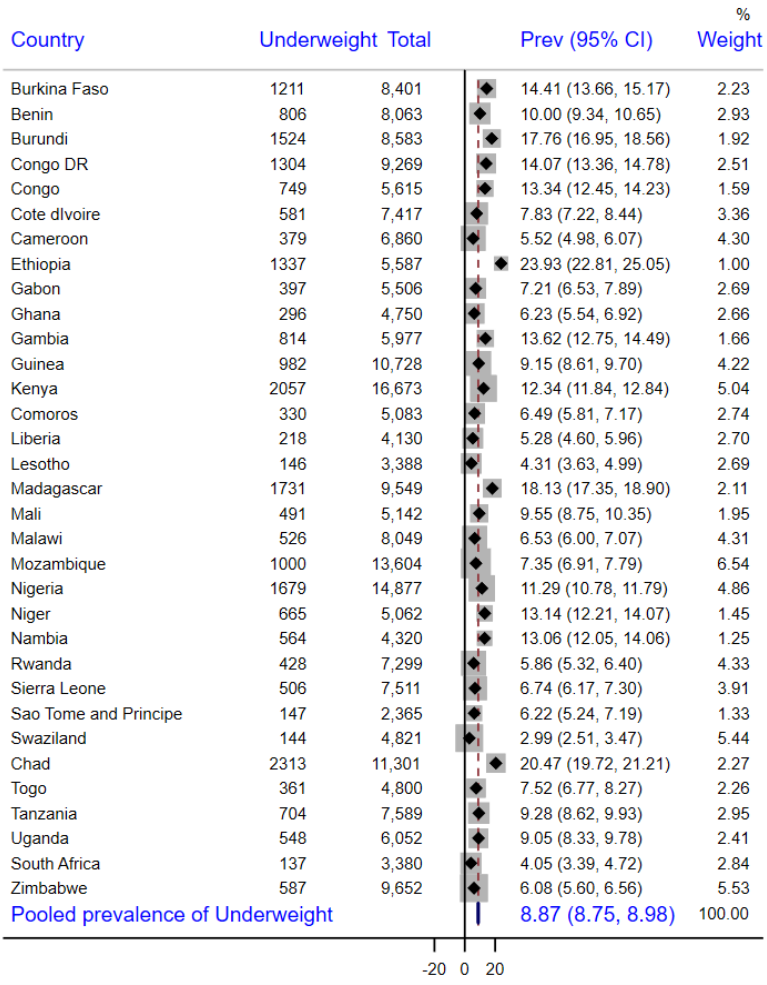


Figure 1 Forest plot of the pooled prevalence of underweight among women of reproductive age in SSA countries. SSA, sub-Saharan Africa.

provide estimates of common health and health-related indicators. However, it is critical for the initial data collection process because household measurements such as weight and height were collected to calculate BMI.

RESULTS

Characteristics of the study participants

Among reproductive-age women, more than half of them (63.44%) were married, and 30.13% had no schooling. More than two-fifth (42.93%) of the study participants had no employment during the survey and majority of the participants (70.42%) had media exposure. Among study participants, 26.30% used hormonal contraceptives, and 23.36% of them were grand multiparous. Nearly two-thirds (61.48%) of women resided in rural households (online supplemental table 2).

The pooled prevalence of underweight, overweight and obesity among women of reproductive age in SSA

The pooled prevalence of underweight among women of reproductive age (WRA) in SSA was 8.87 (95% CI 8.75 to 8.98), Ethiopia 23.93 (95% CI 23.64 to 25.49) and Swaziland 2.99 (95% CI 2.51 to 3.47) had the highest and lowest prevalence, respectively (figure 1). The pooled prevalence of overweight was 16.47 (95% CI 16.33 to 16.62), while Swaziland (28.36; 95% CI 27.08 to 29.63) has the highest prevalence: the lowest prevalence was observed in Burundi (7.55; 95% CI 6.99 to 8.11) (figure 2). The pooled prevalence of obesity among RAW in SSA was 6.10 (95% CI 6.01 to 6.20), the highest prevalence of obesity was observed in South Africa (34.59; 95% CI 32.98 to 36.19) while the lowest was in Chad (2.19; 95% CI 1.92 to 2.46) (figure 3).

Prevalence of underweight, overweight and obesity by study factors among women of reproductive age in SSA

The prevalence of underweight was higher among reproductive-age women whose age were 15–24 (13.76%) compared with those whose age were 35–49 (8.01%). Women who resided in wealthy households had a higher prevalence of overweight (23.56%) compared with those who resided in poor households (12.66%). The prevalence of obesity was higher among

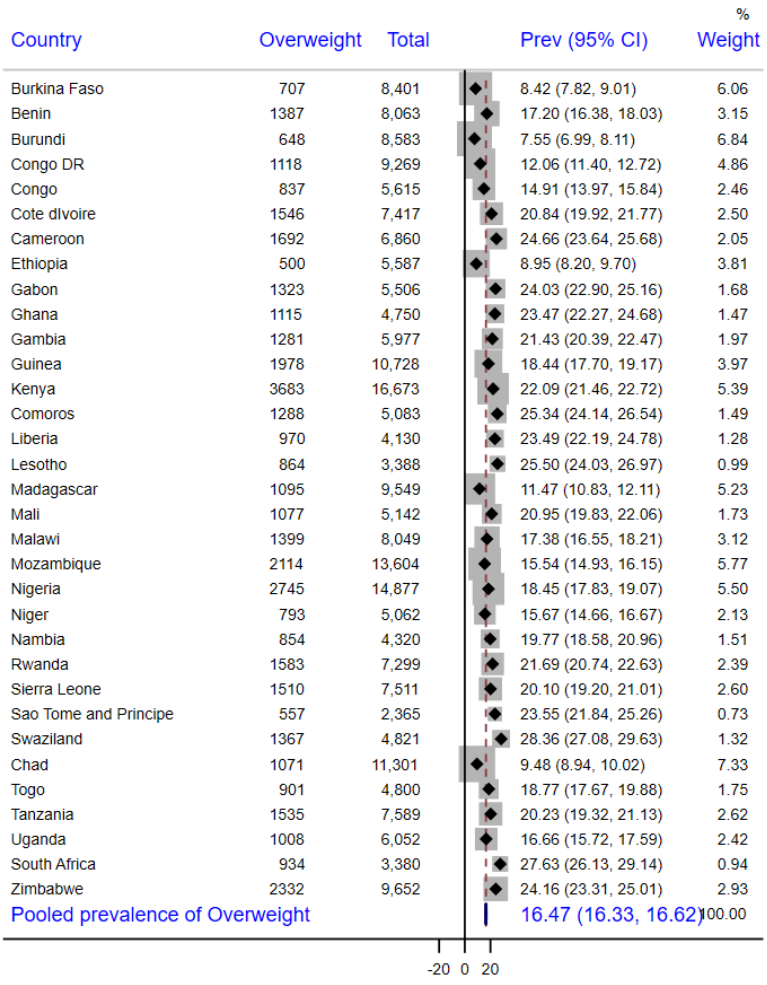


Figure 2 Forest plot of the pooled prevalence of overweight among women of reproductive age in SSA countries. SSA, sub-Saharan Africa.

reproductive-age women who were married (10.68%) compared with those who were not married (5.15%) (table 1).

Statistical analysis and model comparison

As we can see from table 1, the ICC in the empty model was 23.5%, indicating that 23.5% of the total variability for malnutrition was due to differences between clusters/EA, with the remaining unexplained 76.5% that is attributed by individual differences. Moreover, the MOR for malnutrition was 2.59 in the null model, which indicates that there was variation between clusters. If we randomly select an individual from two different clusters, individuals at the cluster with a higher risk of malnutrition had 2.59 times higher odds of being malnourished as compared with individuals at cluster with a lower risk of malnutrition. The models were compared with deviance and model IV was chosen as the best-fitted model since it had lowest deviance value (418 931) (table 2).

Determinants of underweight among women of reproductive age in SSA

Reproductive-age women who were currently married were less likely to be underweight compared with those who were single (aRRR 0.62; 95% CI 0.59 to 0.66). Reproductive-age women who were multiparous were less likely to be underweight compared with their counterparts (aRRR 0.74; 95% CI 0.70 to 0.79). The likelihood of being underweight among women who smoke cigarettes (aRRR 1.29; 95% CI 1.09 to 1.54) and rural residence (aRRR 1.04; 95% CI 1.01 to 1.09) was significantly higher compared with those who did not smoke cigarettes and reside in urban households. Those who had media exposure (aRRR 0.80; 95% CI 0.77 to 0.84) were less likely to be underweight compared with their counter parts (table 3).

Determinants of overweight among women of reproductive age in SSA

Reproductive-age women who were currently married had a higher likelihood of being overweight compared with those who were not married (aRRR 1.15; 95% CI 1.08 to 1.21) and those who attained higher education were more likely to be overweight compared with those

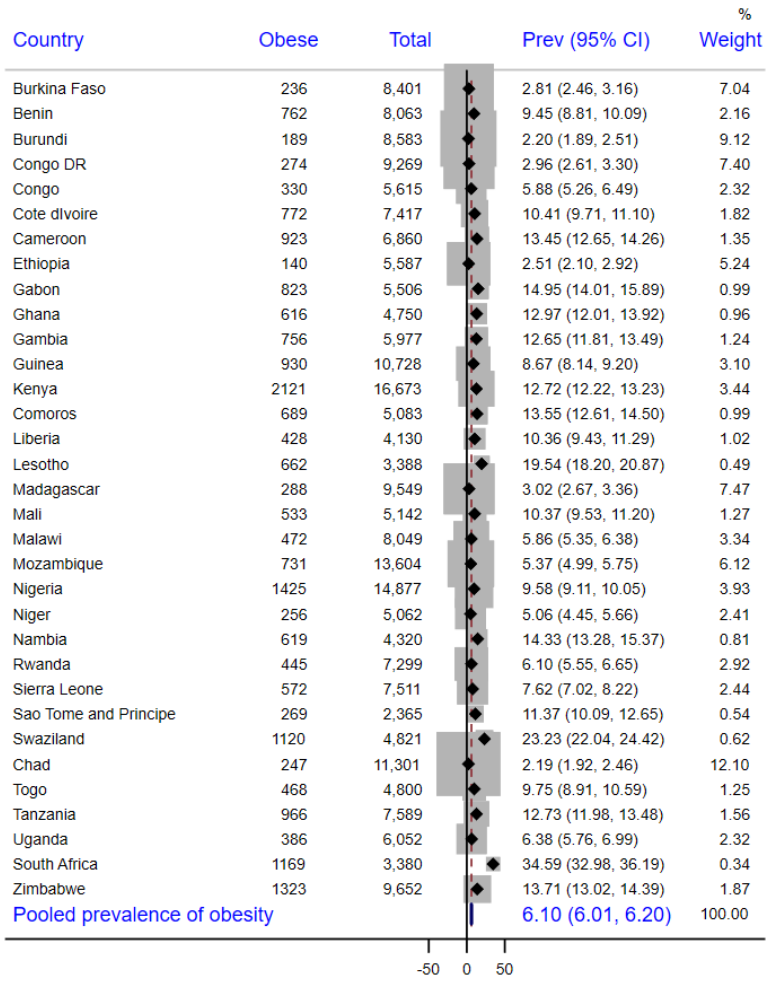


Figure 3 Forest plot of the pooled prevalence of obesity among women of reproductive age in SSA countries. SSA, sub-Saharan Africa.

who had no schooling (aRRR 2.18; 95% CI 2.02 to 2.35). Women who reported media exposure (aRRR 1.38; 95% CI 1.32 to 1.43) and those who resided in wealthier households (aRRR 1.56; 95% CI 1.50 to 1.63) were more likely to be overweight compared with their counterparts, respectively (table 3).

Determinants of obesity among women of reproductive age in SSA

The risk of being obese was higher among women who attained higher education compared with those who had no education (aRRR 3.44; 95% CI 3.13 to 3.77), and formally employed women were less likely to be obese compared with those who had no employment (aRRR 0.84; 95% CI 0.79 to 0.87). Women who were multiparous (aRRR 1.81; 95% CI 1.67 to 1.96), and those who use hormonal contraceptives (aRRR 1.29; 95% CI 1.23 to 1.35) had a higher risk of being obese compared with those who were nulliparous and do not use hormonal contraceptives, respectively (table 3).

DISCUSSION

The current study examined the pooled prevalence, individual-level (sociodemographic and behavioural) and community-level factors that are associated with underweight, overweight and obesity among women of reproductive age in SSA countries. In our study, the risk of being underweight was associated with residing in rural area and cigarette smoking. Reproductive-age women who were married/formerly married, attained primary education and above, resided in wealthy households, use contraceptives, uniparous and multiparous, also have a media exposure were found to be more likely to be overweight and/or obese. From community-level factors, residing in rural households was associated with lower risk of obesity.

This study delineated a composite association between age and weight, encompassing a positive correlation with overweight, obesity and with underweight. These findings are consistent with study conducted among WRA in LMIC.[59] The observed positive correlation between older age and overweight/obesity may potentially be attributed to several factors. One such factor is parity, which is commonly associated with advanced age as

Table 1 Prevalence of underweight, overweight and obesity by study factors among women of reproductive age in sub-Sahara African (n=240 414)

Variable	Underweight n (%)	Normal weight n (%)	Overweight n (%)	Obesity n (%)
Sociodemographic factors				
Women's age				
15–24	12 962 (13.76)	66 937 (71.07)	11 542 (12.26)	2741 (2.91)
25–34	5937 (7.76)	46 148 (60.28)	16 418 (21.44)	8057 (10.52)
35–49	5577 (8.01)	36 311 (52.12)	16 189 (23.24)	11 592 (16.64)
Women's marital status				
Not married	9655 (14.55)	43 997 (66.32)	9273 (13.98)	3413 (5.15)
Currently married	12 892 (8.45)	92 993 (60.97)	30 341 (19.89)	16 297 (10.68)
Formerly married	1929 (8.95)	12 407 (57.57)	4536 (21.04)	2681 (12.44)
Women's educational status				
No schooling	9254 (12.78)	48 841 (67.43)	10 278 (14.19)	4056 (5.60)
Primary school	7268 (10.01)	46 686 (64.30)	12 703 (17.50)	5949 (8.19)
Secondary school	7229 (8.83)	47 704 (58.27)	17 249 (21.07)	9678 (11.82)
Higher	724 (5.36)	6165 (45.61)	3919 (29.00)	2708 (20.03)
Women's current work status				
Not working	12 615 (12.23)	66 153 (64.13)	16 965 (16.45)	7421 (7.19)
Working	11 838 (8.63)	83 135 (60.63)	27 169 (19.82)	14 966 (10.92)
Household wealth status				
Poor	11 396 (13.15)	60 928 (70.28)	10 976 (12.66)	3387 (3.91)
Middle	4971 (10.59)	30 556 (65.08)	8017 (17.07)	3407 (7.26)
Rich	8109 (7.60)	57 913 (54.24)	25 157 (23.56)	15 596 (14.61)
Parity				
Nulliparous	9582 (15.05)	43 145 (67.77)	8421 (13.23)	2519 (3.96)
Multiparous	9484 (7.87)	72 062 (59.76)	25 035 (20.76)	14 004 (11.61)
Grand multiparous	5409 (9.63)	34 190 (60.88)	10 694 (19.04)	5868 (10.45)
Behavioural factors				
Media exposure				
No	10 001 (14.08)	49 791 (70.08)	8586 (12.08)	2668 (3.75)
Yes	14 439 (8.54)	99 455 (58.80)	35 534 (21.01)	19 713 (11.65)
Cigarette smoking				
No	23 143 (99.0)	139 891 (99.2)	37 552 (99.1)	18 242 (98.8)
Yes	231 (1.0)	1202 (0.8)	340 (0.9)	231 (1.2)
Contraceptive use				
No	20 209 (11.47)	113 483 (64.05)	29 550 (16.68)	13 943 (7.87)
Yes	4268 (6.75)	35 914 (56.80)	14 599 (23.09)	8449 (13.36)
Community level factors				
Residence				
Urban	6990 (7.55)	48 788 (52.68)	22 376 (24.16)	14 457 (15.61)
Rural	17 486 (11.83)	100 609 (68.07)	21 774 (14.73)	7934 (5.37)
Sub-Sahara African region				
Central Africa	5951 (14.18)	28 818 (68.66)	5544 (13.21)	1659 (3.95)
East Africa	5972 (11.80)	30 612 (60.51)	9321 (18.42)	4687 (9.26)
South Africa	3125 (6.65)	28 742 (61.17)	9420 (20.05)	5698 (12.13)
West Africa	9428 (9.35)	61 225 (60.70)	19 865 (19.69)	10 346 (10.26)

Continued

Table 1 Continued

Variable	Underweight n (%)	Normal weight n (%)	Overweight n (%)	Obesity n (%)
Community illiteracy level				
Low	1164 (7.00)	8912 (53.60)	4132 (24.85)	2419 (14.55)
High	23312 (10.42)	140485 (62.78)	40018 (17.88)	19972 (8.92)
Community poverty level				
Low	7735 (9.70)	47601 (59.71)	15808 (19.83)	8573 (10.75)
High	16742 (10.42)	101796 (63.35)	28342 (17.64)	13818 (8.60)

well as overweight/obesity. Evidence shows that women typically experience weight gain during pregnancy, which can have long-term implications for weight retention if postpartum weight loss strategies are not implemented.[60–62] According to the current research, women who have experienced childbirth once, multiple times or several times were found to have a higher likelihood of being overweight or obese, and a lower likelihood of being underweight, compared with nulliparous women. Furthermore, the accumulation of adipose tissue may be attributed to the changes in hormonal levels and body composition that occur during the ageing process.[63]

According to this study, ever-married women had a significantly higher likelihood of being overweight and a significantly lower likelihood of being underweight when compared with unmarried women. This finding is consistent with previous research in Ghana[64] Ethiopia[55] and Nepal.[36] This could be explained by the fact that single women, as opposed to married, widowed or divorced counterparts, are less likely to be multiparous, as multipara women are more likely to gain weight during pregnancy and the puerperium period.[65 66] Another explanation could be based on the attractiveness model, which states that currently married women are less concerned with their body weight than never-married women, who are constantly trying to minimise weight gain in order to attract a partner.[67]

Unlike the findings from studies conducted in high-income countries, the USA[68] and Germany,[69] in this study, we discovered that a woman's socioeconomic status (wealth and education) were associated with overweight and obesity. This is in line with studies conducted in Tanzania,[37] Uganda[56] and Bangladesh.[70] Women from higher-income households and those who have a primary, secondary and higher education were more likely to be obese than those from lower-income household and with no formal education. Whereas previous studies in the USA and Germany found a decrease in the prevalence of obesity in the studied populations as educational attainment and income increased, we found the opposite in our study. This could be due to low household wealth status may limit families' access to luxury lifestyles, such as eating habits, leisure time and many other aspects of life. Low-income earners in Africa toil every day of the week just to earn a living.[71 72] Their daily long hours of hard labour burn off any extra calories they may have stored in their bodies. However, In SSA, women with a higher socioeconomic status are more likely to engage in sedentary workplace activities, shifting from manual labour to less physically demanding tasks, resulting in significantly lower levels of physical activity.[73] These types of lifestyles have been linked to an increased risk of being overweight or obese.[74]

In this study, women who had formal employment were less likely to be overweight/obese compared with those who had no employment. One possible explanation for why employed women tend to maintain a healthy weight is because they often have a structured routine, including regular meal times and physical activity.[75]

Women's increasing number of parities and contraceptive use were associated with high risk of overweight/obesity and a lower risk of underweight. Hormonal changes associated with childbearing could cause weight gain among women.[76] Moreover, women with high parities are also more likely to take hormonal contraceptives, a factor that is thought to be associated with weight gain.

In this study, smoking was linked to both being underweight and being overweight/obese. According to the

Table 2 Model comparison and random effect results

	Null model	Model 1	Model 2	Model 3
Log-likelihood	–248 211.1	–210 253	–243 324.5	–209 465.5
Deviance	496422.2	420506	486649	418931
ICC (%)	23.5 (23.4, 23.6)	19.2 (17.4, 20.6)	20.1 (18.7, 22.5)	16.7 (15.6, 18.2)
MOR	2.59	1.64	1.78	1.93

ICC, intraclass correlation coefficient; MOR, median odds ratio.

Table 3 Factors associated with underweight, overweight and obesity among women of reproductive age in sub-Sahara African

Variables	Underweight ARRR (95% CI)	Overweight ARRR (95% CI)	Obesity ARRR (95% CI)
Woman's age			
15–24	1	1	1
25–34	0.95 (0.89 to 1.00)	1.96 (1.88 to 2.05)*	4.16 (3.88 to 4.48)*
35–49	1.12 (1.00 to 1.19)	3.01 (2.86 to 3.17)*	10.86 (10.06 to 11.73)*
Women's marital status			
Not married	1	1	1
Currently married	0.62 (0.59 to 0.66)*	1.15 (1.08 to 1.21)*	0.95 (0.89 to 1.02)
Formerly married	0.71 (0.65 to 0.77)*	1.09 (1.02 to 1.17)*	0.84 (0.77 to 0.92)*
Women's educational status			
No schooling	1	1	1
Primary school	0.75 (0.72 to 0.79)*	1.36 (1.31 to 1.42)*	1.55 (1.45 to 1.65)*
Secondary school	0.69 (0.66 to 0.73)*	1.82 (1.74 to 1.89)*	2.65 (2.48 to 2.83)*
Higher	0.60 (0.53 to 0.69)*	2.18 (2.02 to 2.35)*	3.44 (3.13 to 3.77)*
Women's current work status			
Not working	1	1	1
Working	0.91 (0.88 to 1.00)	0.88 (0.86 to 0.91)*	0.84 (0.79 to 0.87)*
Household wealth status			
Poor	1	1	1
Middle	0.83 (0.79 to 0.87)*	1.19 (1.14 to 1.25)*	1.40 (1.30 to 1.49)*
Rich	0.71 (0.68 to 0.75)*	1.56 (1.50 to 1.63)*	2.00 (1.88 to 2.13)*
Parity			
Nulliparous	1	1	1
1–4 children	0.74 (0.70 to 0.79)*	1.32 (1.25 to 1.39)*	1.81 (1.67 to 1.96)*
>5 children	0.76 (0.71 to 0.83)*	1.18 (1.09 to 1.26)*	1.49 (1.35 to 1.65)*
Behavioural factors			
Media exposure			
No	1		1
Yes	0.80 (0.77 to 0.84)*	1.38 (1.32 to 1.43)*	2.05 (1.93 to 2.18)*
Cigarette smoking			
No	1		
Yes	1.29 (1.09 to 1.54)*	1.03 (0.88 to 1.19)*	1.46 (1.23 to 1.72)*
Contraceptive use			
No	1	1	1
Yes	0.89 (0.85 to 0.93)*	1.15 (1.11 to 1.19)*	1.29 (1.23 to 1.35)*
Community-level factors			
Residence			
Urban	1	1	1
Rural	1.04 (1.01 to 1.09)*	0.70 (0.68 to 0.73)*	0.52 (0.49 to 0.54)*
Community illiteracy level			
Low	1	1	1
High	1.11 (0.99 to 1.24)	0.94 (0.88 to 1.01)	1.11 (1.00 to 1.21)
Community poverty level			
Low	1	1	
High	0.95 (0.91 to 0.99)*	1.02 (0.98 to 1.05)	1.00 (0.98 to 1.21)

Continued

Table 3 Continued

Variables	Underweight ARRR (95% CI)	Overweight ARRR (95% CI)	Obesity ARRR (95% CI)

*p-value<0.05
†
aRRR, adjusted relative risk ratio.

study, women who smoke are more likely to be underweight than non-smokers. This finding is supported by evidence from a study conducted in a rural Indian population, which indicated that any type of smoking could be a risk factor for underweight.[77] The possible explanation could be, due to the complex pathways of smoking-related physiological changes (direct pathways, weight loss due to nicotine increasing the metabolic rate, decreasing metabolic efficiency, or decreasing caloric absorption (reduction in appetite),[78] or indirect pathways decreasing the amount of money available for food) which might increase the probability of underweight.[79] Cross-sectional studies indicate that heavy smoking could be associated with a greater risk of obesity.[42 80] There is increasing evidence that heavy smokers tend to have greater body weight than do light smokers or non-smokers, which likely reflects a clustering of risky behaviours (eg, low degree of physical activity, poor diet and smoking) that is conducive to weight gain. In addition, smoking increases insulin resistance and is associated with central fat accumulation.[81]

Apart from the sociodemographic factors, media use status also appeared to be a significant predictor of overweight and obesity among women population. The media use–obesity relationship represents another paradoxical situation given the fact that media is regarded as a key instrument for public health communication and behavioural modification strategy.[77 82] In traditional SSA societies where women tend to have lower socioeconomic capacity and access to outdoor entertainment resources, electronic media such as TV and radio serve as a common form of pastime which in turn encourages sedentary behaviour.[83] In LMICs, having a television can also be considered as a proxy indicator for the higher socioeconomic status of women, which in turn increases the risk of exposure to energy-dense and junk foods advertisements.[84]

Scientific evidence consistently supports urbanisation as a major underlying factor in the rise in overweight prevalence in LMICs,[85] whereas underweight has traditionally affected mainly rural households.[85–87] Our study showed that women who resided in rural areas were more likely to be underweight compared with those who resided in urban households. This finding is consistent with the studies conducted in Ethiopia[88] Tanzania[37] and Bangladesh.[70] This could be due to differences in educational status, food security and access to information regarding nutrition education among rural dwellers compared with the urban population.[89] Additionally, women from rural households may be engaged in occupational physical activities such as agricultural occupations subject them to labour-intensive activities (manual work) which promotes weight loss and less excess weight gain.[40]

The use of large nationally representative samples with appropriate statistical modelling is the study's main strength. The use of large, nationally representative datasets and multilevel analysis helps to provide more reliable estimates of observed associations while also improving the results' generalisability. However, the findings should be interpreted concerning some limitations. For initial reasons, this study used cross-sectional data, which does not allow for establishing a temporal relationship between the factors and outcome variables. Second, because the DHS did not collect information on these variables, we cannot include key covariates such as physical activity, dietary intake, other comorbid conditions and energy expenditure. Based on the limitations mentioned above, we would like to suggest that future DHS surveys include variables related to physical activity, dietary intake and comorbidities.

CONCLUSION

The findings of this study show that women of reproductive age in SSA face a double burden of underweight and overweight/obesity. The proportion of overweight and obese adults is significantly higher among the wealthiest, most educated women. This suggests that unless effective intervention strategies are developed and implemented, the problem of overweight/obesity is likely to worsen. Nonetheless, underweight among RAW remains a major public health challenge in LMICs, particularly among the poor and uneducated. Both conditions are linked to an increased risk of NCD morbidity and mortality from NCDs and related conditions. As a result, effective public health intervention approaches to address these conditions and risk factors are critical. These could include improved primary healthcare systems that prioritise NCD prevention and care, increased NCD awareness among the general population, a healthier lifestyle and the use of a multifaceted approach and multisectoral collaboration in NCD prevention and control efforts. Furthermore, the global goal of eliminating all forms of malnutrition should be based on a close collaborative approach that integrates policies and organisations in order to provide context-specific and population-specific interventions.

The DBM paradox will persist in LMICs in the absence of these.

Author affiliations
[1]Department of Public Health, College of Medicine and Health Sciences, Samara University, Samara, Ethiopia
[2]Department of Nursing, College of Medicine and Health Sciences, Samara University, Samara, Ethiopia
[3]Department of Pediatrics and Neonatal Nursing, School of Nursing and Midwifery, Institute of Health Sciences, Wollega University, Nekemte, Ethiopia
[4]School of Public Health, College of health sciences and Medicine, Dilla University, Dilla, Ethiopia

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Contributors Conceptualisation: BLS. Data curation: BLS and KU. Formal analysis: BLS and KU. Methodology: BLS, KU, BTL and TT. Software: BLS and KU. Writing–original draft: BLS and KU. Writing–review and editing: BLS, KU, BTL and TT.Guarantor: BLS

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ORCID iDs
Beminate Lemma Seifu http://orcid.org/0000-0002-9278-6826
Bruck Tesfaye Legesse http://orcid.org/0000-0001-6639-3060
Tsion Mulat Tebeje http://orcid.org/0000-0002-2911-2095

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