Journal of Nutrition and Food Security
Shahid Sadoughi University of Medical Sciences
School of Public Health
Department of Nutrition
Shahid Sadoughi University of Medical Sciences
School of Public Health
Nutrition Department

eISSN: 2476-7425 pISSN: 2476-7417 JNFS 2026; 11(3): 393-403 Website: jnfs.ssu.ac.ir

Overweight/Obesity and Anemia among Women of Reproductive Age in Burkina Faso

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ARTICLE INFO

ORIGINAL ARTICLE

Article history:
Received:5 Jun 2025
Revised: 15 Feb 2026
Accepted: 21 Mar 2026

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Keywords
Double burden of malnutrition; Overweight; Anemia; Women; Burkina Faso.

ABSTRACT

Background: In low-resource settings, urbanization has intensified the double burden of malnutrition (DBM), where undernutrition and overnutrition coexist within the same individuals. This study aimed to assess the prevalence and determinants of concurrent anemia and overweight/obesity (OWOB) among women of reproductive age (WRA) in Burkina Faso. **Methods:** This cross-sectional analytical study used data from the 2021 Burkina Faso Demographic and Health Survey (BFDHS-V). A total of 7,987 non-pregnant women aged 15–49 year were included. OWOB was defined using body mass index (≥25 kg/m²), and anemia was assessed based on hemoglobin concentration (<12 g/l). Weighted prevalence and 95% confidence intervals of concurrent OWOB and anemia were also estimated. Multivariate logistic regression for complex survey data (*svyglm* function in R) was used to identify associated factors. **Results:** The prevalence of DBM associated with OWOB was 10.1%. The coexistence OWOB and anemia showed a statistically significant positive association with higher wealth index [(Adjusted Odds Ratios (AOR)=1.87; 95 % CI: 1.16, 3.01)], the highest wealth index (AOR=3.28; 95 % CI: 1.99, 5.40;), women's older age 20-29 year (AOR=1.86; CI :1.25, 2.77), 30-39 (AOR=2.12; CI :1.40, 3.21) and 40 years or more (AOR=2.24; CI :1.45, 3.45), and primary education (AOR=1.51; CI :1.04, 2.19). **Conclusions:** DBM associates OWOB with anemia as an emerging problem in Burkina Faso with a prevalence reaching 10%. A positive association was found with older women living in household with higher wealth index. Therefore, urgent strategies and actions need to be put in place in order to avert this trend.

Introduction

Malnutrition is still prevalent with over 9.4 percent of the global population who are undernourished, with an insufficient intake of calories, protein, and micronutrients (FAO *et al.*, 2024). Concurrently, during the last decades, dietary patterns across resources-limited countries have shifted from local traditional diets to the consumption of readily available and accessible energy-dense foods leading to an increase in the prevalence of overweight and obesity (Popkin *et al.*,

This paper should be cited as: Lanou HB, Savadogo B, Diendéré J, Zeba AN. ***Overweight/Obesity and Anemia among Women of Reproductive Age in Burkina Faso.*** *Journal of Nutrition and Food Security (JNFS)*, 2026; 11(3): 393-403.

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[DOI: 10.18502/jnfs.v11i3.22155]

2020). About 2.3 billion people were affected by overweight or obesity in 2022 (UNICEF *et al.*, 2023). These forms of malnutrition may coexist not only within the same community but also within the same individual-particularly in children who experience early-life undernutrition followed by later exposure to unhealthy diets (Wells *et al.*, 2020). The double burden of malnutrition (DBM) has emerged as a critical global health challenge, particularly in low- and middle-income countries (LMICs). It refers to the coexistence, within individuals, households, or populations, of undernutrition (stunting, wasting, micronutrient deficiencies) and overweight, obesity, or nutrition-related non-communicable diseases (WHO, 2017). This paradoxical phenomenon has become increasingly prominent in many low- and middle-income countries, and reflects overlapping dietary inadequacies-excess calorie intake with insufficient micronutrients-alongside factors such as urbanization, sedentary lifestyles, poor dietary diversity, and limited access to healthcare (Popkin *et al.*, 2020).

The coexistence of anemia and overweight/obesity (OWOB) in women of reproductive age is an increasingly common manifestation of the DBM, particularly in low- and middle-income countries. Recent estimates suggest an increase of 0.24 percentage points in people who may simultaneously experience these two conditions in West and Central Africa, with up to 12.4% of women in some settings (Irache *et al.*, 2022a). Anemia, often driven by iron deficiency and infections, impairs maternal health and fetal development, while obesity increases the risk of gestational diabetes, hypertension, and complications during childbirth (Black *et al.*, 2008). The DBM has major implications for public health policy, as it requires rethinking nutrition strategies through integrated approaches. In particular, "double-duty actions" have emerged as a promising framework to address both forms of malnutrition simultaneously (Hawkes *et al.*, 2020).

Although the co-occurrence of anemia and OWOB is a widespread issue in sub-Saharan African countries (Getnet *et al.*, 2024), few national-level studies have been conducted to assess its prevalence and associated determinants in this population group at national level. The prevalence of anemia among women of reproductive age (15–49 year) in Burkina Faso was reported at 28.0%, according to National Survey on Micronutrients (Ministry of Health Burkina Faso and CDC, 2024). This indicates that over half of women in this age group are affected by anemia, posing significant public health concerns. The prevalence of overweight and obesity among women in Burkina Faso has shown an increasing trend over the years. For instance, the prevalence of overweight and obesity among women of reproductive age (15–49) in Burkina Faso was estimated at 11.0%, according to data from the Demographic and Health Survey (INSD, 2023). Understanding the scope and overlap of these nutritional issues can help identify at-risk populations, inform integrated interventions, and prevent long-term health and economic consequences. Therefore, this study aimed to assess the prevalence of DBM - specifically the coexistence of anemia and OWOB - and associated factors in Burkina Faso

Materials and Methods

Data source and survey design

The present study is based on an analysis of secondary data of Burkina Faso Demographic and Health Survey Round-V (BFDHS-V). BFDHS-V was a nationally representative cross-sectional survey conducted between 30 July and 30 November 2021, by the national bureau of statistics of Burkina Faso and The DHS Program ICF Rockville, Maryland, USA. It employed a two-stage, stratified sampling method. In the first stage, the country was divided into 26 strata based on the urban and rural areas of its 13 regions. From these strata, 572 clusters were systematically selected, with a probability proportional to their household count. In the second stage, a random sample of households was drawn from each cluster: 32 households per cluster in the Sahel region and 26 per cluster in all other regions. During the survey, 13,251 households were selected and a total of 17 659 women of reproductive age (15–49 year) were

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interviewed including the full household questionnaires and anthropometric and hemoglobin measurements. For this analysis, a weighted subsample of 7,987 non-pregnant women of reproductive age at the time of the survey who had complete and valid anthropometric and hemoglobin data were considered. Women were excluded if they were pregnant, or had missing data on key outcome variables (BMI or hemoglobin). Additionally, extreme outliers (BMI<12 kg/m² or >60 kg/m^2) and biologically implausible hemoglobin values (Hb <4 g/dl or >18 g/dl) were excluded in accordance with DHS data quality guidelines (**Figure 1**).

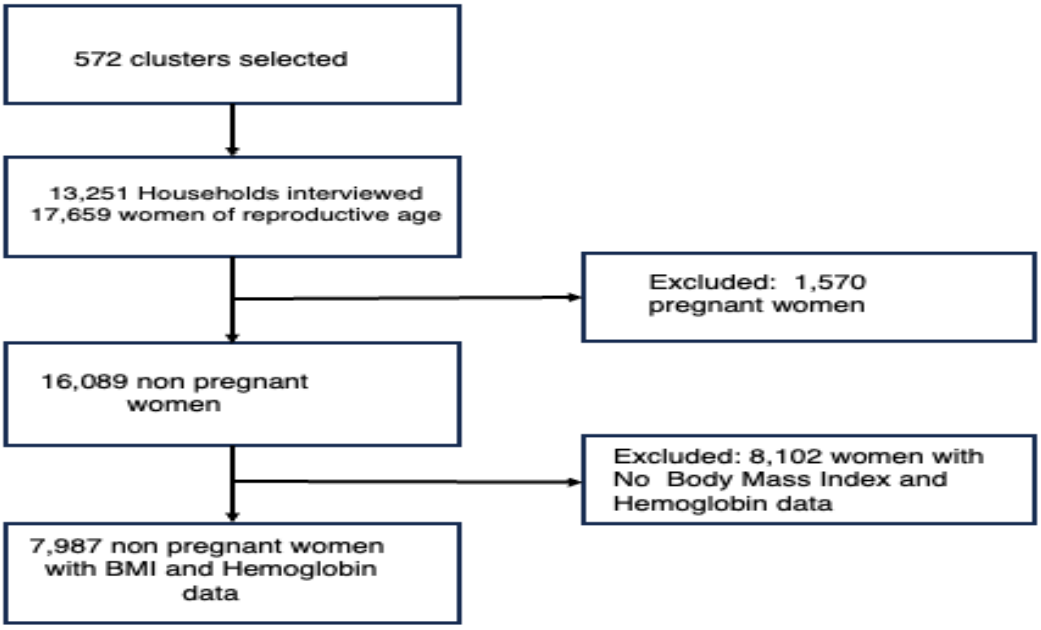


Figure 1. Flowchart describing the sample selection procedure.

Outcome variables

The outcome variable was the presence of overweight or obesity using BMI, and anemia using the hemoglobin concentration. For the BFDHS-V, women weight measurements were taken using digital scales (SECA® 878U), and height measurements using a height board. The BMI was calculated as weight in kilograms divided by height in meters squared (kg/m²). Women with a BMI ≥25 kg/m² were classified as overweight or obese (overweight/obese). Hb was measured using a HemoCue® photometer from capillary blood samples. Anemia among non-pregnant women was defined according to WHO criteria as Hb concentration <12.0 g/dl, in accordance with WHO guideline (WHO, 2024). The variable representing the coexistence of OWOB and anemia was dichotomized: a value of '1' denoted its presence, while a value of '0' denoted its absence.

Explanatory variables and operational definitions

The selection of explanatory variables was guided by previous literature (Getnet *et al.*, 2024) and their availability in the BFDHS-V dataset. For this study, individual and community level variables were considered. The individual (and household) level factors were the following:

- Age : <25 y, 25–29 y ; 30–34 y and ≥ 35 y;
- Age at first birth: <18 y, 18-24y, 25y or more;
- Marital status: never in union, married, living with partner, divorced/widowed/separated;
- Occupation: not working, currently working;
- Education: no education, primary education, secondary and higher education;
- Last child's antenatal visits: did not have, 1 to 3, 4 or more;
- Sex of household head: male, female;
- Minimum dietary diversity (MDD): met, not met;

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MDD was computed according to the FAO/FANTA guidelines (FAO and FHI 360, 2016). Women who had consumed at least five out of ten defined food groups during the previous 24 hours were classified as having achieved MDD-W (MDD-W=1), while those consuming fewer than five groups were classified as not achieving it (MDD-W=0). The ten food groups include: 1) grains, white roots and tubers, and plantains; 2) pulses (beans, peas and lentils); 3) nuts and seeds; 4) dairy; 5) meat, poultry and fish; 6) eggs; 7) dark green leafy vegetables; 8) other vitamin A-rich fruits and vegetables; 9) other vegetables; and 10) other fruits.

- Partner's occupation: did not work, technical and clerical, sales and services, agriculture or self-employed, manual or household or domestic;
- Media exposure: not at all, less than once a week, at least once a week exposure to watching TV, listening to radio, reading newspapers or magazine, using Internet;
- Partner's education: no education, primary, secondary, higher;
- Smoking: smoking, not smoking;
- Wealth index:

The wealth index is a composite measure of a household's cumulative living standard. It is calculated using principal component analysis (PCA) on data concerning a household's ownership of selected assets (e.g., television, bicycle; materials used for housing construction; and types of water access and sanitation facilities). The resulting scores are standardized and then divided into quintiles, ranging from the "poorest" to the "richest". This pre-calculated index, as provided in the BFDHS-V dataset, was used in this analysis.

- Contraceptive use: no use, use traditional method, use modern method;
- source of drinking water: protected, non-protected sources;
- Toilet facility: improved, non-improved;
- Number of under 5 children: 0 or 1, 2 or 3, 4 children or more;
- Household size: less than 5, 5 or 6, 7 members or more;

The community variable was the place of residency: urban or rural.

Data analysis

The BFDHS-V survey used a two-stage stratified cluster sampling technique. Therefore, the recommended multilevel modeling for DHS data was used in this analysis (Elkasabi *et al.*, 2020). For descriptive statistics, the authors reported weighted frequency distribution to summarize the categorical variables and means (standard errors) to summarize the continuous variables. Relationship between the outcome and the explanatory variables were assessed using a generalized linear model for complex survey data (Lumley, 2004). The *'svyglm'* function (survey-weighted generalized linear model with binomial family and logit link) from the 'survey' package in R (version 4.4.2) was used to perform multivariate logistic regression analyses, accounting for sampling weights, stratification, and clustering. Statistical significance was set at P-value<0.05. All significant variables and non-significant variable (at $P<0.20$) in the bivariate regression were included in the multivariable analysis to determine their collective associations with DBM. Multicollinearity between the independent variables was tested using the variance inflation factor (VIF) with a cutoff point of VIF=3, ensuring that the independent variables were not highly correlated. Associations were expressed as adjusted odds ratio (AOR) with 95 % confidence intervals (%95CI).

Ethical considerations

This analysis used secondary data from the Burkina Faso Demographic and Health Survey, accessed with permission from The DHS Program. Ethical approval for the original survey was obtained from the Burkina Faso National Ethics Committee and the ICF International Institutional Review Board.

Results

Characteristics of the study sample

The mean age (±SD) of women was 28.8±9.8 years; 58.8% had no formal education and only 4.9%

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had higher education. The mean BMI was 22.6±4.9 kg/m^2 and their mean Hb concentration was 11.6±1.5 g/dl. The prevalence of overweight and obesity was 15.5% and 5.9%, respectively. Three-quarters of the women (75.6%) met the MDD. Participants characteristics are presented in **Table 1.**

Table 1. Sociodemographic characteristics of the participants.

Characteristics	N	%
Place of residence		
Urban	2829	33.2
Rural	5158	66.8
Age (y)		
<25	3213	40.1
25-29	1176	14.7
30-34	1112	13.9
≥35	2519	31.4
Education		
No education	4702	58.8
Primary education	111	13.9
Secondary education	1802	22.4
Higher education	373	4.9
Working status		
Not working	2688	35.1
Currently working	5299	64.9
Partner's education		
No education	4057	74.0
Primary	667	11.8
Secondary	607	11.1
Higher	165	3.1

Prevalence of double burden of malnutrition

Among women of reproductive age, the prevalence of OWOB was 21.4% (95%CI: 20.1, 22.7%) and anemia was 55.1% (95%CI: 53.7, 56.6%). The co-occurrence of these conditions - DBM associating OWOB with anemia was 10.1% (95%CI: 9.3, 11.1%) as presented in **Figure 2**.

Factors associated with the coexistence of the coexistence OWOB and anemia

In bivariate analysis, the following factors were significantly associated with the DBM: women's age, age at first birth, education level, working status, marital status, dietary diversity, media exposure, the number of antenatal care visits, household wealth index, source of drinking water, and place of residence. In the multivariable logistic regression model, the coexistence of OWOB and anemia was positively associated with higher wealth quintile (richer: AOR=1.87; 95%CI: 1.16, 3.01), Richest: AOR=3.28; 95%CI: 1.99, 5.40), older age (20-29 y: AOR=1.86; 95%CI: 1.25, 2.77; 30-39 y: AOR=2.12; 95%CI :1.40, 3.21, and >= 40 y: AOR=2.24; 95%CI:1.45, 3.45) and primary education (AOR=1.51; 95%CI: 1.04, 2.19). Conversely, a young age at first birth was negatively associated with the DBM (AOR=0.71; 95%CI: 0.53, 0 .96, **Table 2**)

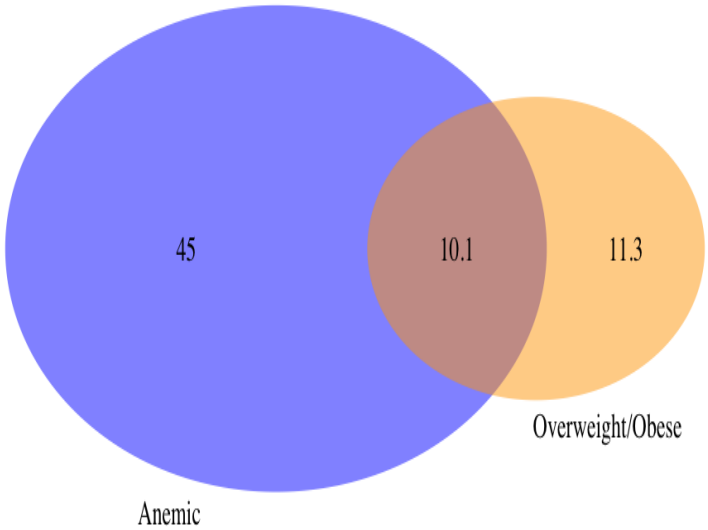


Figure 2. Prevalence (%) of the two overlapping health conditions (OWOB and anemia) and their joint prevalence.

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Table 2. Multilevel analysis of factors associated with co-occurrence of overweight/ obesity and anemia among reproductive women 15–49 in Burkina Faso

Variables	Unadjusted				Adjusted[a]			
	OR	95%CI		P-value	AOR	95%CI		P-value
Place of residence								
Urban	Ref							
Rural	0.415	0.341	0.507	0.000				
Household size								
Small	Ref							
Medium (5-6)	0.909	0.690	1.198	0.497				
Large (>=7)	0.760	0.602	0.959	0.021				
Wealth index								
Poorest	Ref				Ref			
Poorer	1.018	0.707	1.465	0.923	0.814	0.480	1.380	0.444
Middle	1.526	1.107	2.104	0.010	1.264	0.780	2.047	0.341
Richer	2.308	1.683	3.166	<0.001	1.871	1.162	3.011	0.010
Richest	3.701	2.703	5.066	<0.001	3.280	1.993	5.398	<0.001
Number of children								
0-1	Ref				Ref			
2-3	0.785	0.653	0.945	0.011	0.998	0.739	1.348	0.990
>=4	0.466	0.296	0.732	0.001	0.814	0.459	1.445	0.482
Frequency of exposure to media								
At all	Ref				Ref			
Less than once a week	2.002	1.610	2.489	<0.001	1.059	0.732	1.533	0.761
At least once a week	1.943	1.537	2.456	<0.001	1.044	0.746	1.462	0.802
Age at first birth (y)								
<18	Ref				Ref			
18-24	1.024	0.831	1.261	0.826	0.712	0.528	0.962	0.027
>=25	1.417	1.019	1.971	0.038	0.743	0.451	1.225	0.243
Source of drinking water								
Non-protected	Ref				Ref			
Protected	0.749	0.588	0.954	0.019	1.290	0.898	1.851	0.167
Women's age (y)								
<25	Ref				Ref			
25-29	1.695	1.271	2.260	<0.001	1.859	1.249	2.766	0.002
30-34	2.210	1.666	2.932	<0.001	2.121	1.400	3.212	<0.001
>=35	2.498	1.987	3.140	<0.001	2.238	1.452	3.449	<0.001
Marital status								
Never in union	Ref				Ref			
Married	1.749	1.339	2.285	<0.001	1.272	0.491	3.300	0.620
Living with partner	1.383	1.001	1.913	0.050	0.974	0.375	2.531	0.957
Divorced/widowed/separated	1.957	1.265	3.029	0.003	0.526	0.107	2.580	0.428
Women's education								
No education	Ref				Ref			
Primary	1.396	1.093	1.784	0.008	1.512	1.042	2.193	0.030
Secondary	1.007	0.809	1.254	0.948	1.128	0.754	1.687	0.557
Higher	1.982	1.365	2.879	<0.001	0.459	0.164	1.287	0.139
Women's work								
Not working	Ref							
Currently working	1.362	1.119	1.658	0.002				
Modern contraceptive use								
No	Ref							
Yes	0.846	0.518	1.381	0.503				
Sex household head								
Male	Ref							
Female	1.282	0.989	1.662	0.061				

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Minimum dietary diversity								
No	Ref				Ref			
Yes	1.262	1.045	1.524	0.016	1.115	0.769	1.615	0.566
Antenatal visits								
No visits	Ref				Ref			
1-3	0.469	0.162	1.359	0.163	0.745	0.201	2.759	0.659
>=4	0.585	0.210	1.631	0.305	0.786	0.220	2.815	0.711

***OR**: Odds ratio; **CI**: Confidence interval; **AOR**: Adjusted odds ratio; [a]: AOR from a survey-weighted logistic regression model accounting for sampling weights, stratification, and clustering. All significant variables and non-significant variable (at P<0.20) in the bivariate regression were included in the multivariable analysis.*

Discussion

This study showed that the DBM, characterized by the coexistence of OWOB and anemia, is an emerging public health concern among women of reproductive age in Burkina Faso, with a prevalence of 10.1%. The burden was significantly associated with key sociodemographic characteristics, including the woman's older age, higher education, and greater socioeconomic status, pointing to specific population subgroups that may be most vulnerable.

Because DHS surveys measure only hemoglobin concentration, the present analysis could not distinguish the underlying causes or types of anemia. Previous studies in Burkina Faso and sub-Saharan Africa contexts have shown that iron deficiency, infection ,inflammation are the major contributors to anemia among women of reproductive age (Diallo *et al.*, 2020, Silubonde *et al.*, 2023). In addition, there is enough evidence of the role of non-nutritional factors such as chronic disease, genetic blood diseases, and other micronutrients deficiencies in the etiology of anemia (Petry *et al.*, 2016, Wirth *et al.*, 2017). More studies examining the co-occurring OWOB-anemia and the context-specific determinants of anemia are needed to better understand the drivers of this type of DBM. Nevertheless, the co-existence of obesity and anemia is supported by the hypothesis of poor-quality diets which are energy-dense, but poor in vitamins and minerals, consecutive to increased availability and consumption of ultra-processed foods in LMICs in general. Furthermore, substantial evidence exists on a possible causal relationship between obesity and anemia (Alshwaiyat *et al.*, 2023, Wang *et al.*, 2023). One potential explanation is the common inflammatory state in individuals with obesity, which triggers the production of hepcidin - a hormone that blocks iron absorption and release, thereby disrupting iron homeostasis (Aeberli *et al.*, 2009, Coimbra *et al.*, 2013). In addition, the need for greater blood volume required by the increase in body weight in obese women can lead to a decrease in the bioavailability of iron due to its sequestration in the reticuloendothelial system (Ortiz Perez *et al.*, 2020).

Previous analysis using DHS surveys reported a prevalence of 4.5% and 5.3% in 2000 and 2010 respectively for the country (Irache *et al.*, 2023). In another study, the dual burden of OWOB and at least one deficiency in either iron or vitamin A among adults was reported at 8.5% in 2014 (Zeba *et al.*, 2014). This highlights the growing prevalence of the issue. Therefore, identifying and addressing its preventable underlying factors is crucial to mitigating its consequences in the country. The prevalence of the DBM in this study is similar to that of LMICs with a prevalence of 12.4% (Irache *et al.*, 2023). Regarding Latin American countries, in Guatemala it was 12% and in Brazil it was 14% (Rivera *et al.*, 2014). It was lower than a study done in India with 23.1% (Little *et al.*, 2020) and Philippines with 23.7% (de Juras *et al.*, 2021), but higher than that was observed in other Sub-Saharan African (SSA) countries like Ghana, 7% (Christian *et al.*, 2022) and Malawi ,3.4% (Rhodes *et al.*, 2020). The differences observed worldwide could be attributed to geographical diversity, population trends, socioeconomic conditions, and various social, cultural, and health-related influences.

In the current study, the odds of co-occurring OWOB and anemia was higher for older women

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compared to younger ones. This finding is consistent with studies conducted in SSA (Getnet *et al.*, 2024), Ghana (Christian *et al.*, 2022) and Philippines (de Juras *et al.*, 2021). The association between older age and this observed DBM can be explained by several physiological and lifestyle transitions. First, the age-related physiological changes, including greater fat mass and reduced basal metabolic rate, less active lifestyle and increased parity are well-established drivers of obesity (Amarya *et al.*, 2015, Karvonen-Gutierrez and Kim, 2016). In addition, weight retained during pregnancy is often difficult for women to lose, even for obese women, contributing to increased BMI over time (Fadzil *et al.*, 2018).

The wealth index was also positively associated with co-occurrence of OWOB and anemia; women who were in the rich and the richest wealth quantile had higher odds of developing this DBM. Similar findings were reported in Guinea (Diakite *et al.*, 2023), Ghana (Christian *et al.*, 2022), Philippines (de Juras *et al.*, 2021) and in LMICs (Getnet *et al.*, 2024). A plausible reason for this finding is that a transition from traditional diets to more varied eating patterns include energy-dense and nutrient-poor foods, which are the key contributors to both OWOB and micronutrient deficiencies, particularly among individuals with higher socioeconomic status in LMICs (Fadzil *et al.*, 2018). The lack of physical activity, a key determinant of obesity, is common in wealthier households. Furthermore, in many African contexts, cultural norms associate a larger female body size with wealth, and higher social or marital status may contribute to an environment where excess weight is socially desirable, thereby perpetuating the obesity component of the DBM (Okop *et al.*, 2016).

Compatible with the findings of previous studies (de Juras *et al.*, 2021, Irache *et al.*, 2022b, Jayalakshmi *et al.*, 2023), the result of this study shows that women who have primary and secondary education level have higher odds of developing the co-occurrence of OWOB and anemia with regards to their peers having no or lower educational attainment. In contrast, no relationship (Diakite *et al.*, 2023) or a negative association was found in other settings (Getnet *et al.*, 2024). A possible explanation is that educated women of reproductive age tend to have a higher economic status, and are more likely to adopt lifestyles and dietary habits - characterized by energy-dense, nutrient-poor foods - contributing to the simultaneous development of obesity and anemia (Yaya *et al.*, 2018).

This study had some limitations. First, data on other important determinants such as physical activity levels, other micronutrient deficiencies, and socio-cultural influences were not available and thus not included in the analysis. Second, the cross-sectional design of the study prevents us from establishing causal relationships between the identified factors and the outcome. Furthermore, while this study provides insights into the coexistence of OWOB and anemia, it lacks detailed information on dietary intake patterns. Future research should incorporate comprehensive dietary assessments such as food frequency questionnaires to better quantify nutrient intake and identify specific dietary factors contributing to the DBM in this population. Despite these limitations, a key strength of this study is its use of nationally representative data. It is therefore valuable evidence as it is one of the first investigations into the factors associated with the coexistence of OWOB and anemia among women of reproductive age in Burkina Faso.

Conclusion

This study revealed that the DBM, defined by the coexistence of OWOB and anemia affected one in ten non-pregnant women of reproductive age in Burkina Faso. Key factors associated with this condition were higher household wealth, older age, and lower educational attainment. The positive association between household wealth and the DBM suggests that the co-occurrence of overnutrition and undernutrition may be exacerbated by ongoing economic growth, urbanization, and nutrition transition. These findings underscore the urgent need for significant investment in double-duty interventions to address

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malnutrition in all its forms in the country.

Acknowledgements

The authors are grateful to the Demographic and Health Survey (DHS) program for providing free access to the datasets for this study.

Conflicts of interests

The authors declared conflict of interest.

Authors' contributions

Lanou HB designed the study, analyzed the data and wrote the original draft. Savadogo B, contributed to data analysis and reviewed the manuscript. Savadogo B, Diendiere J, and Zeba AN reviewed the manuscript. All authors have read and agreed to the final version of the manuscript.

Funding

No funding or financial support was received for this research

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