

The Trends and Determinants of the Double Burden of Malnutrition among Women and Children in Nigeria Using Pooled DHS Data from 2013, 2018, and 2024

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Abstract

Background

The double burden of malnutrition (DBM) occurs when maternal overweight/obesity and child stunting co-occur in the same household and is a public health challenge in Nigeria amid the ongoing nutrition transition. Trends, geographic disparities and multilevel factors influencing DBM have not previously been explored using pooled nationally representative data. This study examined the national trend, geographic inequalities, and individual-, household- and community-level determinants of DBM among mother–child pairs in Nigeria using the 2013, 2018, and 2024 Nigeria Demographic and Health Surveys (NDHS).

Methods

We analysed pooled cross-sectional data from the NDHS, with mother–child pairs ($n = 48,445$) as the unit of analysis. DBM was defined as household co-occurrence of maternal overweight/obesity ($\text{BMI} \geq 25 \text{ kg/m}^2$) and child stunting ($\text{HAZ} < -2 \text{ SD}$). Survey weights were applied in Stata 18 to account for the complex sampling design. Descriptive statistics summarised prevalence patterns; survey-weighted logistic regression identified determinants. Regional and state-level geographic differences were assessed. Statistical significance was set at $p < 0.05$.

Results

DBM prevalence increased from 5.88% (95% CI: 5.46–6.34) in 2013 to 6.79% (95% CI: 6.17–7.48) in 2018, before declining to 5.66% (95% CI: 5.03–6.37) in 2024, with significant temporal variation ($F = 3.54$, $p = 0.029$). Households surveyed in 2018 had higher odds of DBM than in 2013 ($\text{OR} = 1.17$; 95% CI: 1.02–1.33; $p = 0.021$). Regional and state differences were not statistically significant ($p = 0.240$ and $p = 0.097$, respectively). Higher maternal education ($\text{AOR} = 0.58$; 95% CI: 0.36–0.92), richer (AOR = 0.59; 95% CI: 0.37–0.92) and richest household wealth ($\text{AOR} = 0.34$; 95% CI: 0.21–0.56), and female child sex ($\text{AOR} = 0.68$; 95% CI: 0.55–0.83) were associated with lower odds of DBM. Child age 12–23 months ($\text{AOR} = 2.71$; 95% CI: 1.99–3.70) and 24–59 months ($\text{AOR} = 2.53$; 95% CI: 1.90–3.36), and residence in the North East ($\text{AOR} = 1.84$; 95% CI: 1.20–2.82) and North West ($\text{AOR} = 1.66$; 95% CI: 1.18–2.34) increased the likelihood of DBM, while residence in the South South was protective ($\text{AOR} = 0.64$; 95% CI: 0.44–0.94).

Conclusions

Despite a relatively low prevalence, DBM remains a public health problem among mother–child pairs in Nigeria. Socio-economic inequalities, maternal education, household wealth, child characteristics and regional disparities are important determinants. Tackling maternal overweight/obesity and child stunting

simultaneously in Nigeria requires strengthening integrated nutrition programmes, investing in female education, improving household economic conditions, and pursuing region-specific investments.

Clinical trial registration

Not applicable. This is not a clinical trial and therefore did not need to be registered.

Background to the study

Malnutrition is a significant public health problem, with a major impact on morbidity and mortality, cognitive functioning and economic productivity. To date, numerous LMICs have undergone a nutrition transition with the simultaneous occurrence of a high prevalence of undernutrition and rapidly rising overweight and obesity rates, referred to as the double burden of malnutrition (DBM) [1,2,3]. DBM can be defined as the co-occurrence of undernutrition and overweight and obesity, or diet-related non-communicable diseases, at the individual, household or population level, according to the World Health Organization (WHO) [4].

In 2022, there were an estimated 148 million children under 5 years old who were stunted, 45 million wasted and more than 37 million overweight [5,6]. Meanwhile, there is a trend of over-nutrition in both developed and developing countries, with more than 1 billion people being obese worldwide [7]. Urbanisation, changes in food consumption patterns towards energy-dense foods, reduced physical activity and socioeconomic inequalities are some of the drivers of this dual burden, which is becoming more difficult to tackle at the country level [8,5].

Sub-Saharan Africa is one of the regions most affected by the nutrition transition, not only because of the high prevalence of undernutrition in children, but also because of the prevalence of maternal overweight and obesity [9]. Although some progress has been made in tackling the problem of child malnutrition, Africa continues to grapple with a disproportionate number of stunted children. In 2016, the total number of stunted children worldwide was estimated at 155 million (23%), with more than a third (33%) of the stunted children in Africa [10]. Stunting is still a public health challenge, as over 90% of stunted children under five live in Africa and Asia [10]. Geospatial analyses have revealed considerable within-country disparities in the co-occurrence of child undernutrition and overweight, with especially high prevalence in urbanising regions and among people residing in socio-economically disadvantaged neighbourhoods [11,12].

Thus, household-level DBM is now a public health issue in sub-Saharan Africa due to poverty, food insecurity, changes in food environments, and lack of maternal nutrition and access to health care services [13,14]. This implies that interventions which focus on either undernutrition or obesity alone will be less likely to have sustained nutrition impacts.

Nigeria is a country experiencing such a nutritional transition and has one of the highest malnutrition rates in Africa. Although stunting in childhood is prevalent, overweight and obesity in women of reproductive age is also on the rise, leading to a situation where both stunting and overweight/obesity are present in the same households. Malnutrition is an emerging phenomenon in Nigeria, especially the double burden of malnutrition, as revealed in recent studies. In a study of mother–child pairs in Akwa Ibom State, Alamu et al. [15] found 37.4% of children to be stunted while 23.2% of mothers were overweight and 9.3% obese, thus affirming the presence of under- and over-nutrition in the household. Similarly, Adeyanju and Fadupin [16] revealed the occurrence of DBM at the household level among rural mother–child pairs in Oyo State, indicating that the problem is still affecting the rural population. Recently, a nationally representative study in Nigeria, using pooled DHS data, showed that DBM was a measurable concern at the household level across the country, driven by maternal, child, household and community-level factors [17].

Statement of the problem

Nigeria is undergoing a complex nutritional transition, characterised by undernutrition and overnutrition. Despite much effort to improve the situation of malnutrition in children, stunting remains a public health issue and overweight/obesity is increasing among women of reproductive age, driven by urbanization, changing food consumption patterns and lifestyle. This is referred to as the double burden of malnutrition (DBM) and highlights the maternal and child health concern of co-occurrence of the negative effects of childhood chronic undernutrition and maternal overweight and obesity within the same household.

This phenomenon has already been reported in some states and communities in Nigeria, including Lagos [11], Akwa Ibom [15] and Oyo [16]. A recent national-level study based on the Nigeria Demographic and Health Survey (NDHS) [17] revealed that DBM remains a key nutrition issue at the household level and that both child and maternal, household and community factors contribute to the prevalence of DBM, indicating the need for a comprehensive approach to tackling the issue, rather than treating undernutrition and overnutrition as separate public health problems.

Evidence around maternal obesity, childhood stunting and DBM at the household level is slowly coming to light in Nigeria, but key gaps exist. Previous studies in Nigeria mostly focused on a particular community or state, making them less nationally representative [11,16]. National studies have primarily used only one survey wave of the DHS, which impedes the ability to assess changes over time and limits understanding of temporal nutritional transitions. Furthermore, there is limited literature detailing geographic variation in DBM across Nigeria's states and regions based on multi-year, nationally representative DHS data. Additionally, little is known about the impact of individual, household and community-level factors on the simultaneous occurrence of maternal overweight/obesity and child stunting across time.

Thus, there is little empirical evidence on which to base the design of integrated and geographically targeted nutrition interventions that can tackle both types of malnutrition. This study aims to fill these

gaps by using pooled data from the NDHS 2013, 2018 and 2024 to analyse trends, geographic inequalities and determinants of the double burden of malnutrition at the household level in mother–child pairs in Nigeria.

Objectives of the study

This study seeks to explore the trends and determinants of the double burden of malnutrition in women and children in Nigeria, drawing from the pooled 2013, 2018, and 2024 DHS data. Specific objectives are:

1. To determine trends in the prevalence of double burden of malnutrition (maternal overweight/obesity and child stunting within the same household) in Nigeria across the 2013, 2018, and 2024 DHS surveys.
2. To assess regional- and state-level geographic inequalities in the double burden of malnutrition in Nigeria based on pooled DHS data.
3. To assess the determinants of the double burden of malnutrition at the individual, household and community level among mother and child pairs in Nigeria.

Hypotheses

H_{01} : There is no significant change in the prevalence of double burden of malnutrition among households in Nigeria across the 2013, 2018, and 2024 DHS surveys.

H_{02} : There are no significant geographic differences in the double burden of malnutrition among households across regions and states in Nigeria.

H_{03} : There is no significant relationship between individual, household and community-level factors and double burden of malnutrition among mother–child pairs in Nigeria.

Theoretical framework

Life Course Theory

In line with Life Course Theory, developed by Elder [18], health outcomes are not solely a result of a single event, but rather are the result of experiences across one's entire life course, which includes biological, social, historical, and socioeconomic experiences. The theory emphasizes that the life course of an individual consists of a sequence of age-, family-, education- and socioeconomic-context-specific events, roles and transitions [19]. Likewise, according to Bernardi [20], early-life experiences, family dynamics, diseases and life events influence health outcomes through the lifespan, and interventions during critical periods of life can have a benefit on lifelong health.

Life Course Theory is useful for trying to understand how maternal overweight/obesity can co-occur with child stunting, as both are the result of exposures that add up over time. The mother's nutritional status

is a measure of long-term lifestyle and socioeconomic experiences, while the child's nutritional status is a measure of chronic nutrition deprivation from early life, as is seen in stunting. Thus, it is important to consider and investigate the effect of socio-economic and demographic factors like maternal age, education, household wealth, antenatal care, place of residence and regional differences on the double burden of malnutrition among mother–child dyads in Nigeria.

Social Ecological Model

Health outcomes are determined by a combination of individual, interpersonal, community, organisational and societal factors, as explained by the Social Ecological Model (SEM), which was developed by Bronfenbrenner (1986) and extended by McLeroy et al. (1988) cited in [21]. These influences are represented as nested systems – ranging from the microsystem (immediate environment) through to the macrosystem (broader cultural, economic and policy environment) and the chronosystem (over time) – which all influence health behaviours and outcomes [21]. It recognises that in addition to individual factors, barriers and facilitators are found at various levels that affect health, including family, community, health care systems and socioeconomic factors [22, 23].

The SEM provides a suitable theoretical framework for understanding the multi-level influences on health outcomes for mother–child dyads in this study, as applicable to the double burden of malnutrition in Nigeria. These factors include individual-level (such as maternal age, education, nutritional status and child characteristics), household-level (such as wealth index, household size, and sex of household head) and community-level (such as place of residence, regional disparities and access to health services) factors. The interplay of these factors should be understood against the backdrop of the socioeconomic and policy environment, which has an impact on the co-existence of maternal overweight/obesity and child stunting.

The model successfully provided support for the multilevel analysis in this study, which used pooled data from the Nigeria Demographic and Health Surveys (NDHS) of 2013, 2018, and 2024 to examine the determinants of the double burden of malnutrition.

Conceptual framework

[Fig. 1 – figure file uploaded separately, per BMC Global and Public Health figure requirements] Fig. 1. Conceptual framework linking individual-, household-, and community-level determinants to the double burden of malnutrition among mother–child pairs in Nigeria

Methods

This study employed a cross-sectional analytical design with pooled secondary data from the 2013, 2018 and 2024 Nigeria Demographic and Health Survey (NDHS), a household survey with a two-stage cluster sampling design that is representative of all regions in Nigeria at the national level. The study

population included mother–child pairs with full information on the mother's body mass index (BMI) and the child's height-for-age measurements.

The outcome variable was the double burden of malnutrition (DBM), defined as maternal overweight/obesity ($\text{BMI} \geq 25 \text{ kg/m}^2$) and stunting in children ($\text{HAZ} < -2 \text{ SD}$) in the same household. The factors at the individual, household, and community levels were maternal age, level of education, child age, child sex, birth order, and attendance at antenatal care, household size, sex of the household head, place of residence, region, state, and survey year.

Data were weighted using the sampling weights supplied by the DHS and analysed with complex survey (svy) procedures in Stata version 18, to account for the multistage sampling design. The prevalence and trends of DBM across survey years were estimated using descriptive statistics. Survey-weighted logistic regression, predictive margins and choropleth mapping were used to explore geographic inequalities.

Survey-weighted multivariable logistic regression models were used to determine factors associated with DBM. Adjusted odds ratios (AORs), 95% confidence intervals (CIs) and p-values were provided. A 5% level of significance was used to determine statistical significance.

Ethics approval and consent to participate

The data used for this study is secondary data obtained from publicly available de-identified data from the pooled Nigeria Demographic and Health Survey (2013, 2018 and 2024). Ethical approval and informed consent for the original surveys were obtained by the survey implementers – the National Population Commission, Nigeria, and ICF International – in line with WHO ethical and safety guidelines. This is a secondary analysis, and no further institutional ethical approval was needed. The DHS Program registered and approved the data request and authorized access to and use of the data.

Results

Trends in the prevalence of double burden of malnutrition

Table 1. *Trend in the Prevalence of Double Burden of Malnutrition among Women–Child Pairs in Nigeria, NDHS 2013–2024*

Survey Year	No DBM % (95% CI)	DBM % (95% CI)
2013	94.12 (93.66–94.54)	5.88 (5.46–6.34)
2018	93.21 (92.52–93.83)	6.79 (6.17–7.48)
2024	94.34 (93.63–94.97)	5.66 (5.03–6.37)
Design-based F-test	F = 3.54; p = 0.029	

Source: Computed from pooled Nigeria Demographic and Health Surveys (NDHS) 2013, 2018, and 2024 using survey weights.

For the Nigeria DHS, the prevalence of double burden of malnutrition (DBM) (maternal overweight/obesity and child stunting in the same household) by survey year (2013, 2018, and 2024) is presented in Table 1. The prevalence of DBM increased from 5.88% (95% CI: 5.46–6.34) in 2013 to 6.79% (95% CI: 6.17–7.48) in 2018, before declining to 5.66% (95% CI: 5.03–6.37) in 2024. An overall prevalence of < 7% was observed throughout the study period.

Using the design-based F-test, the differences in DBM prevalence for the three survey years were statistically significant ($F = 3.54$, $p = 0.029$), and therefore the differences were unlikely to be due to chance alone.

[Fig 2 – figure file uploaded separately, per BMC Global and Public Health figure requirements] **Fig 2.** Trend in the Predicted Probability of Double Burden of Malnutrition, Nigeria NDHS 2013–2024

Fig 2 illustrates the adjusted predicted probability of women–child pairs being double burdened with malnutrition in the 2013, 2018, and 2024 Nigeria Demographic and Health Surveys (with 95% confidence intervals). This probability rose from around 5.9% in 2013 to 6.8% in 2018 before falling back to around 5.6% in 2024. This trend matches the prevalence estimates provided in Table 1.

The intervals for each survey year do not overlap; however, this difference was not statistically significant in itself, but was consistent with the survey design-based test result of $p = 0.029$ (Table 1).

The results in Table 1 and Fig 2 indicate that in Nigeria, approximately 1 in every 17 mother–child pairs faced the challenge of both maternal and child malnutrition during the study period. Prevalence was highest in 2018 and fell in 2024, but still presents a public health concern.

The significant temporal change is a reminder of the importance of multi-sectoral nutrition interventions that tackle both maternal overweight/obesity and child undernutrition, and of the changing epidemiology of malnutrition over time.

Table 2. Trend in the Prevalence of Double Burden of Malnutrition and Test of Differences across Survey Years, Nigeria DHS 2013–2024

Survey Year	DBM Prevalence % (95% CI)	Odds Ratio (95% CI)	p-value
2013 (Ref.)	5.88 (5.45–6.32)	1.00	Reference
2018	6.79 (6.14–7.45)	1.17 (1.02–1.33)	0.021
2024	5.66 (4.99–6.33)	0.96 (0.83–1.11)	0.584

Overall model test: Adjusted Wald $F(2, 2686) = 3.66$, $p = 0.026$. Reference category: 2013 NDHS.

Table 2 summarizes the survey-weighted prevalence of the double burden of malnutrition (DBM) and the results of a survey logistic regression model of the differences by survey year.

Compared with 2013, women–child dyads surveyed in 2018 were more likely to report DBM (OR = 1.17, 95% CI: 1.02–1.33, $p = 0.021$). In contrast, the odds observed in 2024 were not statistically different from those in 2013 (OR = 0.96, 95% CI: 0.83–1.11; $p = 0.584$).

There was statistically significant temporal variation in DBM across survey rounds, as survey year was significantly associated with DBM by the overall (adjusted) Wald test ($F(2, 2686) = 3.66, p = 0.026$). Since the overall model was statistically significant ($p < 0.05$), the null hypothesis (H_{01}) was rejected, implying a significant, non-linear trend in DBM prevalence among women–child pairs in Nigeria over the study period.

Geographic inequalities in double burden of malnutrition

Table 3. *Geographic Inequalities in Double Burden of Malnutrition by Region, Nigeria (Pooled DHS 2013, 2018 and 2024)*

Region	Predicted DBM Prevalence % (95% CI)	Odds Ratio (95% CI)	p-value
North Central (Ref.)	5.98 (5.26–6.69)	1.00	Reference
North East	6.10 (5.25–6.96)	1.02 (0.84–1.24)	0.824
North West	6.55 (5.90–7.21)	1.10 (0.94–1.30)	0.241
South East	5.30 (4.49–6.12)	0.88 (0.72–1.08)	0.229
South South	5.53 (4.74–6.32)	0.92 (0.76–1.12)	0.412
South West	5.92 (5.09–6.75)	0.99 (0.81–1.20)	0.920

Adjusted Wald Test: $F(5,2683) = 1.35, p = 0.2399$. Reference category: North Central.

The predicted prevalence of DBM ranged from 5.30% (95% CI: 4.49–6.12) in the South East to 6.55% (95% CI: 5.90–7.21) in the North West (Table 3), with none of the geopolitical regions differing significantly from North Central. The overall adjusted Wald test was not significant ($F(5,2683) = 1.35, p = 0.2399$), indicating no significant regional difference in DBM.

[Fig 3 – figure file uploaded separately, per BMC Global and Public Health figure requirements] **Fig 3.** *Double Burden of Malnutrition by Region*

Fig 3 shows a modest north–south gradient (North West ~6.6%, South East ~5.3%), but confidence intervals overlap considerably across regions, consistent with the non-significant regression results.

Table 4. *Geographic Inequalities in Double Burden of Malnutrition by State, Nigeria (Pooled DHS 2013–2024)*

State	Predicted DBM Prevalence % (95% CI)	Odds Ratio (95% CI)	p-value
Sokoto (Ref.)	4.49 (1.63–7.35)	1.00	Reference
Zamfara	5.33 (2.09–8.57)	1.20 (0.47–3.02)	0.703
Katsina	7.03 (2.93–11.12)	1.61 (0.64–4.02)	0.309
Jigawa	2.32 (0.67–3.96)	0.50 (0.19–1.35)	0.174
Yobe	2.67 (0.45–4.90)	0.58 (0.20–1.73)	0.332
Borno	2.09 (0.09–4.09)	0.45 (0.14–1.48)	0.190
Adamawa	6.04 (1.84–10.23)	1.37 (0.51–3.70)	0.538
Gombe	4.64 (1.70–7.58)	1.03 (0.40–2.65)	0.944
Bauchi	6.62 (2.80–10.43)	1.51 (0.61–3.74)	0.376
Kaduna	6.76 (4.91–8.61)	1.54 (0.74–3.20)	0.246
Kano	4.17 (2.17–6.17)	0.93 (0.40–2.13)	0.856
Kebbi	7.46 (3.12–11.80)	1.72 (0.69–4.29)	0.249
Niger	5.42 (1.52–9.31)	1.22 (0.44–3.35)	0.702
FCT Abuja	5.77 (2.23–9.32)	1.30 (0.51–3.31)	0.577
Nasarawa	7.26 (3.96–10.56)	1.67 (0.73–3.81)	0.227
Plateau	8.04 (4.30–11.79)	1.86 (0.81–4.30)	0.146
Benue	6.44 (3.74–9.14)	1.46 (0.66–3.27)	0.353
Kogi	8.70 (3.47–13.93)	2.03 (0.79–5.18)	0.139
Kwara	10.10 (3.33–16.86)	2.39 (0.88–6.50)	0.088
Oyo	5.54 (4.25–6.83)	1.25 (0.61–2.54)	0.543
Osun	4.36 (1.58–7.14)	0.97 (0.38–2.49)	0.950
Ondo	5.49 (0.94–10.04)	1.24 (0.41–3.72)	0.706
Ekiti	1.15 (0.00–2.76)*	0.25 (0.05–1.18)	0.080
Lagos	5.48 (1.02–9.94)	1.23 (0.41–3.67)	0.706
Ogun	4.90 (1.39–8.41)	1.10 (0.40–3.00)	0.858
Edo	7.91 (2.71–13.12)	1.83 (0.69–4.86)	0.227
Delta	6.83 (3.31–10.35)	1.56 (0.66–3.71)	0.315
Bayelsa	5.47 (3.15–7.79)	1.23 (0.55–2.75)	0.613

Rivers	4.93 (1.50–8.36)	1.10 (0.41–2.97)	0.844
Akwa Ibom	7.73 (5.81–9.65)	1.78 (0.87–3.66)	0.116
Cross River	4.67 (1.30–8.05)	1.04 (0.38–2.86)	0.935
Abia	4.90 (2.52–7.27)	1.10 (0.47–2.54)	0.831
Imo	3.42 (0.83–6.01)	0.75 (0.27–2.11)	0.591
Anambra	8.90 (4.59–13.21)	2.08 (0.89–4.88)	0.093
Enugu	2.83 (0.00–5.88)*	0.62 (0.17–2.26)	0.468
Ebonyi	3.38 (0.22–6.55)	0.75 (0.23–2.41)	0.623
Taraba	5.25 (1.94–8.56)	1.18 (0.46–3.02)	0.733

Overall adjusted Wald test: $F(36, 1329) = 1.32, p = 0.0969$. *Lower CI bound truncated at 0.

The predicted prevalence varied considerably across states, ranging from 1.15% in Ekiti State to 10.10% in Kwara State (Table 4). Higher prevalence was noted in Kwara, Kogi, Plateau, Kebbi and Nasarawa; lower prevalence in Borno, Jigawa and Yobe among northern states, and in Ekiti, Enugu, Imo and Ebonyi among southern states. None of the state-level odds ratios reached statistical significance, and the overall Wald test was not significant ($F(36,1329) = 1.32, p = 0.0969$), suggesting the observed differences may reflect sampling variability rather than true contextual differences once the complex survey design is accounted for.

Table 5. Top 10 and Bottom 10 States by Prevalence of Double Burden of Malnutrition (DBM), Nigeria DHS 2013, 2018 and 2024

2013

Highest Prevalence States	DBM (%)	Lowest Prevalence States	DBM (%)
Yobe	8.73	Ebonyi	1.74
Bayelsa	8.61	Benue	2.64
Kaduna	8.06	Cross River	2.78
Niger	7.40	Jigawa	3.13
Ondo	7.32	Gombe	3.37
Kwara	7.27	Enugu	3.67
Taraba	6.77	Rivers	3.96
Plateau	6.72	Delta	4.05
Lagos	6.36	Borno	4.13
Adamawa	6.04	Oyo	4.20

2018

Highest Prevalence States	DBM (%)	Lowest Prevalence States	DBM (%)
Plateau	12.19	Enugu	2.34
Katsina	9.65	Jigawa	2.65
Delta	8.16	Yobe	2.72
Rivers	8.14	Benue	3.26
Kaduna	7.92	FCT Abuja	3.64
Oyo	7.61	Ebonyi	3.81
Lagos	7.39	Borno	3.82
Bayelsa	7.35	Sokoto	4.00
Anambra	6.81	Niger	4.33
Imo	6.78	Kogi	4.35

2024

Highest Prevalence States	DBM (%)	Lowest Prevalence States	DBM (%)
Akwa Ibom	8.29	Ekiti	1.60
Kwara	7.63	Yobe	1.76
Benue	7.21	Jigawa	2.38
Kebbi	7.14	Borno	2.57
Bayelsa	6.80	Lagos	2.60
Nasarawa	6.71	Delta	3.01
Plateau	6.62	Gombe	3.55
Enugu	6.52	Kaduna	3.62
Anambra	6.25	Rivers	3.78
Kogi	6.19	Oyo	4.03

Source: Computed from pooled Nigeria DHS 2013, 2018 and 2024.

[Fig 4A – figure file uploaded separately, per BMC Global and Public Health figure requirements] **Fig 4A. Double Burden of Malnutrition by State, 2013**

[Fig 4B – figure file uploaded separately, per BMC Global and Public Health figure requirements] **Fig 4B. Double Burden of Malnutrition by State, 2018**

[Fig 4C – figure file uploaded separately, per BMC Global and Public Health figure requirements] **Fig 4C. Double Burden of Malnutrition by State, 2024**

Table 5 and Fig 4A–4C show that the highest- and lowest-prevalence states shifted across survey rounds, though Kwara, Plateau, Bayelsa, Kaduna and Akwa Ibom were consistently among the higher-prevalence states, while Jigawa, Borno, Ekiti, Enugu and Ebonyi were consistently among the lower-prevalence states. This indicates that geographical variation in DBM, while descriptively evident, did not translate into statistically significant regional or state-level inequality once the complex survey design was accounted for.

Determinants of double burden of malnutrition

Table 6. Multivariable Logistic Regression of Individual-, Household-, and Community-Level Determinants of Double Burden of Malnutrition among Mother–Child Pairs in Nigeria, Pooled NDHS 2013, 2018 and 2024

Table 6a: Individual-level factors

Variable	Category	AOR (95% CI)	p-value
Maternal age	15–24 years	1.00 (Reference)	—
	25–34 years	0.80 (0.56–1.15)	0.224
	35–49 years	0.87 (0.54–1.40)	0.572
Maternal education	No education	1.00 (Reference)	—
	Primary	1.01 (0.73–1.41)	0.940
	Secondary	0.80 (0.58–1.10)	0.170
	Higher	0.58 (0.36–0.92)	0.020
Child age	0–11 months	1.00 (Reference)	—
	12–23 months	2.71 (1.99–3.70)	<0.001
	24–59 months	2.53 (1.90–3.36)	<0.001
Child sex	Male	1.00 (Reference)	—
	Female	0.68 (0.55–0.83)	<0.001
Birth order	First birth	1.00 (Reference)	—
	2–3	1.27 (0.90–1.79)	0.182
	4–5	1.12 (0.74–1.71)	0.591
	≥6	1.08 (0.67–1.74)	0.759
ANC visits	None	1.00 (Reference)	—
	1–3 visits	0.89 (0.60–1.31)	0.550
	≥4 visits	0.86 (0.63–1.17)	0.337

Table 6b: Household-level factors

Variable	Category	AOR (95% CI)	p-value
Wealth index	Poorest	1.00 (Reference)	—
	Poorer	0.88 (0.58–1.35)	0.565
	Middle	0.67 (0.44–1.02)	0.063
	Richer	0.59 (0.37–0.92)	0.019
	Richest	0.34 (0.21–0.56)	<0.001
Household size	1–4 members	1.00 (Reference)	—
	5–7 members	0.92 (0.69–1.22)	0.544
	≥8 members	1.02 (0.75–1.39)	0.908
Sex of household head	Male	1.00 (Reference)	—
	Female	0.86 (0.64–1.17)	0.340

Table 6c: Community-level factors

Variable	Category	AOR (95% CI)	p-value
Place of residence	Urban	1.00 (Reference)	—
	Rural	1.03 (0.82–1.30)	0.792
Region	North Central	1.00 (Reference)	—
	North East	1.84 (1.20–2.82)	0.005
	North West	1.66 (1.18–2.34)	0.003
	South East	0.70 (0.48–1.01)	0.059
	South South	0.64 (0.44–0.94)	0.021
	South West	0.98 (0.66–1.44)	0.913
	South West	0.98 (0.66–1.44)	0.913
Survey year	2018	1.00 (Reference)	—
	2024	1.01 (0.82–1.25)	0.917

Model statistics: Survey-weighted logistic regression; Number of observations = 3,397; F(27,1300); p < 0.001.

Tables 6a to 6c, presented the Multivariable Logistic Regression of Individual-, Household-, and Community-Level Determinants of Double Burden of Malnutrition among Mother–Child Pairs in Nigeria. As shown in the tables, overall, the model was statistically significant ($F(27,1300) = 8.32$; $p < 0.001$). Mothers with higher education had 42% lower odds of DBM than those with no formal education (AOR =

0.58; $p = 0.020$); primary and secondary education were not significant. Compared with children aged 0–11 months, those aged 12–23 months ($AOR = 2.71$; $p < 0.001$) and 24–59 months ($AOR = 2.53$; $p < 0.001$) had substantially higher odds of DBM, and female children were significantly less likely to be affected than male children ($AOR = 0.68$; $p < 0.001$).

Household wealth showed a clear gradient: richer ($AOR = 0.59$; $p = 0.019$) and richest ($AOR = 0.34$; $p < 0.001$) households had progressively lower odds of DBM relative to the poorest, with a borderline effect for the middle category ($AOR = 0.67$; $p = 0.063$). Place of residence was not significantly associated with DBM ($AOR = 1.03$; $p = 0.792$), but region was: women in the North East ($AOR = 1.84$; $p = 0.005$) and North West ($AOR = 1.66$; $p = 0.003$) had significantly higher odds than North Central, while those in the South South had significantly lower odds ($AOR = 0.64$; $p = 0.021$). Survey year was not independently associated with DBM after adjustment ($AOR = 1.01$; $p = 0.917$), suggesting that observed year-to-year variation reflects compositional changes in the population rather than a true temporal effect.

Table 7. Joint Wald Tests for the Multivariable Logistic Regression Model of Double Burden of Malnutrition among Mother–Child Pairs in Nigeria, Pooled NDHS 2013, 2018 and 2024

Variable Group Tested	Variables Included	Adjusted Wald F-statistic	p-value	Decision
Maternal education, maternal BMI category, and child age	Maternal education (v106), BMI category (bmi_cat), Child age category (child_age_cat)	$F(5, 1322) = 11.70$	<0.001	Significant
Household wealth, place of residence, and region	Wealth index (v190), Residence (v025), Region (v024)	$F(10, 1317) = 7.41$	<0.001	Significant
Survey year	Survey year (2024 vs. 2018)	$F(1, 1326) = 0.01$	0.917	Not significant

A p -value <0.05 indicates that the corresponding group of variables contributes significantly to explaining variation in the double burden of malnutrition.

The joint Wald tests in table 7, confirm that individual-level factors (maternal education, BMI category, child age) were jointly significant ($F(5,1322) = 11.70$, $p < 0.001$), as were household and community-level factors combined ($F(10,1317) = 7.41$; $p < 0.001$), while survey year alone had no independent effect ($F(1,1326) = 0.01$; $p = 0.917$).

Discussion

The double burden of malnutrition (DBM) among mother–child pairs in the current study did not exceed 7% throughout the study period and differed significantly between time periods (2013: 5.88%, 2018: 6.79%, 2024: 5.66%). The temporal trend indicates a slight increase with fluctuation rather than a

constant downward trend, suggesting that while there may be some improvement in reducing the burden of maternal overweight/obesity and child stunting, it remains a public health problem in Nigeria.

This aligns with the view of Popkin, Corvalan, and Grummer-Strawn [8] that many LMICs are undergoing a nutrition transition with co-occurring undernutrition and overweight/obesity. It also supports the results of the Local Burden of Disease Double Burden of Malnutrition Collaborators [24], Verstraeten [4] and the World Health Organization [5], which all document the persistence of the double burden even amid some improvements in nutrition indicators globally.

The DBM result in this study is also consistent with the results of Alamu et al. [15], Adeyanju and Fadupin [16], and Ortutu [25] in Nigeria, which also reported the co-occurrence of maternal overweight and child stunting, though the current study's three survey rounds enable greater national generalisability than these state-limited studies.

The study showed no statistically significant difference in DBM by region, although significant descriptive variation existed among states, with Kwara, Anambra, Plateau and Akwa Ibom having the highest prevalence and Jigawa, Borno, Ekiti and Enugu the lowest. This suggests that observed geographic differences may reflect underlying population composition rather than geographic area per se, consistent with the general spatial-inequality literature [11,12], though this study is unable to confirm regional significance once the complex survey design is accounted for, in contrast to some prior work [26].

Higher maternal education, female child sex and residence in the South South were protective factors for DBM, while older child age and residence in the North East or North West were strong risk factors, as revealed by the multivariable analysis. The protective role of higher maternal education and wealth is in line with Bose [13], Okyere [26], and Ortutu [25], who found that more highly educated mothers and wealthier households were less prone to DBM, plausibly reflecting greater availability of nutrition information, nutrition health services, and dietary diversity in better-off households. Likewise, the higher risk among older children is consistent with Ortutu [25] and Okyere [26], who reported that risk of stunting is greatest during the complementary feeding period, when children are most vulnerable to inadequate dietary intake.

However, this study contrasts with earlier studies in which maternal age, place of residence, antenatal care utilisation and household size were significantly associated with DBM but were not so in this study after adjustment, suggesting these effects may operate indirectly through socioeconomic factors such as education and wealth.

Overall, socioeconomic inequality and regional disadvantage are key determinants of the double burden of malnutrition faced by mother–child dyads in Nigeria, and several factors often hypothesized to be associated with malnutrition are not independently significant once socioeconomic inequality and regional disadvantage are controlled for.

Theoretical interpretation of the findings

This study's findings fit with Life Course Theory and the Social Ecological Model (SEM). According to Life Course Theory, successive and cumulative exposures — both biological and socioeconomic — affect health outcomes, and early-life exposures and long-term social experiences are crucial in determining health outcomes later in life [18,19,20]. This perspective was confirmed in the present study, as important factors related to DBM prevalence were maternal education, household wealth, child age, and regional disparities — consistent with the idea that nutritional outcomes are a cumulative consequence of additional socioeconomic benefits or drawbacks rather than random or sporadic events.

The Social Ecological Model (Bronfenbrenner, 1986; McLeroy et al., 1988 cited in 21) similarly explains the study results, positing that DBM is influenced by factors interacting at different levels: the mother's education (individual level), household wealth (household level), and region of residence (community level), consistent with the SEM hypothesis that health outcomes are shaped by the interplay of individual, family, community and broader socioeconomic environmental factors [21,22,23]. Regional inequalities — especially the increased risk in the North East and North West — demonstrate the importance of contextual and structural determinants beyond the individual and household level, such as the concentration of poverty, food systems and health services.

Together, Life Course Theory and the SEM offer complementary explanations: the Life Course perspective highlights the intergenerational and cumulative nature of nutritional disadvantage, while the SEM highlights its multi-level and interactive nature. These considerations point to the need for a holistic approach to tackling the double burden of malnutrition in Nigeria, including integrated interventions targeting individuals and households, as well as structural inequalities across regions and over the life course.

Limitations

Because the data used are pooled cross-sectional data from the 2013, 2018 and 2024 NDHS, the exposure and causes of DBM could not be determined causally. Only variables available in the NDHS datasets were analyzed; confounding may have occurred, as important factors such as diet, food security, physical activity, maternal nutrition knowledge, and environmental factors were not accounted for. Some variables were derived from self-reported information, which is susceptible to recall bias. The definition of DBM used in this study was limited to maternal overweight/obesity and child stunting, excluding other forms of malnutrition that may contribute to the overall burden, such as maternal undernutrition, child overweight, or micronutrient deficiencies.

Conclusions

This study concludes that the double burden of malnutrition (DBM) among mother–child pairs continues to be a public health problem in Nigeria despite its relatively low prevalence rate. The prevalence across the 2013, 2018 and 2024 NDHS was significantly different over time, but across regions and states the

difference was not statistically significant after accounting for the complex survey design, despite noticeable descriptive differences across states. Maternal education, child age, household wealth and region of residence were found to be important determinants of DBM, with older child age and residence in the North East and North West regions associated with a higher likelihood of DBM, while higher maternal education and wealth were associated with a lower likelihood of DBM. The findings highlight the importance of integrated, multisectoral and equity-focused nutrition interventions that tackle both maternal overweight/obesity and child stunting, especially in socioeconomically poor households, to improve nutrition outcomes for mothers and children in Nigeria.

Recommendations

1. Increased efforts should be devoted to integrated nutrition programmes targeting maternal overweight/obesity and child stunting in vulnerable households in Nigeria, led by the Federal Ministry of Health in collaboration with the National Council on Nutrition and development partners.
2. State Ministries of Health and Primary Health Care Development Agencies need to reinforce and prioritize nutrition education and behaviour change communication to promote and support good nutrition during pregnancy and appropriate infant/young child feeding practices among women with low education levels.
3. The Federal Ministry of Humanitarian Affairs and Poverty Reduction (FMHAP) and state governments should scale up social protection and livelihoods programmes to boost access to nutritious foods and reduce the socioeconomic inequality associated with the double burden of malnutrition.
4. Routine growth monitoring, nutrition counselling and complementary feeding education should be increased at primary health care facilities and by health workers for mothers of children aged 12–59 months, to curb stunting and promote healthy maternal weight.
5. Surveillance systems need to be strengthened, and evidence-based state-level monitoring of the double burden of malnutrition should be institutionalised to prioritise high-risk areas for geographically targeted interventions.

Implications of the findings

While the 2024 decrease in DBM among mother–child pairs is welcome, it points to the need to develop integrated nutrition policies and programmes that tackle maternal overweight/obesity and child stunting as a single public health problem. The strong associations of DBM with maternal and child education, household wealth, child age, and regional differences suggest that investments in women's education, poverty reduction, and equity in nutrition and health services are crucial for sustainably improving maternal and child nutrition. Variations in DBM across Nigerian states suggest that more targeted and context-specific, evidence-based nutrition interventions, rather than purely national approaches, could improve the effectiveness of nutrition interventions by accounting for the geographical distribution of the problem.

Contributions to knowledge

This is the first study to estimate the double burden of malnutrition among mother–child pairs in Nigeria using the 2013, 2018 and 2024 NDHS, providing a solid evidence base on temporal trends missing from previous single-survey studies. It contributes to empirical knowledge by showing that DBM prevalence differences across time are largely related to individual, household and community characteristics rather than survey year alone, and identifies important multilevel factors (maternal education, child age, child sex, household wealth, geopolitical region) alongside considerable state-level differences, emphasizing the need for locally targeted and integrated nutrition interventions.

Declarations

Ethics approval and consent to participate

The data used for this study is secondary data obtained from publicly available de-identified data from the pooled Nigeria Demographic and Health Survey (2013, 2018 and 2024). Ethical approval and informed consent for the original surveys were obtained by the survey implementers – the National Population Commission, Nigeria, and ICF International – in line with WHO ethical and safety guidelines. This is a secondary analysis, and no institutional ethical approval was needed. The DHS Program registered and approved the data request and authorized access to and use of the data.

Consent for publication

Not applicable. This manuscript contains no individual person's data in any form (images, videos, or other identifying details).

Availability of data and materials

The datasets analysed in this study were obtained from the Nigeria Demographic and Health Survey (NDHS) and are publicly available from the DHS Program (<https://dhsprogram.com>) after registering and completing an online data request form specifying the intended use.

Competing interests

The authors declare that they have no competing interests.

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This study was conducted without any external funds or support.

Authors' contributions

SAO designed the study, provided input into study design and data analysis, and wrote the manuscript. ADO was involved in the design, coordination and critical review of the study for intellectual content.

BMO also participated in the study design and coordination and in manuscript review. HAH was involved in the study design and coordination, and was actively involved in data collection and data analysis. All authors read and approved the final manuscript and agree to be held accountable for all aspects of the work, in accordance with the recommendations of the International Committee of Medical Journal Editors.

Clinical trial registration

Not applicable. This is not a clinical trial and therefore did not need to be registered.

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Figures

CONCEPTUAL FRAMEWORK FOR THE DOUBLE BURDEN OF MALNUTRITION AMONG WOMEN AND CHILDREN IN NIGERIA (DHS 2013–2024)

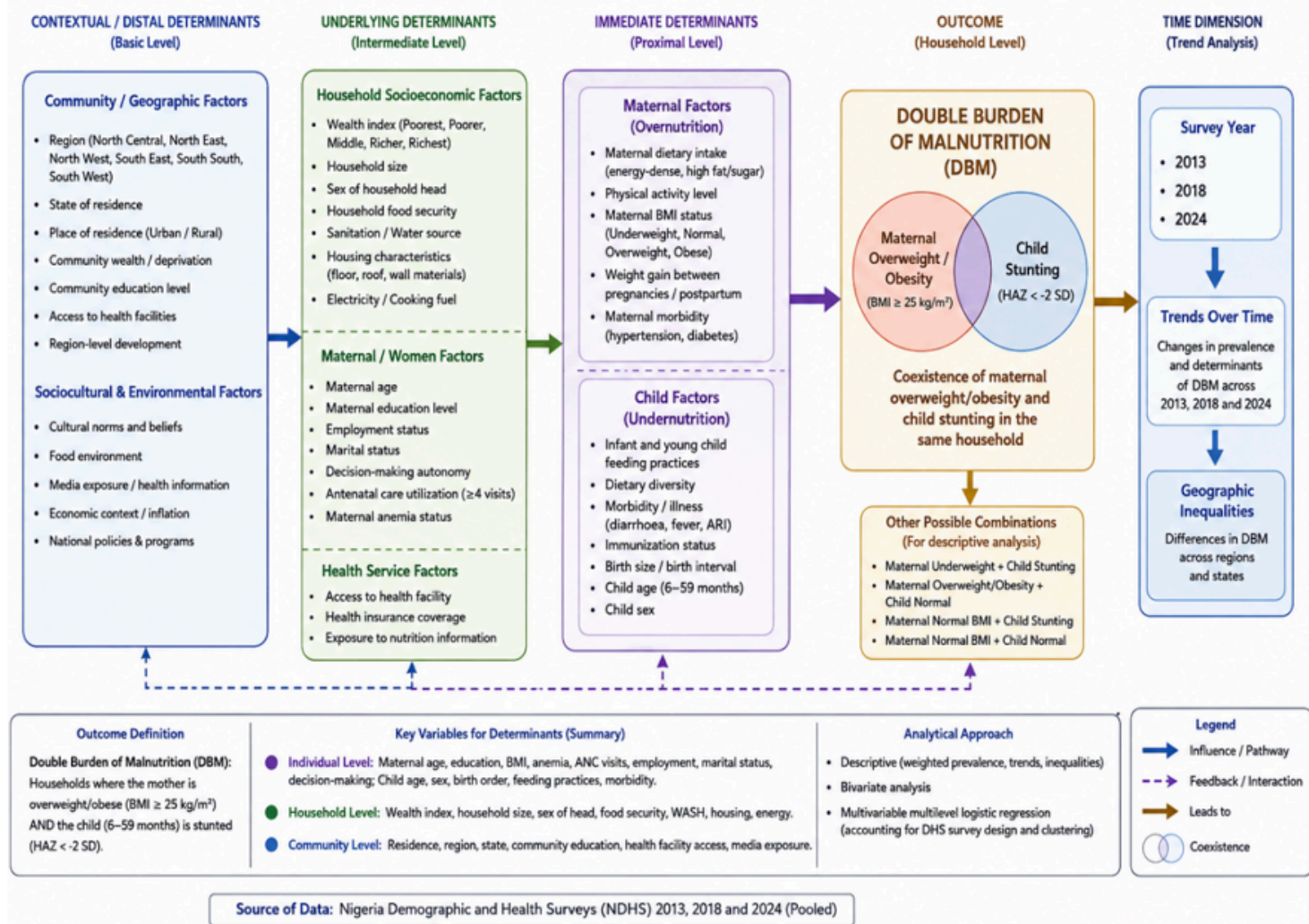


Figure 1

Conceptual Framework

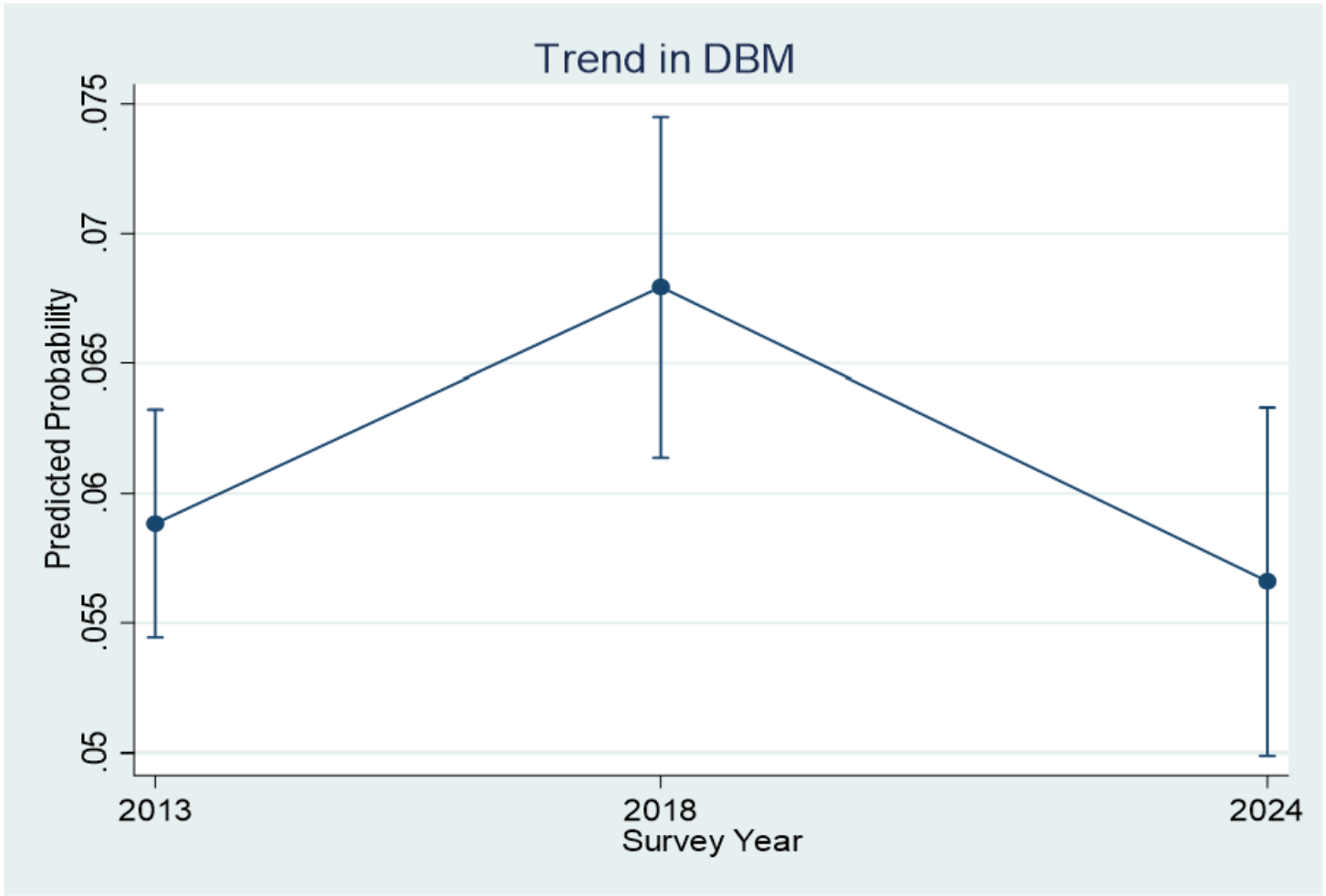


Figure 2

Trends in DBM

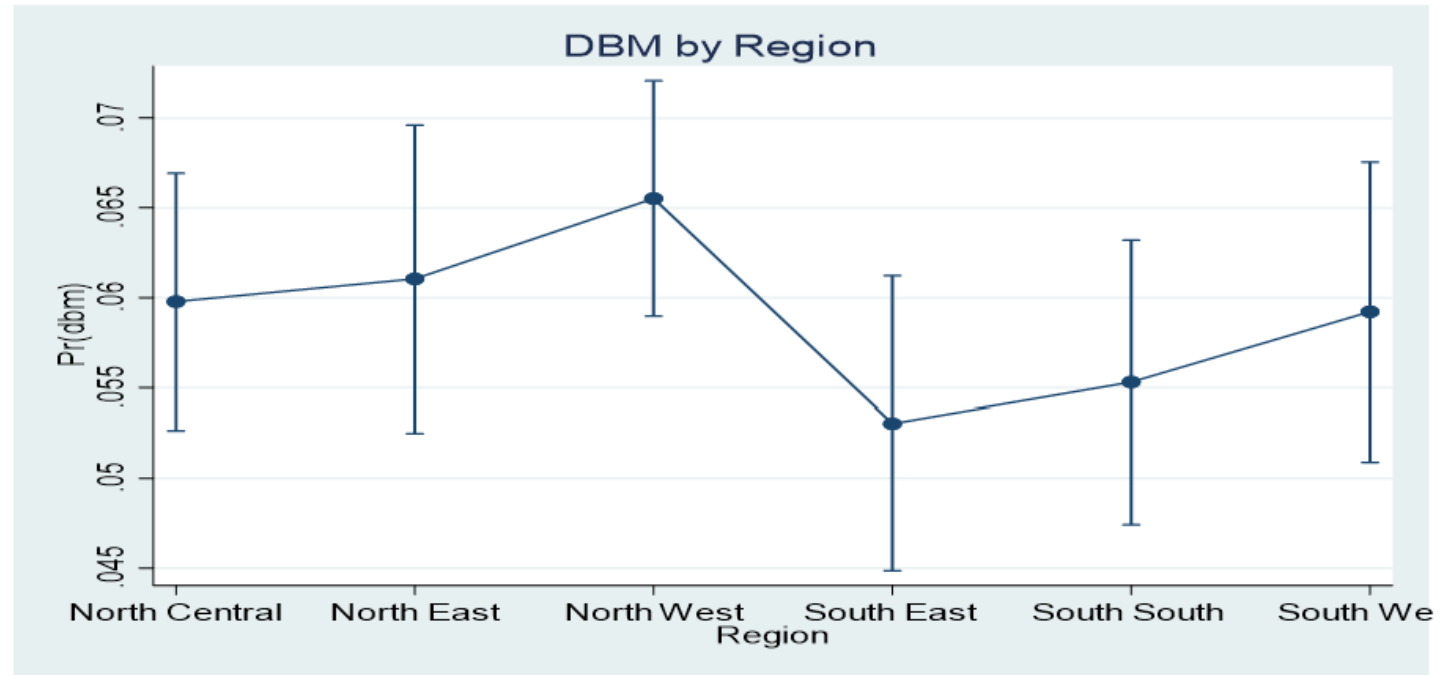


Figure 3

DBM by Region

Double Burden of Malnutrition by State, Nigeria DHS 2013

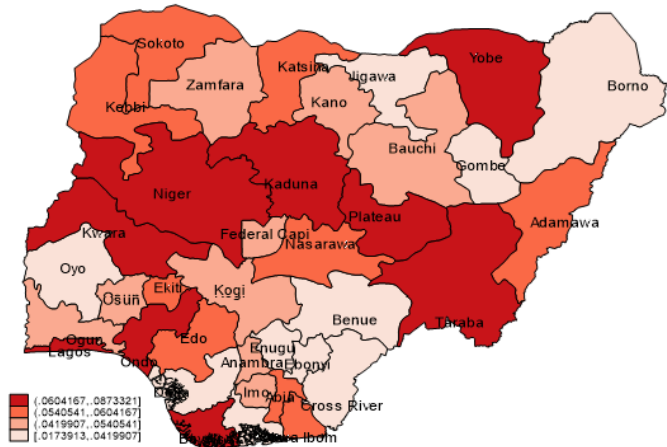


Figure 4A: Double Burden of Malnutrition by State 2013

Double Burden of Malnutrition by State, Nigeria DHS 2018

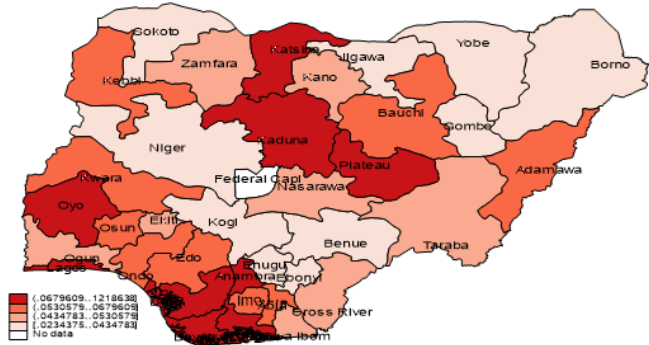


Figure 4B: Double Burden of Malnutrition by State 2018

Double Burden of Malnutrition by State, Nigeria DHS 2024

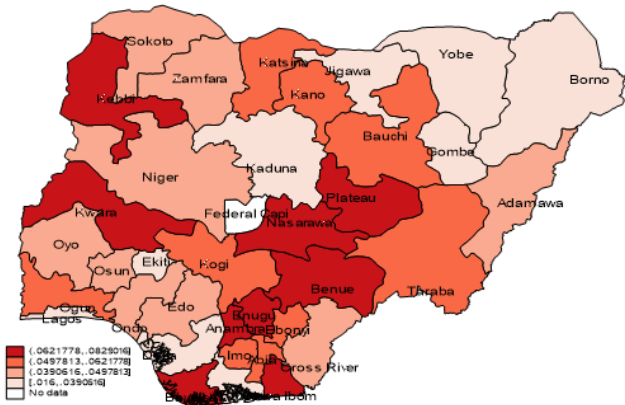


Figure 4C: Double Burden of Malnutrition by State 2024

Figure 4

A: Double Burden of Malnutrition by State 2013

4B: Double Burden of Malnutrition by State 2018

4C: Double Burden of Malnutrition by State 2024