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RESEARCH

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Rural-urban inequalities and determinants of period poverty among women of reproductive age in Nigeria: evidence from a nationwide study

Michael Mensah[1*], Sampson Opoku[2*], Obasanjo Bolarinwa[3] and Rajesh Balkrishnan[4]

Abstract

Introduction Period poverty is a multidimensional public health crisis affecting approximately 1.9 billion individuals globally, characterised by regional inequalities and inadequate access to essential menstrual absorbents and functional Water, Sanitation, and Hygiene (WASH) infrastructure. In Nigeria, socioeconomic and geographic disparities may exacerbate period poverty, particularly between rural and urban populations. However, nationally representative evidence on the magnitude and determinants of these inequalities remains limited. The primary aim of this study is to determine the current prevalence, rural-urban disparities, and intersecting structural determinants and inequalities of period poverty in Nigeria.

Methods A cross-sectional analytical design was employed using a sample of 32,775 women from the 2024 NDHS. The primary outcome, period poverty, was operationalised as the use of improvised or traditional materials during the most recent menstrual cycle. Statistical analyses included Erreygers-corrected concentration indices to quantify wealth-related disparities and Wagstaff decomposition to evaluate the relative contributions of education, geography, and wealth to overall inequality. Multivariable logistic regression models were fitted to examine factors associated with period poverty, with results reported as Adjusted Odds Ratios (AORs) and 95% Confidence Intervals (CIs) in RStudio.

Results The national prevalence of period poverty in Nigeria is 51.3%, escalating sharply to 72.1% in rural areas compared to 31.1% in urban centres. Educational attainment emerged as the most potent structural predictor; women with no formal education exhibited a ten-fold increase in the odds of period poverty nationally (AOR 10.57; 95% CI 8.73–12.8), with the risk doubling in rural contexts (AOR 20.60; 95% CI 15.1–28.2). Regional vulnerability was most pronounced in the Northwest, where rural dwellers were four times as likely to experience deprivation as those in the South (AOR 4.19; 95% CI 2.93–6.00). Additionally, rural residence independently increased the odds of period poverty by 36% (AOR 1.36; 95% CI 1.17–1.58), while the use of polluting cooking fuels (AOR 3.51; 95% CI 2.60–4.76)

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highlighted the intersection of menstrual health with broader energy poverty. Significant contributors to inequality were Educational Attainment (34.82%), Geographic Region (24.94%), Fuel Type and Energy (12.13%), Household Wealth Index (11.67%), Marital Status (8.85%), Residential Status (2.47%), Household Water Source (2.41%), Sex of Household Head (1.56%), Toilet Facility Access (1.14%).

Conclusion Period poverty in Nigeria is a systemic issue driven by the convergence of low education, rurality, and geographic location. The Wagstaff decomposition confirms that education is the largest contributor to inequality, alongside household wealth. Moving forward, for government and policymakers, implementing public health strategies must prioritise educational equity and regional infrastructure, particularly in Northern rural clusters, to ensure that menstrual health is recognised as a fundamental component of human dignity and national development.

Keywords Period poverty, Nigeria, Rural, Urban, Inequality, Menstrual pads

Introduction

Every month, approximately 1.8 to 1.9 billion individuals experience the physiological milestone of menstruation [1, 2]. However, the ability to manage this natural process with dignity remains a global privilege rather than a universally realised human right [2, 3]. The concept of period poverty encapsulates this systemic deprivation as a multidimensional public health crisis characterised by inadequate access to essential menstrual absorbents, comprehensive reproductive education, and functional Water, Sanitation, and Hygiene (WASH) infrastructure [4, 5]. While menstruation is a hallmark of reproductive health, its mismanagement due to financial and structural barriers represents a significant hurdle to achieving the Sustainable Development Goals (SDGs), specifically those targeting health equity (SDG 3), educational parity (SDG 4), and gender justice (SDG 5) [6–8]. The burden of period poverty is characterised by deep-seated geographical and socioeconomic inequalities, particularly across sub-Saharan Africa [9–11]. Unmet menstrual hygiene needs exceed 50% in countries like Burkina Faso (75%), Ethiopia (70%), and Uganda (65%) [9]. An estimated 37 million girls and women lack access to adequate menstrual products and hygiene infrastructure in Nigeria [12]. National surveys and meta-analyses indicate a stark urban-rural divide in menstrual hygiene practices; for instance, adolescent girls in urban settings often have higher odds of practising good menstrual hygiene compared to their rural counterparts [10, 13]. In rural communities, the scarcity of commercial sanitary products is compounded by a lack of private, lockable facilities and a consistent supply of clean water and soap, forcing a reliance on unhygienic traditional materials [10, 14–16]. These disparities are further driven by household wealth, where those in the lowest wealth quintiles face a double burden of economic hardship and sociocultural discrimination, often necessitating difficult trade-offs between purchasing food and essential hygiene supplies [1, 17]. The ramifications of these inequalities extend far beyond physical hygiene, impacting the sexual autonomy and educational attainment of women and girls. In Nigeria, it is estimated that more than 25% of women lack adequate access to products and private management spaces, a figure that surges to 50% in marginalised communities [1, 11]. To cope with product insecurity, many resort to unhygienic substitutes such as old rags, newspapers, or mattress stuffing, which significantly heightens the risk of urogenital and reproductive tract infections (RTIs) [4, 18, 19]. Furthermore, the desperation for sanitary materials has driven a disturbing prevalence of transactional sex, where vulnerable girls exchange sexual favours for money to buy supplies, thereby increasing their exposure to HIV and sexual violence [1, 20]. In the educational sphere, this lack of resources manifests as consistent school absenteeism, estimated to affect one in ten African girls and eventual dropout, perpetuating a cycle of socioeconomic vulnerability [1, 2, 21]. Despite the scale of this crisis, period poverty in Nigeria remains a largely silent issue, frequently obscured by sociocultural taboos and a culture of silence that frames menstruation as impure [1, 8, 21]. The first policy on menstrual health and management in Nigeria was launched in 2025 with strong initiatives to address period poverty [22]. While local NGOs have initiated fragmented interventions, there remains a critical need for up-to-date, nationally representative data to strengthen the newly developed National Menstrual Health Policy [1].

This study utilises recent evidence from the 2024 Nigeria Demographic and Health Survey (NDHS) to determine the current prevalence, inequalities, rural-urban disparities, and intersecting determinants of period poverty. Through the analyses of the unique challenges faced by women across rural and urban divides, this research provides a timely and necessary foundation for evidence-based reproductive justice and structural policy reform in Nigeria.

Methodology

Study design and data source

This study employed a cross-sectional analytical design using data from the 2024 NDHS, a nationally representative household survey implemented by the National Population Commission of Nigeria with technical support from the Demographic and Health Surveys Program. The NDHS collects comprehensive information on demographic characteristics, reproductive health, and household conditions among women of reproductive age across Nigeria. The survey utilised a stratified two-stage cluster sampling design to ensure national representativeness. In the first stage, enumeration areas were selected from the national sampling frame using probability proportional to size. In the second stage, households were systematically selected within each cluster. All women aged 15–49 years who were either permanent residents of the selected households or visitors who stayed in the household the night before the survey were eligible for interview. Sampling weights provided by the NDHS were applied to all analyses to account for the complex survey design and unequal selection probabilities, thereby ensuring nationally representative estimates [23].

Study population

The analytical sample comprised women aged 15–49 years who reported menstruation and had complete information on menstrual product use in the survey [23]. Participants with missing or incomplete data on the outcome variable or key explanatory variables were excluded from the analysis. The study focused on women with available responses to indicators of menstrual hygiene management to estimate the prevalence and distribution of period poverty in Nigeria. Analyses were conducted for the overall population and stratified by place of residence to examine differences between rural and urban populations. A total of 39,050 women were included in the survey. Out of the total, 33,037 had complete data on period poverty and were included in the study. The total weighted sample for the 32,775 participants was 32,775.

Measurement of period poverty

The primary outcome variable for this study was period poverty, operationalized using the type of menstrual product reported by respondents during their most recent menstrual period [1, 9, 20]. Within large population-based surveys such as the NDHS, menstrual product use is frequently used as a proxy indicator for menstrual health inequalities and financial barriers to menstrual hygiene management. In this study, menstrual hygiene materials were categorized as appropriate or inappropriate based on their suitability for safe menstrual management. Appropriate menstrual hygiene products included disposable sanitary pads, reusable pads, tampons, and menstrual cups, and were classified as no period poverty. Inappropriate products comprised cloth or rags, cotton wool, toilet paper, underwear only, no material, and other unspecified materials, and were classified as period poverty [9, 18, 24]. A binary variable was created and coded as 1 = no period poverty (use of appropriate menstrual hygiene products) and 0 = period poverty (use of inappropriate menstrual hygiene products).

Explanatory variables

The explanatory variables included a range of demographic, socioeconomic, and contextual characteristics identified in previous studies as determinants of menstrual hygiene practices. Individual-level factors included age, educational attainment, marital status, employment status, and exposure to mass media. Household-level characteristics included the household wealth index and household size [2, 9, 18, 25]. The wealth index, constructed in the NDHS using principal component analysis of household assets and living conditions, served as a key measure of socioeconomic status. Community-level variables included place of residence (rural or urban) and geopolitical region [2, 21, 26]. These variables were included to capture contextual differences in access to economic resources, social infrastructure, and menstrual hygiene products across geographic locations. The variables were selected from the WHO/UNICEF Joint Monitoring Programme and previous literature [1, 9, 20, 27].

Data management and statistical analysis

All analyses were conducted using survey-adjusted statistical procedures to account for the complex sampling design of the NDHS, including clustering, stratification, and sampling weights. Descriptive statistics were first used to estimate the prevalence of period poverty among women of reproductive age in Nigeria. Weighted proportions and corresponding 95% confidence intervals were calculated to describe the national prevalence of period poverty. In addition, prevalence estimates were stratified by rural and urban residence to examine geographic disparities in menstrual product use [28].

To assess socioeconomic inequalities in period poverty, concentration curves and concentration indices were employed. The concentration curve illustrates the cumulative distribution of period poverty across the population, ranked by household wealth, from the poorest to the richest. If the curve lies above the line of equality, the burden of period poverty is disproportionately concentrated among poorer women [29, 30]. The magnitude of inequality was quantified using the Erreygers-corrected concentration index, which is appropriate for binary outcome variables [31, 32].

Inequality was quantified using the Erreygers -corrected concentration index, which adjusts the standard concentration index for binary outcomes:

$$E = 4\mu\, C$$

where mu is the mean of the outcome and C is the concentration index. The standard concentration index itself is defined as:

$C = \frac{2}{\mu}\mathrm{Cov}(y, R)$where y is the health variable and R is the fractional rank by socioeconomic status. To identify the drivers of inequality, the Wagstaff decomposition was applied, expressed as:

$C = \sum_k \left(\frac{\beta_k x_k'}{\mu}\right) C_k + \frac{GC_\epsilon}{\mu}$which decomposes total inequality into contributions from observed determinants (e.g., education, wealth, geography) and an unexplained residual [29, 31, 33]. A negative index value indicates that period poverty is more prevalent among women in poorer households, whereas a positive value suggests greater concentration among wealthier groups. Inequality analyses were conducted for the entire sample and separately for rural and urban populations to identify variations in wealth-related disparities across residential contexts [31, 32].

Associations between predictors and period poverty were further examined using multivariable logistic regression based on:

$$\log\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 X_1 + \cdots + \beta_k X_k$$

Binary logistic regression models were subsequently fitted to examine the factors associated with period poverty. The results were presented as odds ratios with corresponding 95% confidence intervals [28]. Multivariable logistic regression models were estimated for the overall study population and separately for rural and urban subsamples to explore potential differences in determinants across residential settings [34, 35]. All explanatory variables were included simultaneously in the adjusted models to control for potential confounding effects. Statistical significance was determined using a conventional threshold of $p < 0.05$ [28].

Ethical considerations

The 2024 Nigeria Demographic and Health Survey protocol was reviewed and approved by the National Health Research Ethics Committee of Nigeria and the ICF Institutional Review Board. Written informed consent was obtained from all respondents prior to participation in the survey. This study utilised anonymised secondary data obtained from the Demographic and Health Surveys Program after formal approval to access the dataset. As the data are publicly available and contain no personal identifiers, additional ethical approval was not required for the present analysis.

Results

Demography of study participants: across national, rural and urban distribution

The study included a total sample of 32,775 participants, fairly evenly distributed between urban (50.6%) and rural (49.4%) areas, though period poverty was significantly higher in rural areas (72.1%) than in urban centres (31.1%). Regional disparities were pronounced, with the North West representing the largest geographic cluster (29.2%) and the highest poverty prevalence (72.9%), while the Southwest showed the lowest poverty rates (22.8%). Education significantly correlated with residence and economic status; 80.4% of those with no formal education resided in rural areas, where 91.3% lived in poverty. Household infrastructure also reflected these inequities, as 86.3% of those using unimproved water sources were rural dwellers. Furthermore, 70.4% of wood-fuel users were in rural settings, with nearly three-quarters falling below the poverty threshold, highlighting a critical intersection among rurality, energy poverty, and systemic deprivation. (Table 1; Figs. 1 and 2)

Distribution of menstrual products across rural and urban residences

Use of menstrual materials differed by residence. Disposable sanitary pads were predominantly used in urban areas (75.5%) compared with rural areas (31.6%). In contrast, cloth or rags were the main materials in rural settings (67.8%) but were less common in urban areas (24.2%). Use of alternative materials such as cotton wool and toilet paper was relatively low but slightly higher in urban populations (Table 2).

Table 3: Factors associated with period poverty in Nigeria: national estimates and urban–rural stratified analysis

Multivariate analysis identifies educational attainment and geographic location as the primary structural predictors of period poverty in Nigeria. Women with no formal education exhibited a 10-fold increase in the odds of period poverty nationally (AOR 10.57, 95% CI 8.73–12.8), with the risk increasing to 20.60 (15.1–28.2) in rural contexts. Regional disparities were persistent; the Northwest zone demonstrated the highest vulnerability, particularly among rural dwellers, who were four times as likely to experience deprivation as those in the South (AOR 4.19, 2.93–6.00). Infrastructure and energy poverty emerged as significant independent drivers, with the use of polluting cooking fuels associated with increased risk (AOR 3.51, 2.60–4.76). Also, rural residence independently increased

Table 1 Characteristics of participants across national, rural and urban residences

Variable and Category	Total Sample *N* (%)	Urban *n* (%)	Rural *n* (%)	Total Period Poverty *n* (%)	Urban Period Poverty *n* (%)	Rural Period Poverty *n* (%)
OVERALL	32,775 (100%)	16,588 (50.6%)	16,187 (49.4%)	16,823 (51.3%)	5,154 (31.1%)	11,669 (72.1%)
Age Group						
15–19	7,348 (22.4%)	3,763 (51.2%)	3,585 (48.8%)	3,602 (49.0%)	1,463 (38.9%)	2,139 (59.7%)
20–24	5,733 (17.5%)	2,789 (48.6%)	2,944 (51.4%)	2,704 (47.2%)	1,029 (36.9%)	1,675 (56.9%)
25–29	5,182 (15.8%)	2,515 (48.5%)	2,667 (51.5%)	2,630 (50.8%)	1,006 (40.0%)	1,624 (60.9%)
30–34	4,506 (13.7%)	2,231 (49.5%)	2,275 (50.5%)	2,371 (52.6%)	884 (39.6%)	1,487 (65.4%)
35–39	4,179 (12.8%)	2,214 (53.0%)	1,965 (47.0%)	2,220 (53.1%)	788 (35.6%)	1,432 (72.9%)
40–44	3,544 (10.8%)	1,854 (52.3%)	1,690 (47.7%)	1,990 (56.2%)	621 (33.5%)	1,369 (81.0%)
45–49	2,281 (7.0%)	1,222 (53.6%)	1,059 (46.4%)	1,307 (57.3%)	363 (29.7%)	944 (89.1%)
Geographic Zone						
North West	9,583 (29.2%)	3,252 (33.9%)	6,331 (66.1%)	6,986 (72.9%)	1,847 (56.8%)	5,139 (81.2%)
North East	4,902 (15.0%)	2,008 (41.0%)	2,894 (59.0%)	3,089 (63.0%)	954 (47.5%)	2,135 (73.8%)
North Central	6,231 (19.0%)	2,366 (38.0%)	3,865 (62.0%)	3,815 (61.2%)	1,053 (44.5%)	2,762 (71.5%)
South East	2,927 (8.9%)	1,360 (46.5%)	1,567 (53.5%)	694 (23.7%)	265 (19.5%)	429 (27.4%)
South South	4,037 (12.3%)	3,160 (78.3%)	877 (21.7%)	1,079 (26.7%)	674 (21.3%)	405 (46.2%)
South West	5,095 (15.5%)	4,442 (87.2%)	653 (12.8%)	1,160 (22.8%)	361 (8.1%)	799 (12.3%)
Education Level						
No Education	10,311 (31.5%)	2,023 (19.6%)	8,288 (80.4%)	9,213 (89.4%)	1,643 (81.2%)	7,570 (91.3%)
Primary	3,417 (10.4%)	1,502 (44.0%)	1,915 (56.0%)	2,202 (64.4%)	786 (52.3%)	1,416 (73.9%)
Secondary	14,119 (43.1%)	9,139 (64.7%)	4,980 (35.3%)	4,739 (33.6%)	2,394 (26.2%)	2,345 (47.1%)
Higher	4,926 (15.0%)	3,924 (79.7%)	1,002 (20.3%)	670 (13.6%)	331 (8.4%)	339 (33.8%)
Marital Status						
Never in Union	10,340 (31.6%)	6,497 (62.8%)	3,843 (37.2%)	3,623 (35.0%)	2,274 (35.0%)	1,349 (35.1%)
Currently in Union	20,827 (63.5%)	9,088 (43.6%)	11,739 (56.4%)	12,426 (59.7%)	2,617 (28.8%)	9,809 (83.6%)
Formerly in Union	1,607 (4.9%)	1,003 (62.4%)	604 (37.6%)	776 (48.3%)	263 (26.2%)	513 (84.9%)
Sex of HH Head						
Male	26,150 (79.8%)	12,085 (46.2%)	14,065 (53.8%)	14,630 (55.9%)	4,314 (35.7%)	10,316 (73.3%)
Female	6,624 (20.2%)	4,503 (68.0%)	2,121 (32.0%)	2,193 (33.1%)	840 (18.7%)	1,353 (63.8%)
Wealth Index						
Low (Poorest)	10,908 (33.3%)	1,468 (13.5%)	9,440 (86.5%)	9,325 (85.5%)	1,142 (77.8%)	8,183 (86.7%)
Middle	6,448 (19.7%)	2,748 (42.6%)	3,700 (57.4%)	3,694 (57.3%)	1,141 (41.5%)	2,553 (69.0%)
High (Richest)	15,417 (47.0%)	12,371 (80.2%)	3,046 (19.8%)	3,805 (24.7%)	2,871 (23.2%)	934 (30.7%)
Water Source						
Unimproved	7,110 (22.4%)	974 (13.7%)	6,136 (86.3%)	5,802 (81.6%)	709 (72.8%)	5,093 (83.0%)
Improved	24,666 (77.6%)	14,923 (60.5%)	9,743 (39.5%)	10,660 (43.2%)	4,213 (28.2%)	6,447 (66.2%)
Toilet Facility						
Unimproved	10,160 (31.8%)	1,902 (18.7%)	8,258 (81.3%)	7,564 (74.4%)	1,137 (59.8%)	6,427 (77.8%)
Improved	21,826 (68.2%)	14,375 (65.9%)	7,451 (34.1%)	8,789 (40.3%)	3,838 (26.7%)	4,951 (66.4%)
Cooking Fuel						
Clean Fuels	8,748 (27.5%)	7,602 (86.9%)	1,146 (13.1%)	1,475 (16.9%)	1,163 (15.3%)	312 (27.2%)
Wood	18,015 (56.7%)	5,329 (29.6%)	12,686 (70.4%)	12,363 (68.6%)	2,766 (51.9%)	9,597 (75.6%)
Charcoal	3,453 (10.9%)	2,750 (79.6%)	703 (20.4%)	1,284 (37.2%)	973 (35.4%)	311 (44.2%)
Other Unclean	1,560 (4.9%)	353 (22.6%)	1,207 (77.4%)	1,330 (85.2%)	252 (71.4%)	1,078 (89.3%)

the odds of period poverty by 36% (AOR 1.36(1.17–1.58) after adjusting for household wealth, indicating that geographic barriers exist independent of individual economic status. (Table 3)

Weighted prevalence, absolute/relative gaps, and inequality indices for top predictors

Analysis of inequality indices confirms that educational attainment and wealth are the most significant drivers of period poverty in Nigeria, with socioeconomic disparities heavily skewed against the most disadvantaged cohorts. Education exhibited the highest absolute gap (0.7574) and relative ratio (6.5667), where women with

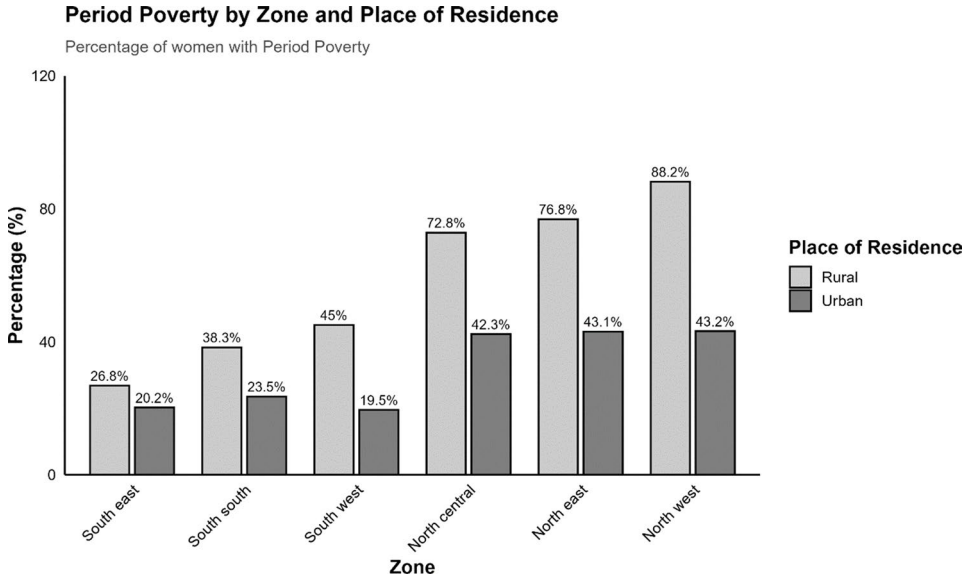


Fig. 1 Distribution of period poverty across zones stratified by residence

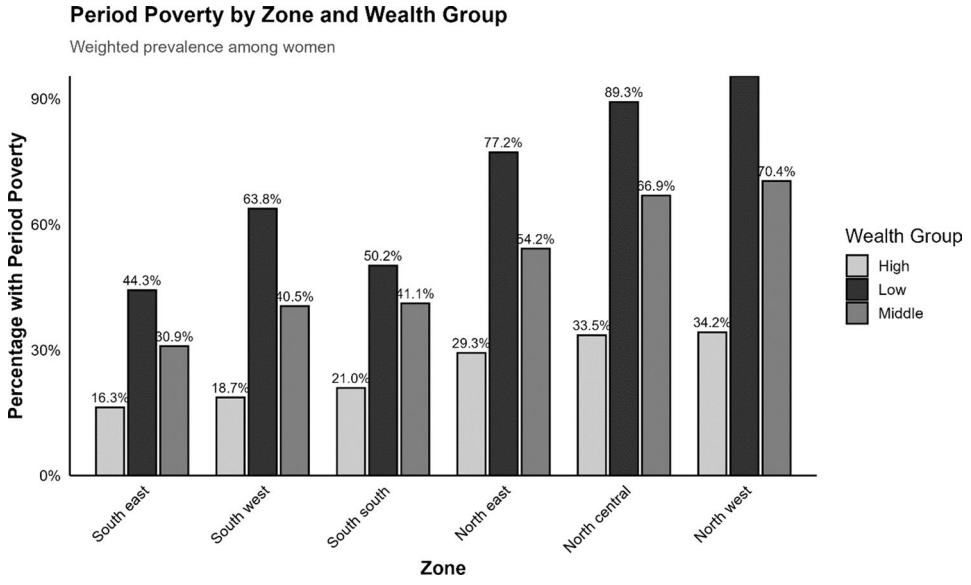


Fig. 2 Prevalence of period poverty across regions stratified by wealth

no formal education reported a prevalence of 89.35% compared to 13.61% among those with higher education. This profound inequity is further evidenced by a Concentration Index (CI) of -0.3418 and an Erreygers Index (EI) of -0.7018, indicating that period poverty is intensely concentrated among the uneducated. Similar patterns persist across wealth quintiles, with the poorest participants at 85.49%, nearly 3.5 times higher than the richest quintile (24.68%). Geographic and residential status also serve as critical axes of inequality. The North West zone recorded a prevalence of 72.91%, resulting in an absolute gap of 0.5014 compared to the South West (22.77%). Furthermore, rural residents faced a significantly higher burden (72.10%) than urban dwellers (31.07%), with a relative ratio of 2.3202. The negative CI and EI values across all socioeconomic and geographic indicators, particularly for male-headed households (CI: -0.2847) and rurality, statistically support the view that period poverty is a pro-poor phenomenon. (Table 4; Fig. 3).

Wagstaff decomposition of inequality in period poverty: individual and aggregated contributions

Wagstaff decomposition analysis identifies educational attainment as the most substantial contributor to the observed socioeconomic inequality in period poverty, accounting for 34.82% of the total concentration. Within

Table 2 Distribution of menstrual products across rural and urban residences

Material	Total Sample (*N* = 32,775)	Urban (*n* = 16,588)	Rural (*n* = 16,187)
	Total *n* (%)	*n* (%)	*n* (%)
Disposable Pads	17,631 (53.8%)	12,522 (75.5%)	5,109 (31.6%)
Cloth / Rags	14,991 (45.7%)	4,011 (24.2%)	10,980 (67.8%)
Cotton Wool	607 (1.9%)	417 (2.5%)	190 (1.2%)
Toilet Paper	503 (1.5%)	326 (2.0%)	177 (1.1%)
Reusable Pads	769 (2.3%)	441 (2.7%)	328 (2.0%)
Underwear Only	330 (1.0%)	63 (0.4%)	267 (1.6%)
Tampons	48 (0.1%)	36 (0.2%)	12 (0.1%)
Nothing Used	79 (0.2%)	30 (0.2%)	49 (0.3%)
Menstrual Cup	29 (0.1%)	11 (0.1%)	18 (0.1%)
Other	43 (0.1%)	31 (0.2%)	12 (0.1%)

this group, higher education (20.23%) and secondary education (16.89%) exerted the strongest negative individual contributions, indicating that increasing educational levels significantly reduces the concentration of period poverty among the disadvantaged. Geographic region emerged as the second most influential factor group, contributing 24.94% to the overall inequality. The South East (9.41%) and North East (5.85%) regions made the largest regional contributions, suggesting that geographic location remains a primary axis of disparity in access to menstrual health care. Socioeconomic and infrastructural proxies further explain the remaining distribution of inequality. Fuel type and the wealth index accounted for 12.13% and 11.67% of the contribution, respectively, with high wealth status alone reducing inequality by 12.77%. Although residence (2.47%) and water source (2.41%) collectively contributed less, the individual effect

Table 3 Factors associated with period poverty in Nigeria: national estimates and urban–rural stratified analysis

Variable and Category	National COR (95% CI)	Urban COR (95% CI)	Rural COR (95% CI)	National AOR (95% CI)	Urban AOR (95% CI)	Rural AOR (95% CI)
GEOGRAPHIC ZONE						
South South (Ref)	1	1	1	1	1	1
North West	7.38 (5.93–9.17)	2.47 (1.88–3.24)	12.02 (8.24–17.52)	2.45 (2.01–2.98)	1.68 (1.32–2.13)	4.19 (2.93–6.00)
North East	4.67 (3.76–5.81)	2.46 (1.83–3.32)	5.35 (3.92–7.32)	1.01 (0.81–1.25)	0.86 (0.65–1.14)	1.56 (1.11–2.18)
North Central	4.33 (3.52–5.33)	2.38 (1.84–3.10)	4.32 (3.19–5.84)	2.09 (1.77–2.47)	2.13 (1.75–2.60)	2.40 (1.81–3.18)
South East	0.85 (0.68–1.06)	0.82 (0.64–1.05)	0.59 (0.43–0.81)	0.58 (0.48–0.69)	0.65 (0.51–0.81)	0.72 (0.54–0.95)
South West	0.81 (0.68–0.96)	0.79 (0.64–0.97)	1.32 (0.88–1.97)	1.10 (0.92–1.30)	1.03 (0.86–1.22)	0.97 (0.60–1.57)
EDUCATION LEVEL						
Higher (Ref)	1	1	1	1	1	1
No education	53.23 (44–64.3)	13.49 (10.6–17.2)	96.33 (71–130.9)	10.57 (8.73–12.8)	5.47 (4.23–7.06)	20.60 (15.1–28.2)
Primary	11.49 (10–13.2)	6.88 (5.77–8.20)	15.88 (12.1–20.8)	4.62 (3.96–5.39)	4.06 (3.35–4.93)	6.54 (4.98–8.59)
Secondary	3.21 (2.87–3.59)	2.57 (2.28–2.90)	4.17 (3.25–5.34)	2.19 (1.93–2.49)	2.12 (1.85–2.44)	2.79 (2.13–3.66)
WEALTH INDEX						
High (Ref)	1	1	1	1	1	1
Low (Poorest)	17.99 (15.4–21.0)	5.65 (4.37–7.29)	18.41 (14.8–22.8)	2.57 (2.17–3.04)	1.98 (1.56–2.51)	2.60 (2.05–3.28)
Middle	4.09 (3.67–4.57)	3.20 (2.77–3.69)	3.94 (3.30–4.69)	1.46 (1.29–1.65)	1.62 (1.37–1.91)	1.42 (1.18–1.71)
COOKING FUEL						
Clean (Ref)	1	1	1	1	1	1
Wood	10.79 (9.6–12.1)	4.79 (4.16–5.51)	14.31 (10.9–18.8)	1.87 (1.64–2.14)	2.24 (1.94–2.60)	1.78 (1.36–2.33)
Other Polluting	28.43 (21.6–37.5)	7.73 (5.21–11.5)	52.33 (34.1–80.3)	3.51 (2.60–4.76)	3.71 (2.38–5.80)	3.38 (2.16–5.27)
SEX OF HH HEAD						
Male (Ref)	1	1	1	1	1	1
Female	0.39 (0.36–0.43)	0.72 (0.64–0.80)	0.30 (0.25–0.35)	0.87 (0.78–0.97)	0.93 (0.82–1.05)	0.77 (0.65–0.90)
SANITATION						
Water (Unimproved)	5.83 (4.84–7.01)	2.38 (1.76–3.22)	3.66 (2.92–4.59)	1.36 (1.17–1.59)	1.00 (0.77–1.31)	1.50 (1.25–1.79)
Toilet (Unimproved)	4.32 (3.80–4.91)	2.33 (1.95–2.78)	2.47 (2.05–2.97)	1.14 (0.99–1.30)	1.08 (0.89–1.32)	1.27 (1.07–1.51)
MARITAL STATUS						
Never Union (Ref)	1	1	1	1	1	1
Currently in Union	2.74 (2.54–2.96)	1.63 (1.47–1.79)	3.38 (3.02–3.79)	1.39 (1.23–1.58)	1.19 (1.00–1.42)	1.57 (1.30–1.88)
Formerly in Union	1.73 (1.52–1.96)	1.96 (1.67–2.30)	1.57 (1.27–1.94)	1.37 (1.12–1.68)	1.31 (1.03–1.67)	1.50 (1.08–2.07)
RESIDENCE						
Urban (Ref)	1	—	—	1	—	—
Rural	5.73 (5.02–6.55)	—	—	1.36 (1.17–1.58)	—	—

Table 4 Weighted prevalence, absolute/relative gaps, and inequality indices for top predictors (*N* = 32,775)

Variable and Subgroup	Prevalence (%)	SE	Abs Gap	Rel Ratio	Concentration Index (CI)	Erreygers Index (EI)
EDUCATIONAL LEVEL			0.7574	6.5667	-0.3418	-0.7018
No education	89.35%	0.0072				
Primary	64.42%	0.0121				
Secondary	33.57%	0.0076				
Higher	13.61%	0.0065				
WEALTH INDEX			0.6081	3.4644	-0.3163	-0.6494
Low (Poorest)	85.49%	0.0082				
Middle	57.29%	0.0122				
High (Richest)	24.68%	0.0065				
GEOGRAPHIC REGION			0.5014	3.2021	-0.2597	-0.5333
North West	72.91%	0.0178				
North East	63.02%	0.021				
North Central	61.23%	0.0199				
South South	26.73%	0.0127				
South East	23.72%	0.0165				
South West	22.77%	0.0105				
RESIDENTIAL STATUS			0.4103	2.3202	0.0924	0.1897
Rural	72.10%	0.0111				
Urban	31.07%	0.0085				
SEX OF HH HEAD			0.2284	1.6886	-0.2847	-0.5846
Male	55.95%	0.009				
Female	33.11%	0.0087				

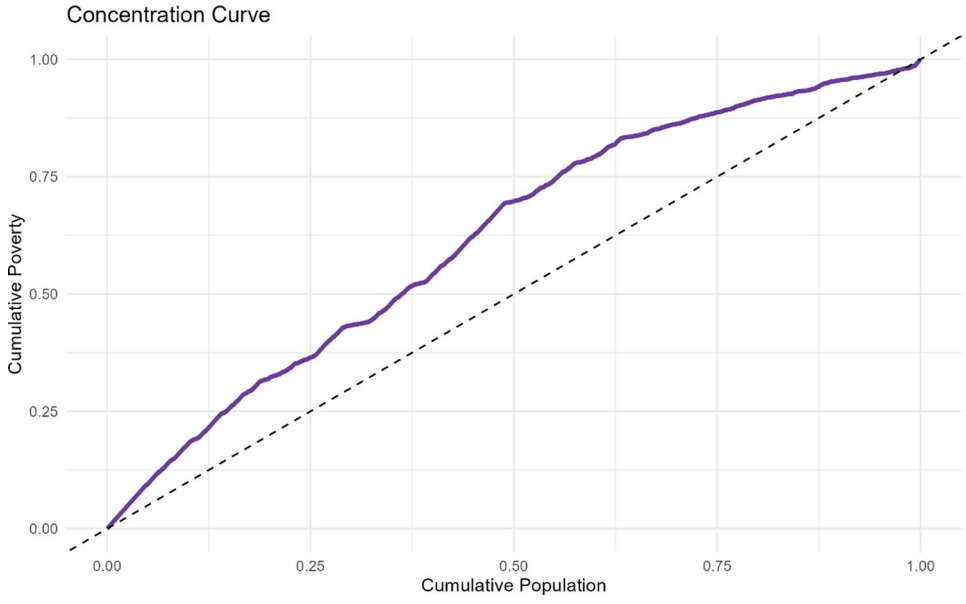


Fig. 3 Distribution of the concentration curve

of rurality (4.89%) remains a statistically significant factor in perpetuating pro-poor concentration. Collectively, these findings demonstrate that over 70% of the inequality in period poverty is driven by the intersection of education, regional location, and household wealth. (Table 5)

Discussion

The findings of this research provide a comprehensive evaluation of the structural drivers of period poverty in Nigeria and demonstrate that menstrual inequity is a significant public health challenge defined by systemic socioeconomic and geographic barriers. A national prevalence of nearly 50% indicates that half of the menstruating population lacks access to standardised hygiene

Table 5 Wagstaff decomposition of inequality in period poverty: individual and aggregated contributions

Factor Group & Specific Variable	Estimate	Std. Error	t-value/F statistics	Contribution (%)
#EDUCATION *	—	—	55.5709	34.82%
Higher Education	-2.6032	0.0957	-27.1917	20.23%
Secondary Education	-1.7785	0.0784	-22.6992	16.89%
Primary Education	-0.8702	0.0807	-10.7845	8.02%
#REGION *	—	—	39.8	24.94%
South East	-1.256	0.0993	-12.6494	9.41%
North East	-0.8337	0.106	-7.8682	5.85%
South West	-0.7675	0.1031	-7.4471	5.54%
South South	-0.661	0.1016	-6.5076	4.84%
North Central	-0.0981	0.0943	-1.0405	0.77%
#FUEL TYPE	—	—	19.3662	12.13%
#WEALTH INDEX *	—	—	18.6294	11.67%
High (Richest)	-1.3743	0.08	-17.1696	12.77%
Middle	-0.7098	0.0719	-9.8667	7.34%
#MARITAL STATUS	—	—	14.1212	8.85%
#RESIDENCE *	—	—	3.9481	2.47%
Rural	0.4848	0.0738	6.5708	4.89%
#WATER SOURCE	—	—	3.8536	2.41%
#SEX OF HH HEAD *	—	—	2.4881	1.56%
Female	-0.2288	0.0496	-4.6099	3.43%
#TOILET FACILITY	—	—	1.8233	1.14%

#Aggregate group (F- statistics were computed for aggregate groups)

materials. This burden escalates to nearly three-quarters of the population in rural settings. This identifies a significant lag in Nigeria compared to other sub-Saharan African contexts. For instance, the prevalence of 45% to 65% among similar low-income groups in Ethiopia, as reported, and the 30% to 40% observed in Kenya following policy interventions, suggest that Nigeria's current trajectory remains stalled [9, 13]. In the current study, nearly 46% do not use disposable sanitary pads. A previous multicounty study found that in Nigeria, 37% of women do not use sanitary pads, a figure that mirrors the significant barriers found in Rajasthan (54%) and Ethiopia (41%), while contrasting with the higher utilisation rates observed in Kinshasa and Ghana. [10, 21] These disparities are consistently linked to household wealth, as evidenced by negative concentration indices (CCIs) across all analysed nations, highlighting that the most basic requirements for menstrual dignity are heavily concentrated among the affluent. The results of the Wagstaff decomposition are particularly instructive as they identify educational attainment as the primary contributor to this inequality, followed closely by geographic regionality. While urban-focused interventions in South Africa have successfully reduced rural period poverty rates to approximately 40%, these data suggest that period poverty in Nigeria is not an isolated economic issue but is instead deeply embedded in the wider landscape of national developmental deficits. In Nigeria, educational attainment and wealth are the primary structural drivers of menstrual inequity, accounting for 34.82% of inequality in period poverty. These findings are consistent with multi-country data, in which wealth is typically dominant, including a previously reported 32% contribution in Nigeria. The extreme prevalence gap between uneducated (89.35%) and highly educated women (13.61%) suggests that education's role is more pronounced here than in Ghana or Indonesia [10, 36]. While wealth remains a significant contributor at 11.67%, its impact appears secondary to and mediated by educational status. This aligns with the multicounty Wealth Concentration Index of −0.586 for pad non-use [10], indicating that while commercial product access reflects deep economic exclusion, the structural capacity to manage menstruation is fundamentally dictated by literacy and schooling [10, 17, 19]. The most prominent finding is the protective effect of formal education against menstrual deprivation. Women with no formal schooling face high odds of experiencing period poverty nationally, a risk that increases significantly in rural contexts. This educational penalty suggests that schooling provides more than just health literacy, as it likely serves as a gateway to the economic agency and supply chain access required to obtain standardised products. While studies in Ethiopia have noted similar links between education and menstrual hygiene, the disparity in Nigeria is notably large. In rural areas, reliance on cloth or rags is almost universal among people with low incomes, reflecting their complete exclusion from modern markets outside the formal education system [15, 16, 37].

Geographic location also remains a persistent axis of inequality that exists independently of household wealth. The Northwest zone exhibits the highest vulnerability, where rural residents are four times as likely to experience deprivation as those in the southern regions. This regional divide indicates that localised factors, such as market accessibility and inflation in essential goods, play a critical role in menstrual health outcomes [6, 9, 20]. Unlike in some emerging economies, where wealth is the sole determinant of access to health care, geography in Nigeria imposes a distinct structural barrier. The concentration of poverty in the northern regions is statistically confirmed by the negative indices calculated in this study, which suggests that national averages frequently mask severe subnational crises.

The current study focuses on the role of geography, with rural residence significantly compounding these disadvantages, resulting in a prevalence of 72.10% compared to 31.07% in urban centers. The urban-rural divide accounts for 16% of MHM inequality, serving as a pro-affluent driver that exacerbates the wealth gap, a trend

mirrored in Ethiopia but contrasting with the pro-poor effects observed in Ghana and Kenya [9, 10]. Our study finds that rural residence independently increases the odds of period poverty by 36%, reinforcing the multi-country evidence that geography imposes structural barriers beyond individual economic status. This suggests that while urban settings offer a relative residential advantage, rural Nigerian women face a unique double burden in which geographic isolation and a lack of secure, lockable sanitation facilities (CCI −0.54) converge to intensify deprivation, primarily in Northern and rural Nigeria. Furthermore, this study identifies a clear intersection between period poverty and broader infrastructure deficits. The association between the use of polluting cooking fuels and increased odds of period poverty suggests that menstrual hygiene is part of a wider deprivation cluster. This finding aligns with a previous study [38] which found that menstrual health is inseparable from water and sanitation infrastructure. For the rural poor in Nigeria, the burden is compounded because they lack both the financial means for disposable products and the clean water needed to maintain reusable alternatives safely. This infrastructure gap explains why coping mechanisms vary by urbanised access rather than just income.

Compared to global trends, the situation in rural Nigeria shows a concerning stagnation. Data from Kenya [9, 10] reported show higher rates of standardised product use across similar wealth quintiles, likely due to targeted policy interventions such as tax exemptions. In contrast, the extreme concentration of period poverty among the Nigerian poor highlights a significant policy void. The reliance on improvised materials such as toilet paper and cotton wool in urban settings, compared with the near-exclusive use of rags in rural areas, further illustrates how geography dictates the quality of menstrual hygiene management.

Implications for policy

The evidence from this study suggests that addressing period poverty requires a shift from simple product distribution toward integrated structural reform. Because education and regionality account for nearly 60% of the observed inequality, interventions must be multisectoral. One primary recommendation is to integrate menstrual health into the universal basic education framework, which should include providing free materials to mitigate the extreme risks faced by uneducated women [4, 20, 27]. Additionally, the government should consider regional subsidies or supply chain incentives specifically for the northern zones to lower the cost of standardised products. Governments, NGOs, and Institutions can model programmes providing free pads for students in basic and Senior high schools, as implemented by some countries to reduce the burden and impact of period poverty. Finally, because period poverty is linked to infrastructure deficits, menstrual health should be a core component of rural water and energy development projects to ensure that women have access to clean water for dignified hygiene [1, 39].

Strengths and limitations

A major strength of this study is the use of a large, nationally representative dataset, which enables a robust stratified analysis of urban and rural populations. The application of the Wagstaff decomposition provides a more nuanced understanding of how specific factors contribute to the concentration of inequality, offering greater depth than standard regression models alone. However, the study is limited by its cross-sectional design, which precludes establishing a causal relationship between the identified predictors and period poverty.

Conclusion

This research confirms that period poverty in Nigeria is a systemic issue driven by the convergence of lack of education, rurality, and geographic location. The findings demonstrate that menstrual inequity is a pro-poor phenomenon that remains deeply entrenched in the northern regions and among those with the least social capital. While individual wealth is a factor, the structural barriers of geography and education are the most potent predictors of deprivation. Moving forward, public health strategies must prioritise educational equity and regional infrastructure to ensure that menstrual health is recognised as a fundamental component of human dignity and national development.

Abbreviations

DHS	Demographic Health Survey Rate
SDG	Sustainable Development Goals
SSA	Sub-Saharan Africa
WHO	World Health Organization

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Author contributions

All authors contributed to the study. MM conceptualized and designed the study. SO, RB and MM led the data curation, statistical modeling, and interpretation of results. SO and JO developed the methodology and drafted the initial manuscript. RB, SO, and MM contributed to data analysis, validation of results, and critical revision of the methods and results sections. All authors read, revised, and approved the final version of the manuscript.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

Not applicable. This study was based on secondary analysis of publicly available, aggregated, and fully anonymized country-level data. The dataset contains no individual identifiers or personal information; therefore, ethical approval and participant consent were not required.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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