







# Alarming disparities of adolescent motherhood in Nigeria: results from 36 states and the Federal Capital Territory

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## ABSTRACT

**Importance** Nigeria has a population of 233 million people and high rates of adolescent motherhood. Reduction of adolescent motherhood is a priority and primarily aligns with the sexual and reproductive health target (indicator 3.7.2) in the specific United Nations Sustainable Development Goals (SDGs).

**Objective** This study examined the trends and social disparities of health impacting adolescent motherhood at the state level.

**Design, settings and participants** The study analysed 24 668 adolescent females aged 15–19 years, drawn from 36 states and the Federal Capital Territory (FCT) using four Nigerian Demographic and Health Surveys (2003–2018). This study estimated the population-weighted prevalence of adolescent motherhood and employed the average annual rate of change (AARC) to compute the state-level trends in the prevalence. The normalised concentration index was also used to understand the sociodemographic inequalities.

**Results** The national prevalence of adolescent motherhood is 18.73%, with substantial variation in AARC and a normalised concentration index across states in different geopolitical zones. The highest prevalence of adolescent motherhood was observed in Bauchi State in the North-East at 40.65%, while the lowest was in Lagos in the South-West at 1.1%. The AARC in Bauchi was +1.7%, while in Lagos it was reported at –9.96%. Out of the 36 states and FCT, 15 (40.5%) either experienced an increasing prevalence of adolescent motherhood (29.7%) or a slow decline (10.8%) while 22 (59.5%) showed progress. With respect to the distribution of adolescent motherhood, most of the high-burden states had a negative normalised concentration index for wealth (92%), education (92%) and area of residence (72%). Moreover, highly statistically significant variations were observed between high-burden states in the North and low-burden states in the South for wealth, education, rurality, child marriage, age at first child and polygyny.

**Conclusions** Adolescent motherhood remains persistently high in Nigeria, particularly in the northern part of the country, due to early marriage, intergenerational poverty and a lack of education. This necessitates scaling up state-specific health education programmes targeting adolescent girls in schools and government policy, enforcing the legal age of marriage to achieve the SDG 3.7.2 target.

## WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ The regional trends in adolescent motherhood in Nigeria are known, but the comprehensive state-level geographical variation in time trends and sociodemographic disparities in the prevalence of adolescent motherhood in the country, using sufficient trend data points, are unknown.

## WHAT THIS STUDY ADDS

⇒ This study revealed that, despite the declining trends in the overall prevalence of adolescent motherhood, significant state-level variations persisted, with some states exhibiting slower declines (eg, Enugu, Rivers, Kaduna, etc), while others experienced an increase (eg, Ebonyi, Anambra, Oyo, etc), and most states showing alarming disparities in adolescent motherhood across social factors such as wealth, education and residence.

## HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Our findings will help international, federal and state policymakers in targeting resources and implementing evidence-based interventions for vulnerable states, potentially reducing inequalities, healthcare expenditures and prevalence rates.

## INTRODUCTION

Adolescent motherhood constitutes a global public health problem<sup>1 2</sup> and imposes significant economic, health and social burdens on mothers, newborn children, their families and society.<sup>3 4</sup> Adolescent pregnancy and childbirth complications remain the major cause of mortality among female adolescents, emphasising the critical need for thorough sexual and reproductive health interventions to address this challenge.<sup>5 6</sup> An estimated 20 million adolescent girls aged 15–19 years become pregnant yearly, with 99% of adolescent maternal mortality occurring in low- and middle-income countries (LMICs).<sup>2 5</sup>

Both adolescent mothers and their children experience elevated risks of adverse health outcomes, including obstetric complications,<sup>7</sup> and for children, an increased risk of neonatal, infant and under-five mortality, anthropometric failure, anaemia and infectious diseases.<sup>8</sup> Considering the consequences of adolescent motherhood, the need to support adolescents to delay pregnancy is identified as a crucial aspect of both the 2030 United Nations (UN) agenda for Sustainable Development Goals (SDGs) indicator 3.7.2, which relates to the reduction of adolescent motherhood,<sup>9</sup> and the UN Global Strategy for Women's, Children's and Adolescents' Health.<sup>10</sup> The mentioned strategies emphasise the reduction of adolescent pregnancy by improving access to sexual and reproductive health services and recommend that their member countries monitor progress throughout the targeted timeframe.

Nigeria, the most populous country in sub-Saharan Africa, continues to have a significantly high prevalence of adolescent motherhood.<sup>11</sup> A multinational study reported that the prevalence of adolescent motherhood in Nigeria decreased at an annual rate of 1.35%, dropping from 25.2% in 1990 to 18.09% in 2018. However, one of the limitations of the study was the lack of focus on subnational geographical variation in the prevalence of adolescent motherhood, which is particularly important in a large country such as Nigeria.<sup>11</sup> Understanding this variation is crucial for implementing tailored interventions and accelerating progress in reducing adolescent motherhood. The WHO strategic guidelines aim to prevent adolescent motherhood in LMICs and recommend more research in diverse settings and specific geographical locations within a country to implement more targeted interventions.<sup>12</sup>

The researchers identified only two studies that provided subnational-level data on adolescent motherhood in Nigeria.<sup>2 13</sup> Akombi-Inyang and colleagues<sup>13</sup> conducted a study on regional trends in adolescent pregnancy, using the Nigeria Demographic and Health Survey (NDHS) data from 2008 to 2018. They reported a decrease in adolescent motherhood across all six geopolitical zones, except in the South-East. Beyond evaluating trends at the subnational level, their study focused on a regional scale rather than state-level estimates.<sup>13</sup> Another Nigerian study used the NDHS dataset to report state-level data on the spatial distribution of adolescent motherhood. However, the study relied on a single survey dataset (2018) and did not analyse yearly trends in adolescent motherhood at the state level.<sup>2</sup> Therefore, providing a comprehensive account of state-level prevalence and trends, using sufficient trend data, has yet to be undertaken to understand state-level progress in reducing adolescent motherhood in Nigeria.

In addition to understanding state-level variation, it is also important to examine disparities in adolescent motherhood with respect to sociodemographic factors. This will help us to understand how these factors influence prevalence within geographical states, thereby aiding in

tailoring interventions. Findings from a multinational study in LMICs indicate the need to concentrate research efforts on sociodemographic inequalities such as wealth quintile, level of educational attainment and area of residence.<sup>11</sup> Adolescent motherhood is more prevalent among adolescents with lower levels of education, lower income and living in rural areas.<sup>5 14</sup> The purpose of this study was to determine how these health disparities impacted adolescent motherhood among the states and territories of Nigeria.

## METHODS

### Study setting

There are 36 states in Nigeria and one Federal Capital Territory (FCT), Abuja. These states make up 774 local government areas (LGAs), and these LGAs are further subdivided into 8813 wards, constituting the lowest administrative units within the Nigerian governmental structure.<sup>15 16</sup> Based on cultural attributes and distinct ethnic composition, the country is also geographically subdivided into six geopolitical zones: South-South, South-East, South-West, North-Central, North-East and North-West.<sup>17 18</sup> Adolescents constitute 22%<sup>19</sup> of the Nigerian population, estimated at 230 million.<sup>20</sup>

### Data source, study design and participants

This study used data from the NDHS to address the research question. The NDHS is a nationally representative cross-sectional survey that employs a multistage stratified sampling design in selecting study participants. The primary sampling unit for the survey involves clusters, and survey participants were randomly selected from each cluster. Data collection was undertaken by the National Population Commission (NPC) and the National Malaria Elimination Programme of the Nigerian Federal Ministry of Health to contribute towards policy formulation and coordination of population activities in Nigeria. Data were accessed based on the Demographic and Health Surveys (DHS) operation guidelines.<sup>16</sup> The target population in this study was adolescent girls aged 15–19 years old. Publicly available data from four surveys (2003,<sup>21</sup> 2008,<sup>22</sup> 2013<sup>23</sup> and 2018)<sup>16</sup> conducted in 36 states and the FCT were used for the study. Surveys undertaken prior to 2003 were excluded due to a lack of state-level data. A total of 24668 adolescent girls were included in the final analytical sample. State-specific and survey-specific sample sizes for this study are shown in online supplemental table 2 (pages 3–6).

### Outcome measurement

The main outcome of interest in this study was adolescent motherhood, defined as having either given birth or first becoming pregnant at the time of the interview before the age of 20 years. A detailed definition is provided in online supplemental table 2 (page 7).

### Measurement of sociodemographic factors

Based on the review of literature, the three most used sociodemographic variables were included in this study,

namely household wealth quintile, level of education and area of residence. The DHS measures women's socioeconomic status by the wealth index of the household of interviewed women and classifies the index into five wealth quintiles, such as poor, poorest, middle, richer and richest.<sup>16</sup> The household wealth index was calculated using principal component analysis on a household's ownership of selected assets such as televisions and bicycles, materials used for housing construction, types of water access and sanitation facilities.<sup>11 24</sup> Women's educational attainment was determined based on the highest educational achievement and categorised into no education, primary education, secondary education or higher education.<sup>24</sup> Place of residence was classified as either an urban or a rural area, as indicated in online supplemental table 1 (page 7).

### Statistical analysis

This study estimated the state-specific population-weighted prevalence of adolescent motherhood. The weights are the inverse of the probability of selection and the response rates (individuals/households) for women in the stratum. All states were ranked by the weighted prevalence of adolescent motherhood in their most recent survey data (2018). Using the latest surveys, the researchers categorised the prevalence into three groups based on the percentile of the prevalence, such as <33<sup>rd</sup> percentile as '1st tertile' (<10.59%), 33<sup>rd</sup>–67<sup>th</sup> percentile as '2nd tertile' (10.59%–22.98%) and >67<sup>th</sup> percentile as '3rd tertile' (>22.98%).

To investigate trends in prevalence, the average annual rate of change (AARC) in the prevalence of adolescent motherhood was calculated using the equation derived from the UN Children's Fund (UNICEF)<sup>25</sup> and was reported with a negative value to indicate a decrease in prevalence, as presented in the online supplemental appendix (pages 1–2). In addition, based on percentile distribution, these AARC negative values were then classified into tertiles, and the observed change was categorised as slow (less than 0% to –1.88%), medium (–1.88% to –4.58%) and fast (–4.5% to –9.96%).

This study adopted Wagstaff's method for the normalised concentration index for bounded variables<sup>26</sup> to evaluate sociodemographic disparities in the prevalence of adolescent motherhood (online supplemental appendix, page 2). Thus, a negative index implied that, on average, adolescent motherhood was higher among disadvantaged groups. Moreover, the observed change in sociodemographic disparities, as indicated by the normalised concentration index, was also measured between the earliest and most recent surveys to see changes in the inequality over time.

A subanalysis was conducted on 12177 women of reproductive age (online supplemental figure 1), drawn from the five highest-burden (Bauchi, Kaduna, Katsina, Sokoto and Zamfara) and five lowest-burden (Enugu, Imo, Lagos, Osun and Rivers) states. The 2018 survey data were used to ascertain differences in sociodemographic and reproductive characteristics of these women. The researchers calculated the proportion of women, based on wealth quintile, education, mean age at first child (MAFC), rurality, child marriage and polygyny. The statistical significance of the observed variations between the high-burden and low-burden states was set at  $p < 0.05$ . All data were analysed using Stata software (V.18, StataCorp, College Station, Texas, USA).

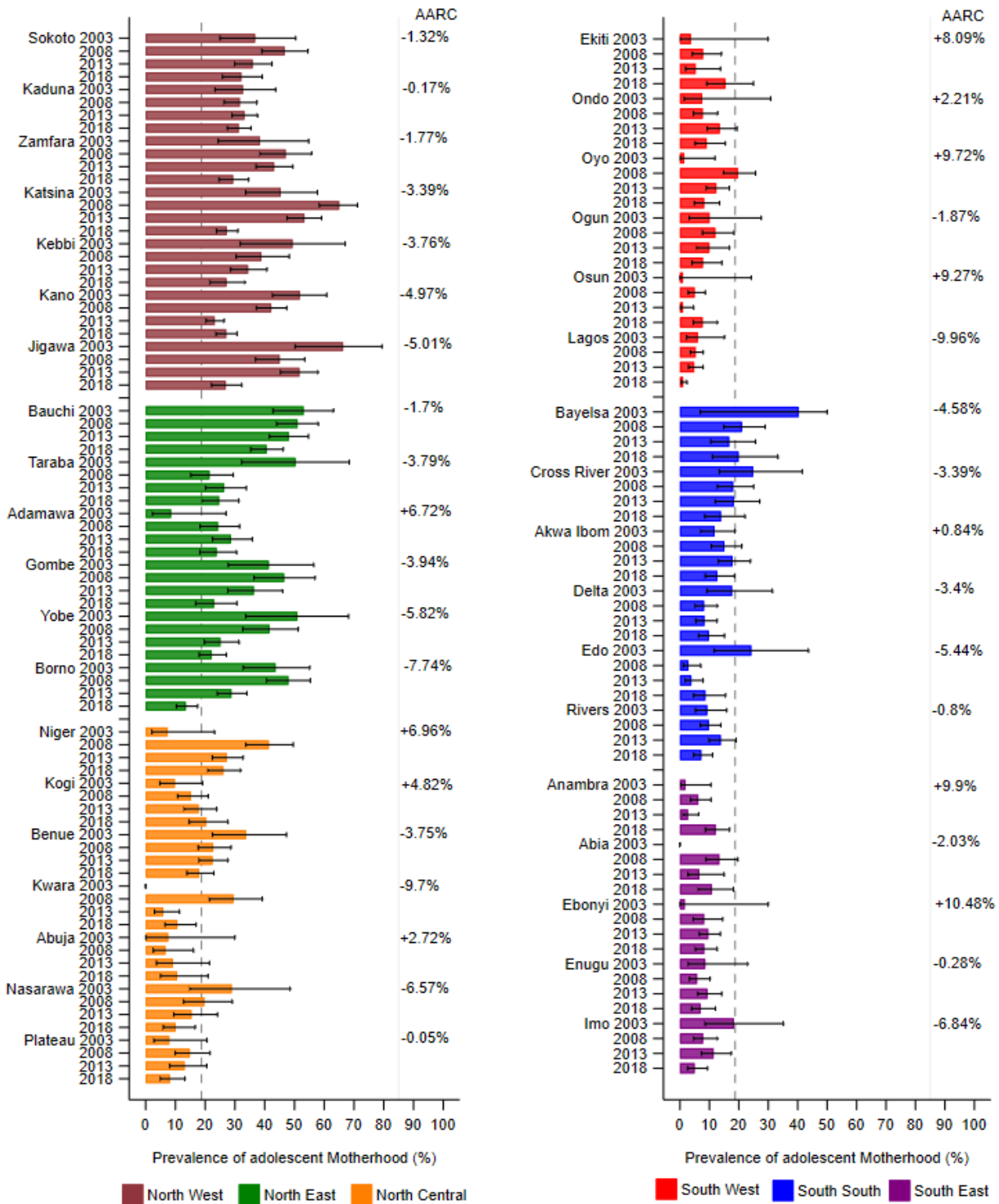
### RESULTS

The national prevalence of adolescent motherhood was 18.73% (95% CI 17.92 to 19.58), which varied across different states in different geopolitical zones, with the highest prevalence of 28.51% (95% CI 26.85 to 30.24) occurring in the North-West and the lowest in South-West, 5.51% (95% CI 4.35 to 6.94) (table 1 and figure 1). At the national level, the overall prevalence of adolescent motherhood decreased from 25.24% in 2003 to 18.73% in 2018 (AARC: –1.81). However, significant variation in the trend of adolescent motherhood was observed across regions and states. The researchers observed that 11 (29.7%) states showed an increase in adolescent motherhood, with Ebonyi State in the South-East being the

**Table 1** National and geopolitical zone weighted prevalence of adolescent motherhood, AARC and inequality across wealth quintiles, education and area of residence from the 2003–2018 surveys

Country/geopolitical zone	Weighted prevalence of adolescent motherhood, % (95% CI)	AARC, 2003–2018	Concentration index value, 2018		
			Wealth quintile	Education	Area of residence
National	18.73 (17.92 to 19.58)	–1.81	–0.41	–0.50	–0.31
North-Central	16.32 (14.32 to 18.53)	–0.35	–0.37	–0.36	–0.18
North-East	24.50 (22.39 to 26.75)	–3.90	–0.27	–0.42	–0.27
North-West	28.51 (26.85 to 30.24)	–3.16	–0.26	–0.47	–0.27
South-East	8.78 (7.12 to 10.78)	2.15	–0.11	–0.07	–0.03
South-South	10.58 (8.72 to 12.78)	–1.73	–0.29	–0.13	–0.08
South-West	5.51 (4.35 to 6.94)	0.81	–0.44	–0.17	–0.13

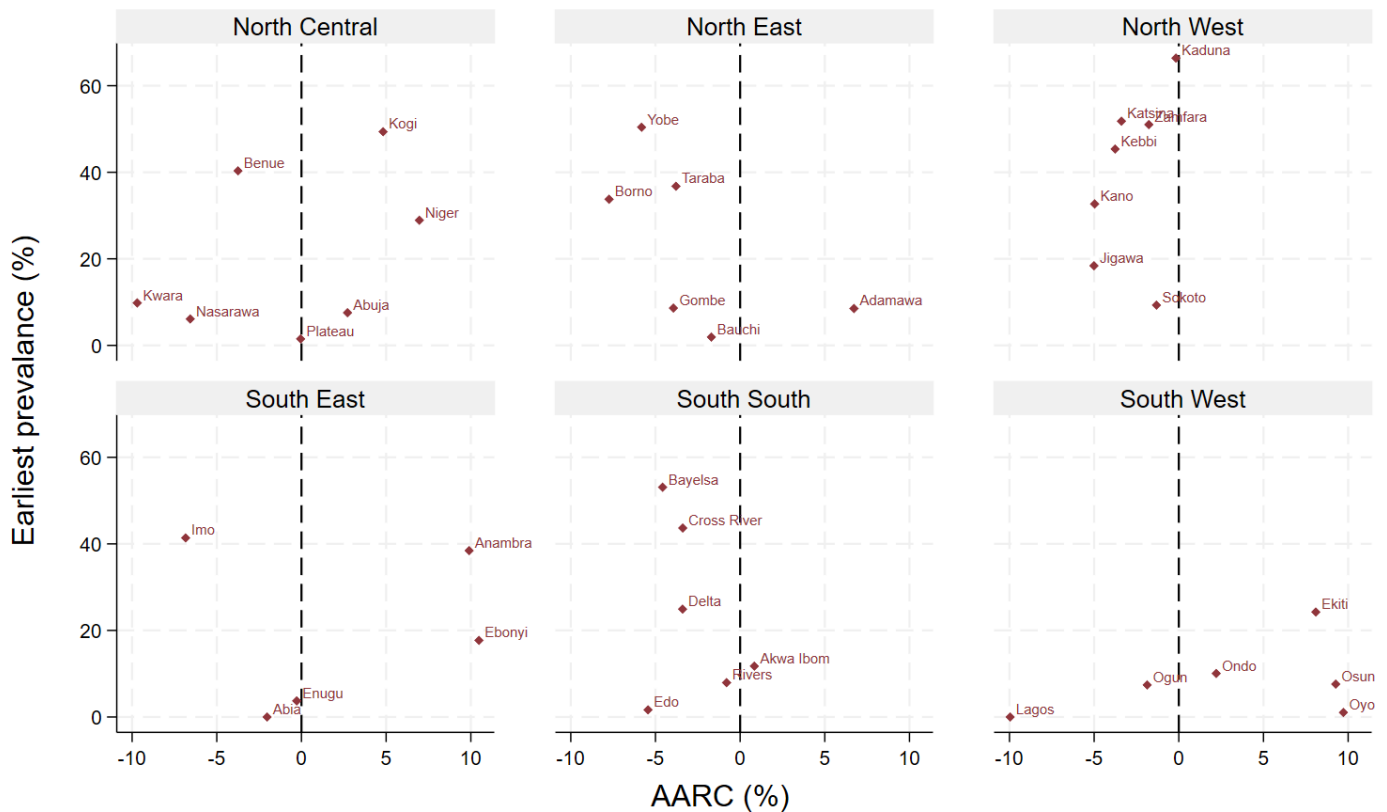
AARC, average annual rate of change.



**Figure 1** The prevalence, trends and average annual rate of change (AARC) of weighted prevalence of adolescent motherhood across Nigerian states and the Federal Capital Territory (FCT) 2003–2018. States are ranked by the prevalence of adolescent motherhood, from high to low, at the latest survey (2018).

highest (AARC: +10.48%) (online supplemental table 1). A very slow reduction rate was exhibited in four states, namely Plateau (-0.05%), Kaduna (-0.17%), Enugu (-0.28%) and Rivers (-0.80%) (table 1 and figures 1 and 2).

The two most prevalent states in northern Nigeria were Bauchi (North-East) and Sokoto (North-West), with prevalence rates of 40.65% (95% CI 35.29 to 46.25) and 32.14% (95% CI 25.83 to 39.17), respectively. All states in the North-West and Bauchi in the North-East



**Figure 2** Earliest prevalence of adolescent motherhood and average annual rate of change (AARC) in Nigerian states, grouped by geopolitical zones.

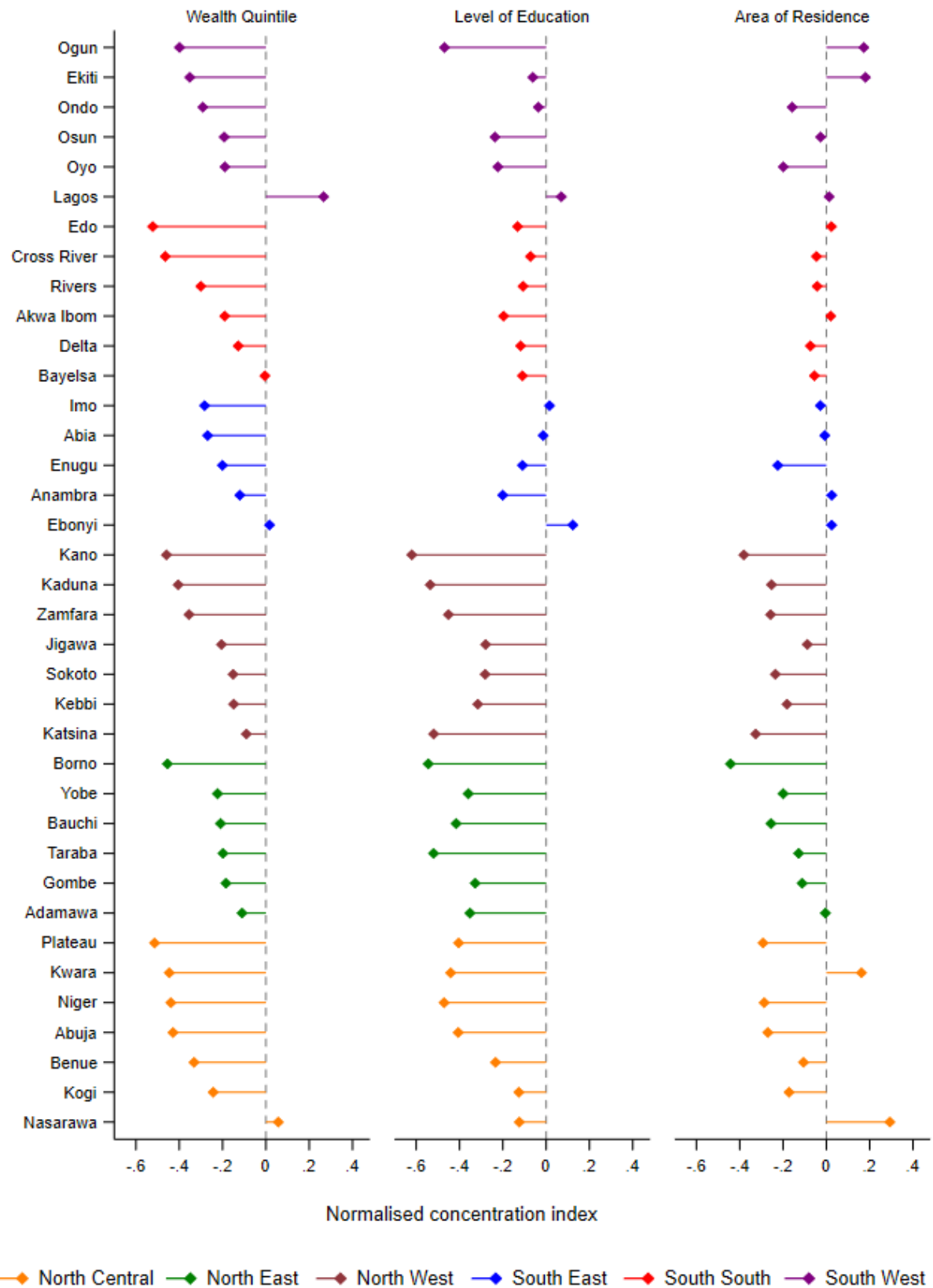
were identified as high-burden (third tertile) areas. The AARC in the north-western states ranged from  $-0.17\%$  to  $-4.97\%$ , with Sokoto being  $-1.32\%$ , while Bauchi experienced a reduction of  $-1.7\%$  AARC (figure 3, online supplemental table 1). Several high-burden states in the North-West had minimal reduction in the prevalence of adolescent motherhood, as shown in figure 3. A typical example is Kaduna, where a prevalence of  $32.68\%$  was recorded in 2003 but experienced a slower rate of reduction with an AARC of  $-0.17\%$ , and the prevalence remained  $31.28\%$  in 2018. Similar patterns were also observed in other high-burden states in the North-West, such as Sokoto and Zamfara, and Bauchi in the North-East (figures 2 and 3). Overall, the researchers observed a significant inequality across sociodemographic characteristics in the North-West and North-East geopolitical zones (figure 3).

The lowest prevalence of adolescent motherhood of  $1.1\%$  (95% CI 0.49 to 2.43) and  $4.99\%$  (95% CI 2.59 to 9.39) was encountered in Lagos in the South-West and Imo (South-East), respectively (figure 4). In terms of AARC, the most significant decrease occurred in Lagos ( $-9.96\%$ ) and Borno in the North-East ( $-7.74\%$ ). Interestingly, an AARC of  $-6.84\%$  was demonstrated in Imo. These low-burden states demonstrated faster rates of reduction of adolescent pregnancy. For instance, a prevalence of  $6.11\%$  was observed in Lagos in 2003 and declined to  $1.1\%$  in 2018. This observation was repeated

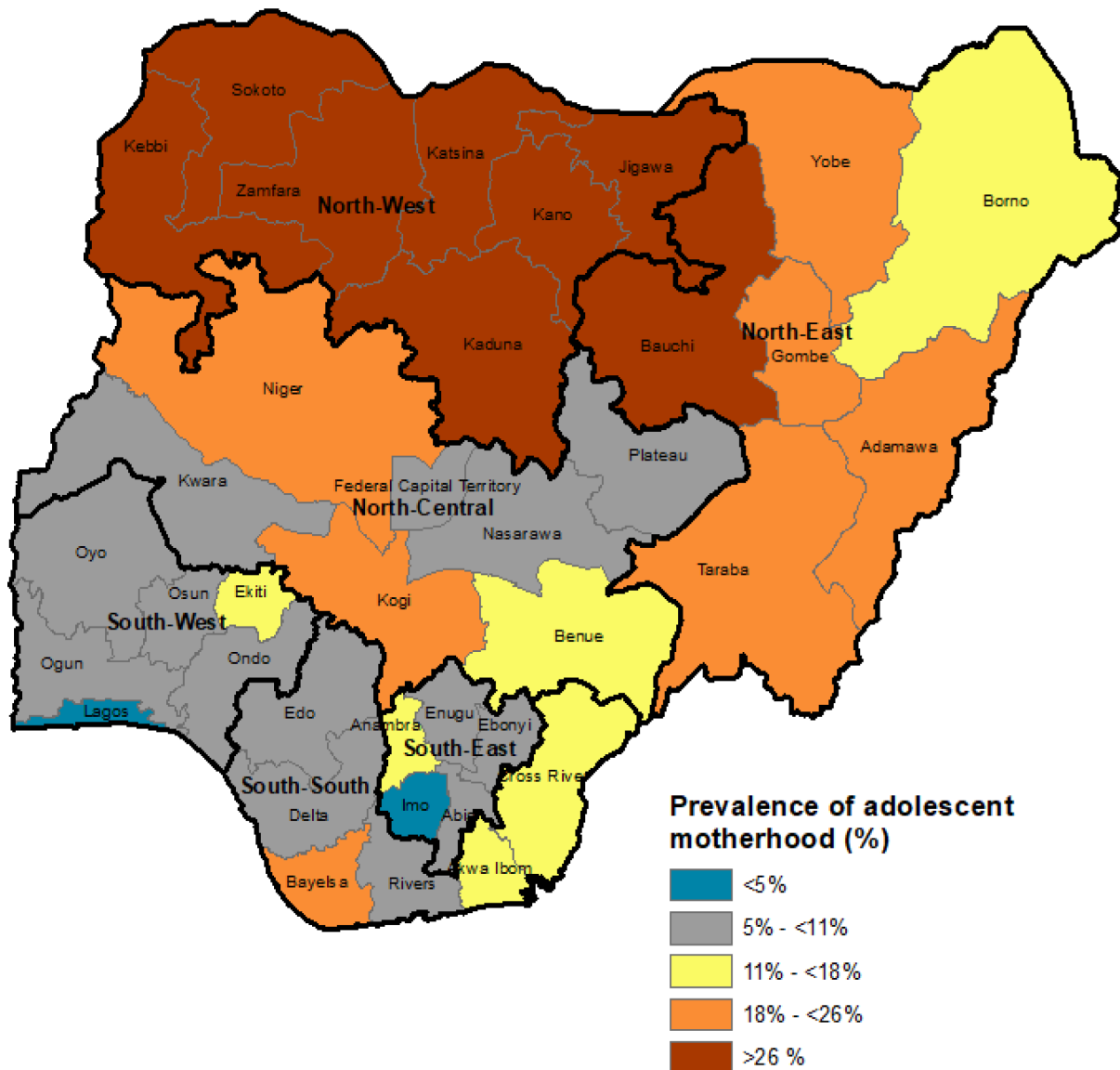
in Imo, where the prevalence reduced from  $18.39\%$  (2003) to  $4.99\%$  (2018).

The normalised concentration index of the measured sociodemographic characteristics, such as wealth quintile (89%), level of education (92%) and area of residence (72%), in most of the states was negative in the most recent survey (2018). This indicates the concentration of adolescent motherhood among socioeconomically disadvantaged populations. Edo State, which is in the South-South, had the highest normalised concentration index at  $-0.52$  for wealth quintile, followed very closely by Plateau ( $-0.51$ ), indicating a higher concentration of adolescent motherhood among the poorest women. Likewise, Bayelsa (South-South) had the least population of adolescent motherhood at  $-0.005$ , followed by Borno in the North-East and Kwara in the North-Central ( $-0.45$ ). Regarding level of education, the researchers observed that the prevalence of adolescent motherhood was higher among those with no education in nearly all states. Borno ( $-0.62$ ) had the most negative concentration index compared with the least in Abia (South-East) at  $-0.01$ . Considering areas of residence, Borno ( $-0.44$ ) was ranked highest, and the least was Abia ( $-0.01$ ), meaning that adolescent motherhood was concentrated among women in rural areas (figure 3, online supplemental figure 2 and online supplemental tables 3–5).

The researchers observed extreme disparities between the southern and northern states, with the former



**Figure 3** State-specific inequalities in the prevalence of adolescent motherhood across different sociodemographic factors in Nigeria. States are ranked by the normalised concentration index (most negative to least negative or positive) at the latest survey (2018).



**Figure 4** Geographic distribution of the weighted prevalence of adolescent motherhood in Nigeria in the 2018 survey, based on geopolitical zones.

exhibiting better outcomes than the latter, as shown in the online supplemental figure 3. This subanalysis demonstrated statistically significant differences in all measured variables: wealth quintile ( $p=0.0001$ ), level of education ( $p=0.0001$ ), MAFC ( $p=0.00001$ ), rurality ( $p=0.0001$ ), child marriage ( $p=0.0001$ ) and polygyny ( $p=0.0001$ ). For example, those living below the poverty line were mainly observed in Zamfara (53.8%) compared with Lagos (0.00%). Similarly, illiteracy (no education) was more widespread in Sokoto (84.2%) than in Imo, which had the least experience at 0.80%. The researchers observed an increase in the MAFC from 17.2 years in Katsina to 23.5 years in Lagos. Regarding rurality, Bauchi had the highest number of rural dwellers at 82.8% in contrast to Lagos (5.0%). The prevalence of child marriage peaked in Bauchi (90.3%), while Lagos had the least at 16.6%. Polygyny was predominant in Zamfara (46.3%), contrary

to the observation in Rivers (6.2%) (online supplemental figure 3).

## DISCUSSION

This study investigated for the first time trends and socio-demographic inequalities at the state level with respect to adolescent motherhood in Nigeria. The researchers observed that the states in the North-West geopolitical zone of the country had a higher prevalence of adolescent motherhood. The state of Bauchi (North-East) had the highest prevalence (40.65%) among all states. Several states, especially in the North-West geopolitical zone, demonstrated a decreasing trend in adolescent motherhood prevalence, suggesting progress in tackling the challenge in the region, but a high burden persists. While a significant decline occurred, some states, such as Plateau, Kaduna, Enugu and Rivers,

experienced slower rates of decline. Extreme variations between the high-burden and low-burden states were further revealed in terms of poverty, education, MAFC, rurality, child marriage and polygyny. While the researchers noted unfavourable outcomes in the northern states, the opposite scenario was evident in the southern region.

The researchers observed that not all states achieved reductions in adolescent motherhood. There have been efforts to address this problem in Nigeria, evidenced by the federal government's allocation of US\$3 million for the purchase of reproductive health products in 2015. This allocation was augmented by an annual increment of US\$8.35 million from 2016 to 2019. It is reported that some donor agencies, such as the UN Population Fund (UNFPA) and UNICEF, were also involved in the donation of modern contraceptives in Nigeria.<sup>27</sup> Additionally, interventional programmes such as the 'Adolescent 360' project, implemented by the Society for Family Health, with an overarching target of improving the uptake of modern contraception use among adolescent girls aged 15–19 years, have been supporting 10 states in Nigeria to reduce adolescent pregnancy. This is reflected in the decline in prevalence observed in Nasarawa, Kaduna, Lagos, Ogun, Edo and Delta, among others. Another possible reason for this reduction is the adoption of the Child's Rights Act by some states, which prohibits early marriage (a formal marriage or informal union involving a child under 18 years and an adult or another child) in Nigeria. This is further supported by interventions from other organisations like Save the Children, whose mission, in part, is to ensure that girls have equal access to education and are protected from child marriage by creating awareness and encouraging communities to change behaviours and norms that perpetuate these social anomalies.<sup>28</sup>

Nigeria was a signatory to the Family Planning 2020 summit of the Economic Community of West African States for the eradication of child marriage and promotion of various aspects of adolescent sexual and reproductive health and rights,<sup>29</sup> yet some states have not made progress in reducing adolescent motherhood. More specifically, not all Nigerian states have enacted laws prohibiting early marriage. Early child marriage has been implicated as a major driver of adolescent motherhood<sup>4</sup>; however, the Child's Rights Act, which prohibits early marriage, had yet to be enforced in 11 states in northern Nigeria in 2020. This suggests the observed variation in the prevalence of child marriage in high-burden (90.3%) versus low-burden (16.6%) states. It is reported that child marriage is a common experience in certain parts of northern Nigeria, indicated by the practice of engaging or marrying off children at a tender age of 10 or 12 years. Evidence suggests that in Islam (the major religion in the North), puberty indicates a girl's readiness for marriage. Therefore, the minimum age at marriage specified in the Child's Rights Act does not align with the religious doctrine.<sup>30</sup>

The influence of religion, ethnic and cultural factors has been identified to militate against the adoption of the Child's Rights Act.<sup>30</sup> This could be one of the possible reasons some states have witnessed a decline in the prevalence of adolescent motherhood, while it is increasing in other states. Our study shows that states in the North-West and North-East are high-burden regions, which may be linked to a more illiterate and socioeconomically disadvantaged adolescent population.<sup>2</sup> It is reported that women's lower educational attainment has a strong correlation with increased fertility rates, and each additional year of education decreases fertility rates by 0.26 births in Nigeria.<sup>31</sup> In recognition of this, the Federal Government of Nigeria has shown commitment to girls' education through supporting initiatives like the Universal Basic Education and Nigeria Human Capital Vision, aiming to double enrolment and completion rates for female secondary school students.<sup>31</sup> This is in addition to the intervention of the Adolescent Girls Initiative for Learning and Empowerment (AGILE), which also ensures access and completion of secondary school education, including instructions on reproductive behaviour, among others, in the country. The AGILE project will be deployed in the future in northern states such as Kano, Kebbi, Kaduna, Katsina, Borno and Plateau.<sup>32</sup> However, these efforts have been challenged by violence, increased attacks on schools and mass abduction of students.<sup>31</sup>

A multisectoral approach involving social welfare, health and economic development schemes tailored to specific states or geopolitical zones, will be effective in ensuring the health and well-being of the Nigerian adolescent population. Poverty alleviation programmes targeting vulnerable groups, which include employment opportunities, are encouraged. While programmes such as the Nigerian Urban Reproductive Health Initiative target only urban areas, they are encouraged to also reach rural and remote communities where adolescent motherhood and its drivers prevail.

### Study limitations

The study was subject to a few limitations. First, DHS exclusively collects data from women aged 15–19 years, requiring the exclusion of the early adolescent age group 10–14 years from the analysis. Meanwhile, the WHO regards adolescence as the age of 10–14 years. Second, the precision of participants' ages reported during the interview and the year they had their first childbirth may be impacted by recall bias, which may have been introduced into the prevalence estimate. Third, the researchers observed that the reported ages might have been affected by legal changes. Fourth, the study estimates did not consider stillbirths, miscarriages or abortions but encompassed live births and current pregnancies. Fifth, AARC could have been slightly affected by small samples across the states in the 2003 survey year compared with later years. Finally, underestimation of the prevalence of adolescent motherhood might have occurred due to its

risks among the youngest adolescents in the 15–19 years age group, several years after data collection. Notwithstanding the highlighted limitations, this study offers a detailed report on the prevalence, patterns and state-level variations in adolescent motherhood in Nigeria.

## CONCLUSIONS

Our study provides the first comprehensive state analysis of adolescent motherhood in Nigeria, including time trends and sociodemographic factors. The study reveals considerable disparities in prevalence rates across states and geopolitical zones. There is a need to address these inequalities to achieve SDG 3.7.2, especially in high-burden areas in the North-West of the country. Evidence-based interventions should address early marriage, education, poverty, religious practices and cultural norms that drive adolescent motherhood.

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**Contributors** Conceptualisation: AEA, MMH and AGR; data curation: AEA, MMH and MMR; formal analysis: MMH and MMR; methodology: AEA, MMH, MMR, VMO, OA, CME, BOA, AN-E, FHA, ST, SM and AGR; supervision: AGR; writing—original draft: AEA; writing—review and editing: AEA, MMH, MMR, VMO, OA, CME, BOA, AN-E, FHA, ST, SM and AGR. AEA is the guarantor of this study.

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**Patient and public involvement** Patients and/or the public were not involved in the design, conduct, reporting or dissemination plans of this research.

**Patient consent for publication** Not applicable.

**Ethics approval** This study involves human participants, and ethical approvals for the DHS project were obtained from the Institutional Review Board of ICF International and the Nigerian Health Research Ethics Committee of the Federal Ministry of Health before the surveys were conducted. The DHS dataset is anonymous and publicly available with no identifiable information about the survey participants. Approval was sought from MEASURE DHS, and permission was granted for this use. Informed consent was sought and obtained from study participants prior to data collection, while ensuring that their privacy and confidentiality were

maintained. The reference numbers or IDs for ethics approval include: 2013 NHREC Approval Number: NHREC/01/01/2007-04/02/2013; 2013 ICF Project Number: 631561.0.000.00.123.01; 2008 ICF Project Number: 31406.00.002.12; 2018 ICF Project Number: 132989.0.000.NG.DHS.01; and 2018 ICF Project Number: 132989.0.000. The email response from Sara Scates of ICF (Sara.Scates@icf.com) stated: "The Institutional Review Board of Macro International reviewed and approved the MEASURE Demographic and Health Surveys Project Phase II. The 2008 Nigeria DHS is categorised under that approval (attached: 2008 31406.00.002.12). The Institutional Review Board of Macro International reviewed and approved the MEASURE Demographic and Health Surveys+ Project. The 2003 Nigeria DHS would also be categorised under that approval. The Institutional Review Board of Macro International complied with the US Department of Health and Human Services requirements for the Protection of Human Subjects (45 CFR 46). (Macro International became ICF/Macro and is now known as ICF). We do not have documents to share from this time period or previous surveys, as review procedures have changed over time."

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**Data availability statement** Data are available in a public, open access repository. All data relevant to the study are included in the article or uploaded as supplementary information. The data used for this study are freely available at <http://dhsprogram.com/data/available-datasets.cfm>.

**Supplemental material** This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

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**Author note** The reflexivity statement for this paper is linked as an online supplemental file 1.

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