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A Comprehensive Assessment Model of Maternal Mortality Among Nigerian Adolescents and Young Adults: Evidence from The Global Burden of Disease Study, 1990-2017

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Abstract

Maternal mortality among adolescents and young adults remains an important public-health and health-system challenge in Nigeria, where early pregnancy may intersect with inadequate access to skilled obstetric care, socioeconomic disadvantage, and age-related vulnerability. This study develops a comprehensive assessment model for examining maternal mortality among Nigerian adolescents and young adults using the conceptual and analytical foundations of the Global Burden of Disease (GBD) Study, with particular attention to the 1990–2017 period. The study adopts a structured secondary-analysis approach based exclusively on the supplied literature, integrating global mortality evidence with empirical studies from Nigeria and comparable African settings. The proposed assessment model incorporates temporal trends, age-specific mortality, geographical and sociodemographic context, causes of maternal death, and health-system and obstetric factors. Existing evidence indicates that adolescents constitute an important risk group within maternal mortality research, while Nigerian hospital-based studies demonstrate substantial concern regarding obstetric outcomes among teenage pregnancies. The analysis further identifies a gap between broad population-level burden estimation and locally grounded explanations of adolescent maternal mortality. The proposed framework addresses this gap by connecting GBD-derived mortality patterns with contextual evidence concerning obstetric outcomes and health-service conditions. The study concludes that effective assessment of adolescent and young-adult maternal mortality requires simultaneous consideration of age, temporal change, causes of death, and contextual determinants rather than reliance on aggregate maternal mortality measures alone.

Keywords: Adolescent maternal mortality; Young adult pregnancy; Nigeria; Global Burden of Disease; Mortality trends; Maternal health; Obstetric outcomes; Health-system assessment; Epidemiological analysis.

1. Introduction

Maternal mortality represents a critical indicator of population health, healthcare accessibility, and the effectiveness of reproductive and obstetric services. Its distribution is not uniform across age groups, and adolescents may experience distinctive risks associated with pregnancy and childbirth. Research comparing maternal mortality across age groups has demonstrated the importance of age-specific analysis rather than treating women of reproductive age as a homogeneous population (Blanc, Winfrey, & Ross, 2013; Nove, Matthews, Neal, & Camacho, 2014). This distinction is particularly relevant in Nigeria, where evidence from individual health facilities has documented serious maternal and obstetric concerns among teenage pregnancies.

The Nigerian evidence base illustrates the importance of examining adolescent pregnancy through both maternal and obstetric outcomes. Airede and Ekele (2003) investigated adolescent maternal mortality in Sokoto, while Ujah et al. (2005) examined maternal mortality among adolescent women in Jos. These studies provide geographically differentiated evidence that adolescent maternal mortality cannot be understood exclusively through national averages. Similarly, Nwobodo and Panti (2012) specifically examined adolescent maternal mortality in north-west Nigeria, reinforcing the

importance of regional and institutional context.

Obstetric outcomes provide another important dimension of this problem. Nwobodo and Adoke (2005) examined teenage pregnancies at a tertiary care hospital in Sokoto and demonstrated the relevance of pregnancy-related obstetric outcomes when assessing adolescent maternal health. Such evidence is valuable because mortality is the final outcome of a broader chain involving pregnancy, complications, timely intervention, and quality of obstetric care. Consequently, mortality assessment should incorporate indicators that help explain how adverse pregnancy outcomes may contribute to maternal death.

At the global level, the GBD framework provides a systematic approach for examining mortality according to age, sex, cause, geography, and time. The GBD 2017 Causes of Death Collaborators (2018) produced age-sex-specific mortality estimates for 282 causes across 195 countries and territories, providing an analytical foundation for investigating changes in mortality over extended periods. The GBD 2017 results therefore offer a suitable basis for constructing an age-sensitive assessment of maternal mortality in Nigeria.

The central problem addressed in this study is the fragmentation between population-level mortality estimation and context-specific evidence concerning adolescent pregnancy. A national or global estimate can identify the scale and temporal direction of mortality, but it may not adequately explain the clinical and health-system mechanisms associated with the observed burden. Conversely, hospital-based studies can provide detailed obstetric evidence but may not represent national patterns. This study therefore proposes an integrated assessment model that combines these complementary perspectives.

The primary objective is to develop a comprehensive analytical framework for assessing maternal mortality among Nigerian adolescents and young adults during 1990–2017. Specifically, the study seeks to integrate temporal mortality trends, age-specific vulnerability, causes of death, Nigerian obstetric evidence, and contextual health-system considerations into a coherent analytical structure.

2. Literature Review

2.1 Age as a determinant of maternal mortality

Age-specific analysis is fundamental to understanding maternal mortality. Blanc, Winfrey, and Ross (2013) demonstrated that maternal mortality patterns vary according to maternal age, challenging approaches that rely exclusively on aggregate reproductive-age estimates. Their findings provide a theoretical justification for treating adolescents and young adults as analytically distinct populations.

Nove et al. (2014), using evidence from 144 countries, similarly emphasized differences in maternal mortality among adolescents compared with women in other age groups. Their international analysis is particularly relevant to the Nigerian context because it establishes that adolescent maternal mortality represents a measurable population-level phenomenon rather than merely a collection of isolated clinical cases.

The theoretical implication is that age should function as a principal stratification variable within maternal mortality assessment. Adolescence may represent a period in which biological, social, behavioral, and healthcare-access factors interact. Therefore, age-specific mortality should be examined alongside causes and temporal patterns.

2.2 Nigerian evidence on adolescent maternal mortality

Nigerian studies provide important contextual evidence. Airede and Ekele (2003) focused specifically on adolescent maternal mortality in Sokoto, demonstrating the importance of examining adolescent pregnancy within regional Nigerian settings. Ujah et al. (2005) extended this evidence through research involving adolescent women in Jos, north-central Nigeria. Nwobodo and Panti (2012) further emphasized the problem in north-west Nigeria.

These studies collectively suggest that geographical context is important. However, hospital-based evidence and regional studies may not independently establish national temporal trends. This creates a methodological gap that population-level datasets such as GBD can help address.

The obstetric dimension is equally important. Nwobodo and Adoke (2005) investigated the obstetric outcomes of teenage pregnancies at a tertiary-care hospital in Sokoto. Their contribution is significant because maternal mortality should not be evaluated independently from the complications and outcomes associated with teenage pregnancy. Linking obstetric outcomes to mortality trends provides a stronger explanatory framework than simply documenting mortality levels.

2.3 Causes and socioeconomic distribution

Maternal mortality is influenced by the distribution of causes across social and demographic groups. Evidence from Ghana by Asamoah et al. (2011) demonstrates the value of examining causes of maternal mortality across different sociodemographic populations. Although Ghana is not Nigeria, the study provides a relevant comparative African perspective for understanding why aggregate mortality statistics can obscure unequal distributions of risk.

Lule et al. (2006) placed adolescent health within a broader development and health-program context, emphasizing the importance of interventions addressing adolescent health conditions. This perspective supports a multidimensional interpretation in which maternal mortality is influenced not only by clinical care but also by the broader adolescent health environment.

2.4 GBD as an analytical foundation

The GBD framework provides the principal population-

level basis for the proposed assessment. The Global Burden of Disease Collaborative Network and Institute for Health Metrics and Evaluation (2018) provide GBD 2017 results, while the GBD 2017 Causes of Death Collaborators (2018) describe the systematic analysis of mortality by cause, age, sex, geography, and time.

The methodological strength of GBD is its standardized comparative structure. It allows mortality to be conceptualized as a longitudinal and multidimensional outcome. However, GBD estimates do not eliminate the need for local empirical interpretation. Hospital-based evidence from Sokoto and Jos illustrates why national estimates should be interpreted alongside local studies.

The World Health Organization (2008) also provides a broader burden-of-disease framework, while the Institute for Health Metrics and Evaluation provides methodological information through its GBD resources. Together, these sources support the use of standardized epidemiological assessment while highlighting the importance of transparent interpretation.

2.5 Research gap

The literature demonstrates three important evidence streams: global age-specific mortality research, GBD-based population-level estimation, and Nigerian hospital-level studies. However, these streams are insufficiently integrated. Existing Nigerian studies offer valuable local evidence but are geographically and institutionally constrained. Conversely, GBD provides a standardized longitudinal framework but requires contextual interpretation.

The present study addresses this gap by developing a comprehensive assessment model connecting age-specific mortality, temporal change, causes, geographical context, and obstetric evidence. The model is therefore positioned between population epidemiology and clinical-contextual assessment.

3. Methodology

3.1 Research design

This study adopts a structured secondary-analysis and conceptual-model design. The analytical foundation is the Global Burden of Disease Study 2017, particularly its age-sex-specific mortality framework for the period extending across 1990–2017. The study does not generate new clinical observations or independently estimate mortality rates. Instead, it synthesizes the supplied GBD documentation and peer-reviewed literature concerning adolescent maternal mortality.

The methodological logic consists of four analytical dimensions: temporal, age-specific, cause-specific, and contextual assessment. These dimensions are subsequently integrated into a comprehensive maternal mortality assessment model.

3.2 Temporal assessment

The temporal component examines maternal mortality as a changing phenomenon rather than a static indicator. The 1990–2017 observation period enables the assessment of long-term direction and potential changes in the burden of maternal mortality.

A conceptual trend function can be represented as:

M(t,a,c) = maternal mortality burden at time t, age group a, and cause c

where t represents year, a represents the adolescent or young-adult age category, and c represents the relevant cause of maternal death.

This structure allows researchers to determine whether mortality changes are concentrated within particular age groups or causes. The GBD framework is especially appropriate because its systematic analysis is designed to produce comparable mortality estimates across years, locations, ages, and causes (GBD 2017 Causes of Death Collaborators, 2018).

3.3 Age-specific assessment

The second component separates adolescents from young adults. Such stratification is theoretically important because adolescent pregnancy should not be assumed to have the same mortality profile as pregnancy among older women.

The assessment should therefore distinguish adolescent maternal mortality from mortality among young adults and, where the underlying dataset permits, apply narrower age bands. This approach is supported by international evidence demonstrating variation in maternal mortality according to maternal age (Blanc, Winfrey, & Ross, 2013; Nove et al., 2014).

The Nigerian studies provide a contextual validation layer. Evidence from Sokoto and Jos indicates that adolescent maternal mortality is sufficiently important to warrant dedicated investigation (Airede & Ekele, 2003; Ujah et al., 2005). The specific investigation of teenage pregnancy outcomes in Sokoto further demonstrates the importance of connecting age-specific mortality with obstetric outcomes (Nwobodo & Adoke, 2005).

3.4 Cause-specific assessment

The third component categorizes maternal mortality according to causes. Cause-specific analysis is essential because a decline in overall mortality may conceal persistent or increasing mortality from particular causes.

The GBD 2017 analytical framework provides a standardized basis for cause-specific mortality assessment. The comparative African evidence from Ghana further indicates that causes may vary across sociodemographic groups (Asamoah et al., 2011).

The proposed model therefore treats total maternal mortality as an aggregate outcome of multiple causes

rather than a single homogeneous phenomenon.

3.5 Contextual and health-system assessment

The fourth component addresses contextual interpretation. Population-level estimates should be interpreted alongside Nigerian evidence concerning teenage pregnancy and maternal mortality. Studies from Sokoto, north-west Nigeria, and Jos demonstrate the importance of local healthcare and obstetric contexts (Airede & Ekele, 2003; Nwobodo & Panti, 2012; Ujah et al., 2005).

Nwobodo and Adoke (2005) are particularly relevant because obstetric outcomes provide an intermediate analytical layer between pregnancy and maternal mortality. A comprehensive model can therefore be represented conceptually as:

Age → Pregnancy/Obstetric Outcome → Complication/Cause → Access and Response to Care → Maternal Mortality

This is not presented as a causal estimate from the supplied dataset, but as an analytical pathway for interpreting mortality evidence.

3.6 Comprehensive assessment model

The proposed model integrates five analytical layers:

Layer 1: Population profile — adolescent and young-adult population characteristics.

Layer 2: Mortality measurement — mortality levels and temporal changes from the GBD framework.

Layer 3: Cause structure — distribution of mortality according to causes.

Layer 4: Contextual validation — comparison with Nigerian hospital and regional studies.

Layer 5: Intervention interpretation — identification of health-system and adolescent-health implications.

This architecture reduces the risk of interpreting maternal mortality solely as a numerical outcome. It also creates a framework through which national-level mortality evidence can be examined alongside locally observed obstetric patterns.

3.7 Analytical limitations

A major methodological limitation is that the supplied materials do not contain the underlying Nigeria-specific GBD numerical extraction for every year from 1990 to 2017. Consequently, this study does not fabricate numerical estimates or calculate unsupported percentage changes. The framework instead identifies how those data should be analyzed.

A second limitation concerns comparability between hospital-based studies and population-level GBD estimates. Hospital studies such as the Sokoto investigation by Nwobodo and Adoke (2005) represent particular clinical settings and cannot automatically be generalized to the national population.

4. Results

The integrated assessment produces several principal findings from the available evidence base. First, maternal mortality among adolescents requires explicit age-specific analysis. International evidence indicates that maternal mortality differs by age, while Nigerian studies specifically document adolescent maternal mortality in different geographical settings (Blanc, Winfrey, & Ross, 2013; Nove et al., 2014; Airede & Ekele, 2003).

Second, the evidence supports a longitudinal approach. The GBD 2017 framework permits mortality to be assessed across an extended period rather than through isolated observations. This is important because a single-year mortality estimate cannot adequately establish whether the burden is increasing, declining, or remaining stable. The 1990–2017 period therefore provides an appropriate analytical window for identifying long-term patterns.

Third, the Nigerian evidence demonstrates that mortality should be interpreted together with obstetric outcomes. Nwobodo and Adoke (2005) provide evidence from a tertiary-care hospital in Sokoto concerning teenage pregnancy outcomes. This supports the inclusion of an intermediate obstetric layer in the proposed assessment model rather than treating mortality as an isolated endpoint.

Fourth, geographical context emerges as an important interpretive dimension. Evidence from Sokoto and Jos, together with the north-west Nigerian study by Nwobodo and Panti (2012), indicates that adolescent maternal mortality has been investigated in distinct regional environments. Such findings suggest that national-level results should be interpreted carefully because national aggregation can mask subnational differences.

Fifth, cause-specific assessment is necessary. The GBD 2017 framework explicitly supports age-, sex-, cause-, and location-specific mortality analysis, while the Ghanaian evidence illustrates how causes of maternal mortality can differ across sociodemographic groups (Asamoah et al., 2011; GBD 2017 Causes of Death Collaborators, 2018).

Finally, the evidence indicates that adolescent maternal mortality is best conceptualized as a multidimensional health-system outcome. The proposed model demonstrates that mortality assessment becomes analytically stronger when population-level mortality estimates are combined with age, cause, obstetric outcome, and contextual dimensions. However, because raw Nigeria-specific GBD estimates were not provided, numerical mortality trends and effect sizes cannot responsibly be asserted from the supplied materials alone.

5. Discussion

The findings support an integrated rather than narrowly statistical understanding of adolescent maternal mortality. Age-specific analysis is theoretically justified because maternal mortality patterns vary by maternal age. The international studies by Blanc et al. (2013) and Nove et al. (2014) establish the importance of this perspective, while Nigerian evidence demonstrates its local relevance.

The principal contribution of the proposed model is the integration of population-level and clinical-contextual evidence. GBD data provide standardized longitudinal measurement, whereas Nigerian hospital studies provide contextual evidence regarding adolescent pregnancy and obstetric outcomes. The two approaches answer different questions and should therefore be viewed as complementary rather than competing methods.

The Sokoto evidence is especially significant in this respect. Nwobodo and Adoke (2005) demonstrate why obstetric outcomes should be incorporated into interpretation of adolescent maternal mortality. Mortality represents the most severe endpoint, but the pathway toward that endpoint includes pregnancy-related complications and the capacity of healthcare services to identify and manage them. Therefore, a mortality assessment framework that excludes obstetric outcomes risks losing important explanatory information.

The geographical dimension introduces another important consideration. Evidence from Sokoto, north-west Nigeria, and Jos suggests that adolescent maternal mortality has been studied across different Nigerian settings. This creates a trade-off between national comparability and local specificity. GBD offers broad comparability, whereas facility-based research offers contextual depth. A robust assessment should preserve both dimensions.

The model also has implications for intervention planning. Lule et al. (2006) position adolescent health within broader development priorities, implying that maternal mortality prevention cannot be separated completely from adolescent health programming. Similarly, evidence concerning sociodemographic differences in maternal mortality supports targeting interventions toward populations experiencing disproportionate risks (Asamoah et al., 2011).

Nevertheless, the proposed model has limitations. GBD estimates are standardized analytical products rather than substitutes for detailed clinical investigation. Hospital studies may also have limited generalizability. Furthermore, differences in study design, location, population composition, and measurement approach can complicate direct comparison. These limitations reinforce the need for cautious interpretation.

Another important limitation is data availability. Without the underlying Nigeria-specific GBD extraction, the present analysis cannot determine exact annual mortality values or statistically quantify changes between 1990 and 2017. Such estimates should be obtained directly from the GBD results database before publication of a fully empirical version of the study.

The practical implication is that future research should combine GBD estimates with Nigerian administrative, hospital, and demographic evidence. This would enable researchers to test whether population-level patterns correspond with observed clinical outcomes and whether particular regions or age groups experience substantially different burdens.

6. Conclusion

This study developed a comprehensive assessment model for examining maternal mortality among Nigerian adolescents and young adults during 1990–2017 using the analytical foundation of the Global Burden of Disease framework. The evidence indicates that adolescent maternal mortality should be evaluated through multiple dimensions, including age, temporal trends, causes of death, geographical context, and obstetric outcomes.

The literature demonstrates that age-specific maternal mortality is analytically meaningful and that Nigerian studies provide important contextual evidence from Sokoto, north-west Nigeria, and Jos. In particular, evidence concerning teenage pregnancy outcomes reinforces the need to connect mortality statistics with the obstetric pathway leading to severe maternal outcomes.

The principal contribution of the proposed framework is its integration of population-level epidemiological measurement with locally grounded obstetric evidence. It provides a structured architecture through which GBD mortality patterns can be interpreted without treating aggregate national estimates as sufficient explanations of adolescent maternal mortality.

For policymakers and health-system planners, the findings support age-sensitive and context-sensitive maternal-health assessment. Future empirical research should extract the complete Nigeria-specific GBD 1990–2017 estimates and combine them with subnational hospital and demographic evidence. Such integration would permit formal statistical analysis of trends, identification of high-risk groups, and evaluation of changes in cause-specific maternal mortality.

Ultimately, reducing adolescent and young-adult maternal mortality requires more than measuring the number of deaths. It requires understanding who is at risk, how the burden changes over time, which causes dominate, where inequalities occur, and how obstetric and health-system conditions shape outcomes. The proposed comprehensive assessment model provides a foundation for such an integrated research strategy.

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