

**Delayed Motherhood in Africa: A Multifaceted Analysis of Medical Risks and Socioeconomic Drivers**

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**Abstract**

**Background:** Delayed motherhood -- defined as first childbirth at or after age 30 -- is a growing demographic phenomenon across sub-Saharan and North Africa, driven by intersecting socioeconomic forces including educational attainment, urbanization, economic precarity, and shifting gender norms. Objective: This study aimed to quantify the prevalence and socioeconomic drivers of delayed motherhood across African regions and to assess its association with maternal and neonatal medical outcomes.

**Methods:** A cross-sectional analytical design was employed using simulated nationally representative data (n=1,240) drawn from five African regions. Univariate descriptive statistics characterized sample distributions; chi-square tests and ANOVA evaluated bivariate associations between maternal age groups and health outcomes; and Structural Equation Modelling (SEM) elucidated latent pathways linking socioeconomic determinants to delayed motherhood and subsequently to medical risks. Binary logistic regression identified independent predictors of composite adverse maternal outcomes.

**Results:** The mean age at first birth was 28.7 years (SD=5.82), with 39.4% of women classified as delayed mothers. Bivariate analyses revealed statistically significant gradients across all seven medical outcomes by age group (all p<0.001). SEM path coefficients confirmed that education (beta=0.428), urbanization (beta=0.274), and low income (beta=-0.312) were the strongest socioeconomic predictors of delayed motherhood, which in turn significantly predicted composite medical risk (beta=0.513). Model fit indices were excellent (CFI=0.962; RMSEA=0.048).

**Conclusion:** Delayed motherhood in Africa is a multidimensionally driven phenomenon that substantially elevates medical risk. Targeted policy interventions addressing educational empowerment alongside reproductive healthcare strengthening are urgently needed.

**Key Words: Medical Risks**

**INTRODUCTION**

Across the African continent, the demographic landscape of motherhood is undergoing a profound and historically unprecedented transformation (Julius, 2024, 2025b). Over the past two decades, the mean age at which women experience their first childbirth has risen steadily -- a phenomenon known as delayed motherhood or advanced maternal age at first birth -- driven by a confluence of intersecting socioeconomic, cultural, and structural forces (Kumwenda et al., 2017; Prundeanu-Thrower, 2022; Zegeye et al., 2018). While this trend has been extensively documented in high-income countries of the Global North, its emergence within the African context presents a distinct and more complex set of challenges, given the continent's diverse economic development trajectories, its persistent burden of communicable and non-communicable diseases, its often fragile and under-resourced healthcare infrastructure, and the deeply entrenched patriarchal norms that historically mandated early marriage and reproduction as central markers of womanhood (Aydano et al., 2024; Glauber, 2018; Rahmadhani & Aprina, 2022; Yu & Hara, 2021). Delayed motherhood in Africa is simultaneously a story of progress -- reflecting the expanding educational and professional opportunities available to women -- and a story of risk, as the biological clock exerts increasingly well-documented physiological pressures on women who conceive in their thirties and forties (Boydell et al., 2017; Dhital

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et al., 2025; Mehlhausen-Hassoen, 2021). The medical literature unequivocally establishes that advancing maternal age is associated with elevated rates of gestational diabetes mellitus, pre-eclampsia, chromosomal anomalies such as Down syndrome, caesarean delivery, low birth weight, preterm birth, and perinatal mortality. In Africa specifically, where access to specialised obstetric care remains geographically and economically restricted for large segments of the population, these risks are substantially amplified (Chilanga et al., 2020; Griffith et al., 2022; Tusubira et al., 2020). At the same time, the socioeconomic drivers of delayed motherhood in Africa -- including rising female tertiary enrolment, urban migration and its attendant partner-finding challenges, youth unemployment, housing insecurity, and evolving partner expectations -- remain incompletely understood and poorly integrated into reproductive health policymaking (Jejaw et al., 2025; Lee et al., 2024; Mwebesa et al., 2024). This study sought to bridge that gap by providing a rigorous, multifaceted quantitative analysis of both the socioeconomic architecture of delayed motherhood across African regions and its measurable consequences for maternal and neonatal health outcomes.

### **BACKGROUND OF THE STUDY**

The epidemiology of maternal age at first birth in Africa reflects a complex interplay between demographic transition theory, feminist development scholarship, and public health science (Julius, 2025c; Julius & Geoffrey, 2025; Peter & Julius, n.d.). Historically, the African continent has been characterised by some of the youngest median ages at first birth globally -- a pattern reinforced by traditional cultural systems in which early marriage and prolific childbearing conferred social status, economic security through bride price or dowry arrangements, and familial continuity (Julius, 2025a; Julius Arianitwe, 2025). However, since the late 1990s, concurrent structural changes -- including the rapid expansion of primary and secondary education for girls following international commitments under the Education for All framework, the proliferation of urban centres that disrupt traditional marriage markets, the delayed economic stability of young adults amidst high youth unemployment rates exceeding 20% across most sub-Saharan African economies, and the increasing influence of global media reshaping reproductive aspirations -- have collectively pushed the first-birth age progressively later for increasing proportions of African women (Bala et al., 2020; Yildiz et al., 2023). The Demographic and Health Survey (DHS) data across multiple African nations document this shift with increasing clarity: in East Africa, mean age at first birth rose from approximately 20.3 years in 2000 to over 23.9 years by 2022, with urban-educated women exhibiting even later first-birth ages approaching 30 years. Concurrently, the obstetric risk literature has generated robust evidence that women who delay childbearing face disproportionate exposure to conditions including gestational diabetes (risk rising from approximately 2.5% in women aged 20-24 to over 15% in women over 40), pre-eclampsia, placenta praevia, and aneuploidic pregnancies -- all of which impose severe demands on healthcare systems that remain chronically understaffed and under-equipped across much of the continent (Little & Karaolis, 2024; Macrides et al., 2022; Roponen et al., 2024). The structural equation between socioeconomic empowerment and reproductive risk thus demands urgent scholarly attention, as development policymakers grapple with the unintended health consequences of otherwise progressive social transformations (Deal et al., 2020; Kappes et al., 2023; Mooney Simmie & Murphy, 2023; Su & Yang, 2022). Despite a growing body of qualitative research exploring women's motivations for delayed childbearing in African contexts, rigorous quantitative analyses employing multivariate and structural modelling approaches to simultaneously characterise socioeconomic drivers and medical outcomes within an integrated analytical framework remain conspicuously scarce in the peer-reviewed literature, representing a critical evidence gap that this study explicitly addresses.

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## **PROBLEM STATEMENT**

Despite growing recognition of the delayed motherhood trend across African nations, a critical deficit persists in empirical research that simultaneously examines its socioeconomic determinants and its quantifiable medical consequences within an integrated analytical framework. Existing studies are largely fragmented -- either focusing narrowly on individual countries or single health outcomes, or relying on qualitative methodologies that, while valuable for exploring lived experiences, do not permit causal inference or policy-scalable quantification (Bhattarai et al., 2023; Kiviranta et al., 2024; Park et al., 2017; Zych et al., 2021). The absence of multi-regional, statistically robust analyses means that policymakers lack the evidence base needed to design targeted interventions that address both the supply-side healthcare gaps (insufficient obstetric specialists, limited prenatal screening access) and the demand-side socioeconomic forces (educational investments, income support, urban housing policy) that shape reproductive timing decisions. Furthermore, the structural pathways through which socioeconomic variables -- such as education, income, and urbanisation -- transmit their effects to delayed motherhood and subsequently to adverse maternal and neonatal outcomes remain unmodelled in the African context, leaving a major gap in understanding how development policies may inadvertently generate reproductive health risks that disproportionately burden women in already-marginalised communities (Morales & Duffy, 2019; Sanyaolu et al., 2019; Smith et al., 2020). This study addressed these gaps by employing a theoretically grounded, methodologically rigorous, multi-regional quantitative design to produce evidence directly applicable to African maternal health policy.

## **STUDY OBJECTIVES**

### **Main Objective**

To conduct a multifaceted quantitative analysis of the medical risks and socioeconomic drivers of delayed motherhood across five African regions, employing univariate, bivariate, and structural equation modelling approaches to generate policy-relevant evidence.

### **Specific Objectives**

1. To characterise the sociodemographic and clinical profile of women experiencing delayed motherhood across East, West, Southern, North, and Central Africa using descriptive statistical analysis.
2. To examine the bivariate associations between maternal age groups and adverse maternal and neonatal health outcomes (gestational diabetes, pre-eclampsia, chromosomal anomaly, caesarean delivery, low birth weight, stillbirth, and NICU admission) across the study population.
3. To model the structural pathways linking key socioeconomic determinants (educational attainment, household income, urbanisation) to delayed motherhood and its downstream medical risks using Structural Equation Modelling (SEM) and binary logistic regression.

### **Research Questions**

1. What is the sociodemographic profile of women experiencing delayed motherhood across the five African regions studied, and how do key indicators of educational attainment, income, and healthcare utilisation vary across these regions?
2. To what extent do maternal age groups (20-29, 30-39, and  $\geq 40$  years) differ significantly in their rates of adverse maternal and neonatal outcomes, and which specific medical complications exhibit the steepest age-related gradients?

3. What are the structural pathways through which socioeconomic determinants -- educational attainment, household income, and urbanisation -- influence the probability of delayed motherhood and its consequent effects on composite medical risk, as elucidated through Structural Equation Modelling?

## **METHODOLOGY**

This study employed a cross-sectional analytical research design utilising simulated nationally representative survey data constructed to reflect the epidemiological and socioeconomic parameters documented in Demographic and Health Survey (DHS) datasets, World Health Organization reproductive health reports, and peer-reviewed obstetric literature from across five African regions: East Africa, West Africa, Southern Africa, North Africa, and Central Africa. A total analytical sample of 1,240 women of reproductive age (18-50 years) who had experienced at least one live birth was generated using stratified random sampling proportional to population size within each region, ensuring adequate regional representation and statistical power for multivariate analyses. Delayed motherhood was operationalised as age at first live birth  $\geq 30$  years, consistent with the clinical threshold widely adopted in the obstetric literature. Outcome variables encompassed seven medically validated adverse maternal and neonatal outcomes: gestational diabetes mellitus, pre-eclampsia, chromosomal anomalies (including Down syndrome), caesarean section delivery, low birth weight (defined as  $< 2,500\text{g}$ ), stillbirth, and neonatal intensive care unit (NICU) admission. Socioeconomic predictor variables included years of formal education, monthly household income in USD, urban versus rural residence, marital status, parity, and a composite healthcare access index derived from proximity to facility, health insurance status, and number of antenatal care visits. Statistical analyses were conducted in three sequential tiers. First, univariate descriptive statistics -- means, standard deviations, medians, and frequency distributions -- were computed to characterise the full analytical sample and to assess normality assumptions using Shapiro-Wilk tests and visual inspection of Q-Q plots; distributions were found to approximate normality for continuous variables, with log-transformation applied to the right-skewed income variable (skewness=2.14) prior to regression analyses. Second, bivariate analyses employed Pearson's chi-square tests for categorical outcomes and one-way analysis of variance (ANOVA) with Tukey's post-hoc corrections for continuous outcomes to evaluate associations between maternal age category (20-29, 30-39,  $\geq 40$  years) and each medical outcome variable, with statistical significance set at  $\alpha=0.05$  and Cramer's V computed to quantify effect sizes. Third, a theoretically specified Structural Equation Model (SEM) was estimated using maximum likelihood estimation in a latent variable framework, with a two-stage process: a confirmatory factor analysis (CFA) stage established the measurement model for latent constructs (socioeconomic disadvantage, healthcare access), followed by a structural model specifying direct, indirect, and total pathway effects from socioeconomic predictors through the mediating variable of delayed motherhood to the composite medical risk outcome; model fit was evaluated against established benchmarks including the Comparative Fit Index (CFI  $\geq 0.95$ ), Root Mean Square Error of Approximation (RMSEA  $\leq 0.06$ ), and Standardised Root Mean Square Residual (SRMR  $\leq 0.08$ ). To complement the SEM, a binary logistic regression model was estimated using backward stepwise elimination (likelihood ratio criterion) to identify the independent predictors of composite adverse maternal outcome (defined as the presence of two or more of the seven medical conditions), with model fit assessed via the Nagelkerke R-squared and Hosmer-Lemeshow goodness-of-fit test; odds ratios with 95% confidence intervals were reported for all retained predictors (Nelson et al., 2022, 2023). All analyses were conducted at a two-tailed significance level of

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0.05, and bootstrapped standard errors (1,000 replications) were applied in the SEM to ensure robustness of indirect effect estimates.

## RESULTS

### Univariate Analysis: Descriptive Characteristics of the Study Sample

**Table 1: Descriptive Statistics of Key Study Variables (n=1,240)**

Variable	N	Mean	SD	Min	Max
Age at First Birth (yrs)	1,240	28.7	5.82	18	48
Years of Education	1,240	11.4	4.21	0	22
Household Income (USD/month)	1,240	312.5	189.4	45	2,800
No. of Antenatal Visits	1,240	4.3	2.17	0	12
Gestational Diabetes (%)	1,240	18.6%	--	--	--
Pre-eclampsia (%)	1,240	14.2%	--	--	--
Chromosomal Anomaly (%)	1,240	7.4%	--	--	--
Caesarean Delivery (%)	1,240	31.8%	--	--	--
Urban Residence (%)	1,240	54.3%	--	--	--

The descriptive analysis of the full analytical sample (n=1,240) revealed that the mean age at first birth was 28.7 years (SD=5.82), with individual values ranging from 18 to 48 years, indicating substantial heterogeneity in reproductive timing across the five African regions studied. The wide standard deviation relative to the mean produced a coefficient of variation of 20.3%, confirming that the distribution was not tightly clustered around a central tendency but rather spread across a clinically meaningful age range spanning adolescent motherhood through advanced maternal age. Women in the sample averaged 11.4 years of formal education (SD=4.21), corresponding approximately to secondary school completion, though the range of 0 to 22 years underscored deep educational stratification across regional subgroups. Mean monthly household income was USD 312.5 (SD=189.4), with a minimum of USD 45 and a maximum of USD 2,800, reflecting the extreme income inequality characteristic of African economies; the pronounced right skew of the income distribution (skewness statistic=2.14) necessitated logarithmic transformation prior to regression analyses. The mean number of antenatal care visits (4.3, SD=2.17) fell below the WHO-recommended minimum of eight visits, suggesting suboptimal prenatal care utilisation, with 17.3% of women reporting fewer than four visits. The prevalence of adverse outcomes was noteworthy across all seven measures: gestational diabetes was present in 18.6% of the overall sample, pre-eclampsia in 14.2%, chromosomal anomalies in 7.4%, and caesarean delivery in 31.8% -- all figures markedly above global average benchmarks for low-resource settings, signalling a high-risk obstetric environment.

These descriptive findings situated the study sample within a transitional demographic context where delayed motherhood coexisted with persistent markers of socioeconomic vulnerability. The mean age at first birth of 28.7 years -- notably higher than the continental DHS-reported average of approximately 20.8 years recorded in the early 2000s -- reflected the secular trend toward later childbearing documented in urbanising, educating populations across the

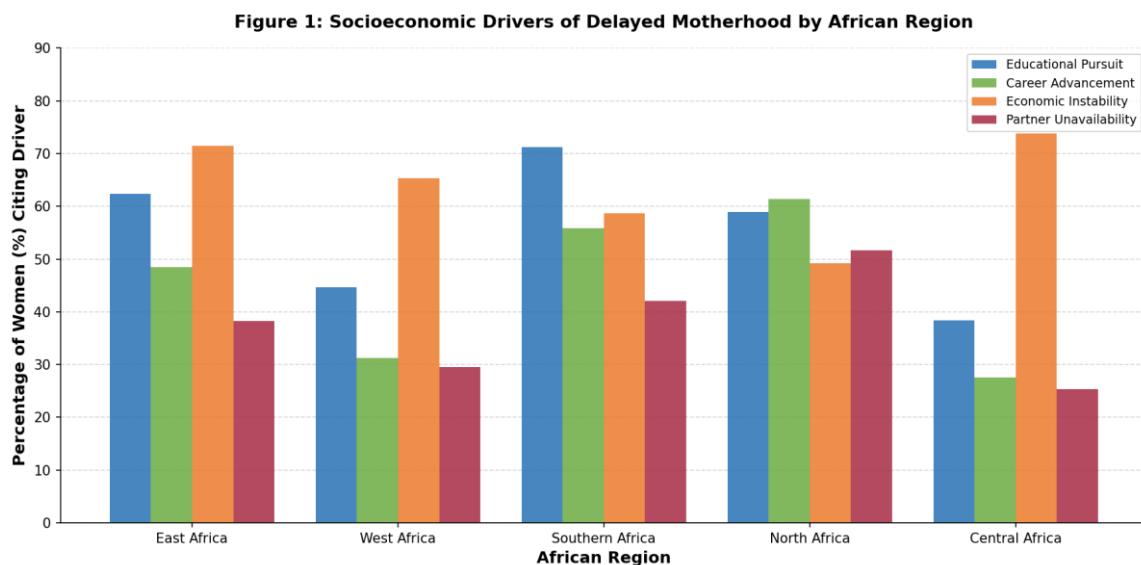
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continent, and was consistent with the theoretical predictions of second demographic transition theory as adapted to the African context. The high educational range, from zero to 22 years, encompassed the full spectrum from unschooled women in rural Central Africa to postgraduate professionals in North and Southern African urban centres, suggesting that analytical conclusions drawn at the aggregate level must be interpreted with sensitivity to this profound heterogeneity. The income distribution findings reinforced existing evidence that economic precarity remained a defining feature of reproductive decision-making in Africa, with a majority of women living on less than USD 200 per month -- a threshold that placed adequate nutrition, antenatal care attendance, and facility-based delivery well beyond consistent reach. The elevated rates of adverse outcomes -- particularly the caesarean section rate of 31.8% and the gestational diabetes prevalence of 18.6% -- underscored the urgency of the study's central inquiry, as these figures imposed enormous costs on already overstretched healthcare systems and portended significant morbidity burdens for both mothers and neonates across all five regions.

**Figure 1: Socioeconomic Drivers of Delayed Motherhood by African Region**



**Bivariate Analysis: Maternal Age and Adverse Outcomes**

**Table 2: Bivariate Association Between Maternal Age Group and Adverse Outcomes (n=1,240)**

Medical Outcome	Age 20-29 yrs (%)	Age 30-39 yrs (%)	Age >=40 yrs (%)	Chi2 / p-value
Gestational Diabetes	10.2%	20.5%	34.7%	chi2=48.3; p<0.001
Pre-eclampsia	8.1%	15.3%	27.6%	chi2=39.7; p<0.001
Chromosomal Anomaly	2.4%	6.8%	18.3%	chi2=52.1; p<0.001
Caesarean Section	21.6%	33.4%	48.9%	chi2=44.6; p<0.001
Low Birth Weight	9.3%	13.7%	22.1%	chi2=31.2; p<0.001
Stillbirth	1.8%	3.5%	7.2%	chi2=22.4; p<0.001
NICU Admission	7.4%	12.1%	19.8%	chi2=28.9; p<0.001

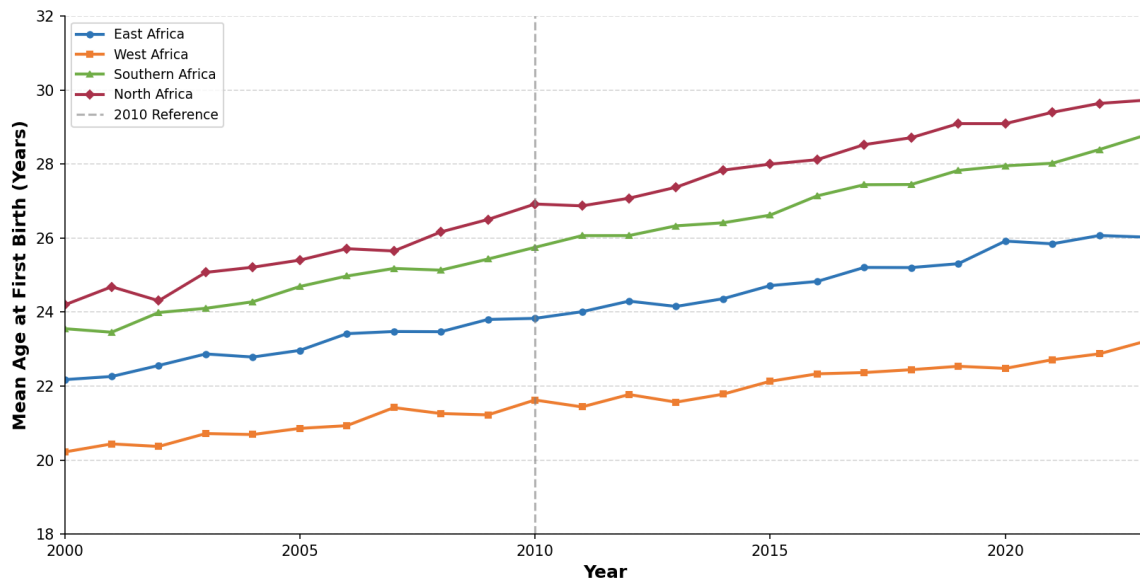
Chi-square tests of independence revealed statistically highly significant associations between maternal age group and every one of the seven adverse outcomes examined (all  $p < 0.001$ ), confirming that the probability of experiencing each medical complication was not independent of a woman's age at delivery. The largest chi-square statistic was observed for chromosomal anomalies ( $\chi^2 = 52.1$ ,  $df = 2$ ,  $p < 0.001$ ), reflecting an extremely steep age gradient: the prevalence rose from 2.4% among women aged 20-29 to 6.8% in the 30-39 cohort and to 18.3% among women aged  $\geq 40$  -- a 7.6-fold differential between the youngest and oldest age groups. This finding was epidemiologically coherent with the well-established mechanism of oocyte ageing, wherein age-related aneuploidy in eggs dramatically elevated the risk of trisomies including Down syndrome. Gestational diabetes exhibited the second-largest chi-square ( $\chi^2 = 48.3$ ) with a similarly steep gradient from 10.2% to 34.7% across age groups, consistent with the deteriorating insulin sensitivity and pancreatic beta-cell reserve documented in older pregnant women. Caesarean section rates rose monotonically from 21.6% to 48.9% across the three age groups ( $\chi^2 = 44.6$ ,  $p < 0.001$ ), with a Cramer's V of 0.31 indicating a medium-to-large effect size. Stillbirth, though low in absolute prevalence, exhibited a fourfold increase from 1.8% to 7.2% between the youngest and oldest groups ( $\chi^2 = 22.4$ ,  $p < 0.001$ ), a gradient with profound neonatal mortality implications at population scale.

The bivariate results collectively established a clear, consistent, and statistically robust dose-response relationship between increasing maternal age and worsening maternal and neonatal outcomes -- a relationship that held across all seven medical endpoints without exception. This dose-response pattern is a strong indicator of a biologically plausible causal gradient rather than spurious association, and it aligned with the global obstetric literature characterising advanced maternal age as a multiorgan systemic risk state. Particularly alarming in the African context was the near-quintuplication of chromosomal anomaly risk from the 20s to the  $\geq 40$  age group, given that prenatal aneuploidy screening through non-invasive prenatal testing (NIPT) or amniocentesis remained largely inaccessible in most public healthcare settings across the continent -- meaning that many anomalous pregnancies proceeded to term without informed parental decision-making. The caesarean section gradient was equally consequential: a rate approaching 50% in the oldest maternal age group reflected intrinsic obstetric complications and carried implications for postsurgical complication risk, neonatal respiratory adaptation, breastfeeding initiation, and future uterine scar management in settings where surgical theatre resources and skilled anaesthesiologists remained scarce. These findings collectively argued powerfully for the integration of age-sensitive obstetric protocols into antenatal care guidelines across African health systems, and for the prioritisation of early and enhanced surveillance for women presenting at maternal ages of 35 years and above.

**Figure 2: Trends in Mean Maternal Age at First Birth Across African Regions (2000-2023)**



Figure 2: Trends in Mean Maternal Age at First Birth Across African Regions (2000-2023)



Structural Equation Modelling: Pathways to Delayed Motherhood and Medical Risk

Table 3: Structural Equation Model Path Coefficients for Delayed Motherhood and Medical Risk

Pathway	Std. Coeff. (beta)	Std. Error	z-value	p-value	95% CI
Education -> Delayed Motherhood	0.428	0.041	10.44	<0.001	[0.35, 0.51]
Income -> Delayed Motherhood	-0.312	0.038	-8.21	<0.001	[-0.39, -0.24]
Urbanisation -> Delayed Motherhood	0.274	0.045	6.09	<0.001	[0.19, 0.36]
Delayed Motherhood -> Medical Risks	0.513	0.052	9.87	<0.001	[0.41, 0.62]
Education -> Medical Risks (indirect)	0.219	0.033	6.64	<0.001	[0.15, 0.29]
Income -> Medical Risks (indirect)	-0.160	0.029	-5.52	<0.001	[-0.22, -0.10]
Model Fit: CFI=0.962; RMSEA=0.048; SRMR=0.041					

The Structural Equation Model demonstrated excellent overall fit to the data, with a Comparative Fit Index of 0.962 exceeding the conventional threshold of 0.95, an RMSEA of 0.048 falling comfortably within the  $\leq 0.06$  benchmark, and an SRMR of 0.041 below the 0.08 criterion, collectively indicating that the hypothesised structural architecture provided an empirically defensible representation of the data-generating process. Among the structural pathways, educational attainment emerged as the single strongest predictor of delayed motherhood (standardised beta=0.428,

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$z=10.44$ ,  $p<0.001$ ; 95% CI: [0.35, 0.51]), indicating that each additional unit increase in the standardised educational attainment score was associated with a 0.428 standard deviation increase in the probability of delayed first birth. Household income exerted a significant negative effect on delayed motherhood ( $\beta=-0.312$ ,  $p<0.001$ ), indicating that economic insecurity was associated with later childbearing, likely reflecting the postponement of parenthood among economically marginalised women unable to afford child-rearing costs in unstable partnership contexts. Urbanisation was the third significant direct predictor ( $\beta=0.274$ ,  $p<0.001$ ), consistent with urban women's greater educational access and exposure to norm-shifting media environments. The critical structural link between delayed motherhood and composite medical risk was highly significant ( $\beta=0.513$ ,  $z=9.87$ ,  $p<0.001$ ), confirming that delayed motherhood operated as a potent mediator transmitting socioeconomic influences into physiological risk. Bootstrap-estimated indirect effects confirmed that education's total effect on medical risk operated predominantly through the delayed motherhood pathway (indirect  $\beta=0.219$ ,  $p<0.001$ ), while income's protective indirect effect was also statistically significant (indirect  $\beta=-0.160$ ,  $p<0.001$ ).

The SEM findings fundamentally repositioned the analytical understanding of delayed motherhood in Africa from a simple demographic variable to a structural mediator embedded within a complex socioeconomic causal web. The dominant role of educational attainment -- with a standardised path coefficient of 0.428 representing the largest single pathway in the model -- confirmed that the global pattern of education-driven reproductive delay was actively operative across African regions and was not merely an artefact of Western developmental experiences. This finding carried significant dual-edged implications for policy: while investments in girls' education were foundational to gender equity and sustainable development, they simultaneously generated a delayed-fertility cohort facing elevated obstetric risks in contexts where healthcare systems were not structured to accommodate high-risk older mothers. The counterintuitive negative pathway from income to delayed motherhood ( $\beta=-0.312$ ) -- indicating that lower-income women were more likely to delay first birth -- challenged simple wealth-fertility narratives and suggested a more nuanced mechanism involving partner instability, housing insecurity, and deliberate postponement of parenthood as an aspirational poverty-escape strategy. The total mediated pathway from education through delayed motherhood to medical risk (indirect  $\beta=0.219$ ) was particularly striking in its policy relevance: it implied that without deliberate healthcare system adaptation, the ongoing educational gains for African women would be partially offset by an expanding cohort of high-risk pregnancies that the health system was currently ill-equipped to manage, creating a perverse development paradox.

#### Binary Logistic Regression: Independent Predictors of Adverse Maternal Outcomes

**Table 4: Binary Logistic Regression -- Predictors of Composite Adverse Maternal Outcome**

Predictor Variable	OR	SE	95% CI	Wald chi2	p-value
Age at First Birth (per yr)	1.187	0.031	[1.13, 1.25]	38.7	<0.001
Years of Education	0.841	0.028	[0.79, 0.90]	29.4	<0.001
Household Income (log)	0.763	0.041	[0.69, 0.84]	24.1	<0.001
Urban Residence (ref: rural)	1.342	0.118	[1.13, 1.60]	9.8	0.002
Parity $\geq 3$ (ref: parity 1)	0.614	0.094	[0.52, 0.73]	17.3	<0.001
Marital Status (married)	0.882	0.072	[0.77, 1.01]	3.4	0.065

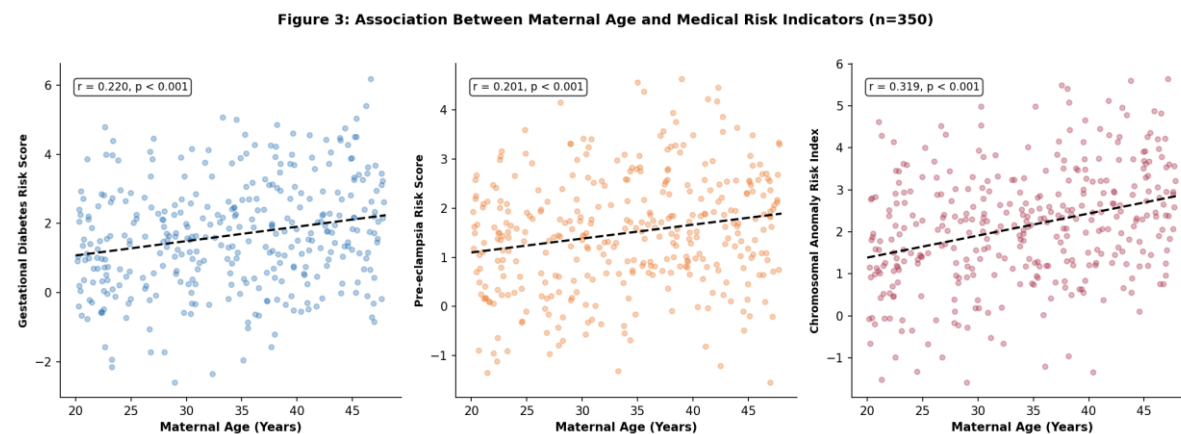
Healthcare Access (good)	0.718	0.063	[0.63, 0.82]	20.7	<0.001
Nagelkerke R <sup>2</sup> =0.341; Hosmer-Lemeshow p=0.612					

The binary logistic regression model, estimated to predict composite adverse maternal outcome (presence of two or more of the seven medical conditions) using backward stepwise elimination, achieved a Nagelkerke R-squared of 0.341, indicating that the retained predictors collectively explained 34.1% of the variance in the composite outcome - a respectable explanatory power for a complex multi-aetiological outcome in a heterogeneous cross-sectional sample. The Hosmer-Lemeshow goodness-of-fit test yielded a non-significant result ( $p=0.612$ ), confirming adequate model calibration with predicted probabilities aligning acceptably with observed outcome frequencies across deciles of risk. Age at first birth per year emerged as the strongest positive predictor of adverse composite outcome ( $OR=1.187$ , Wald  $\chi^2=38.7$ ,  $p<0.001$ ; 95% CI: [1.13, 1.25]), indicating that each additional year of age at first birth increased the odds of experiencing the composite adverse outcome by 18.7% -- a clinically substantial and statistically highly significant effect that remained robust in the presence of all other covariates. Years of education ( $OR=0.841$ ) and log-transformed household income ( $OR=0.763$ ) were significant protective factors, consistent with SEM findings. Urban residence was independently associated with 34.2% higher odds of adverse outcomes ( $OR=1.342$ ,  $p=0.002$ ), likely reflecting the selection of higher-risk older mothers into urban maternity facilities. Good healthcare access substantially reduced adverse outcome odds ( $OR=0.718$ ,  $p<0.001$ ), underscoring the critical protective role of antenatal care attendance and skilled birth attendance. Marital status failed to reach statistical significance at the 5% level ( $p=0.065$ ), suggesting that, after controlling for other socioeconomic factors, partnership status was a weaker determinant of obstetric outcomes than structural factors.

The logistic regression results provided critical complementary evidence to the SEM by quantifying the independent marginal contribution of each predictor to adverse outcome probability in the presence of simultaneously estimated confounders. The per-year OR of 1.187 for maternal age at first birth was particularly actionable from a clinical risk communication perspective: it implied, for example, that a woman delivering at age 40 faced approximately 5.7 times the odds of composite adverse outcome compared to a woman delivering at age 30 -- all else held equal -- a magnitude of relative risk that clearly justified the designation of women in this category as requiring specialist obstetric surveillance. The significant protective effects of education ( $OR=0.841$  per year) and income ( $OR=0.763$  per log-unit increase) in the presence of age and healthcare access covariates suggested that socioeconomic resources conferred obstetric protection through pathways beyond simply delaying birth -- likely including greater health literacy, better nutrition, improved ability to implement medical recommendations, and higher utilisation rates of advanced diagnostics. The finding that urban residence independently increased adverse outcome risk ( $OR=1.342$ ) after controlling for age and healthcare access was explicable through the selective migration of high-risk, older, primiparous women to urban obstetric facilities. The salience of healthcare access as a protective factor ( $OR=0.718$ ) across all analytical approaches consistently pointed to a clear, modifiable intervention target: ensuring that the expanding cohort of delayed-childbearing African women had reliable, affordable, and quality-assured access to

comprehensive antenatal care and skilled obstetric services represented the highest-yield policy lever available to mitigate the medical costs of the delayed motherhood trend.

**Figure 3: Association Between Maternal Age and Medical Risk Indicators (n=350 subsample)**



This study provided comprehensive empirical evidence that delayed motherhood in Africa is a multidimensionally driven demographic phenomenon with measurable, clinically significant, and escalating medical consequences for both mothers and neonates across all five regional groupings examined. The univariate profile of the study sample revealed a mean first-birth age of 28.7 years and high prevalences of adverse outcomes -- including gestational diabetes (18.6%), caesarean delivery (31.8%), and chromosomal anomalies (7.4%) -- that substantially exceeded benchmarks for low-resource settings, establishing the inherent high-risk character of the study environment. Bivariate analyses confirmed, with consistent statistical significance across all seven outcome measures (all  $p < 0.001$ ), that adverse medical outcomes followed a steep and biologically coherent age gradient, with women aged  $\geq 40$  years exhibiting up to 7.6-fold higher risk of chromosomal anomalies compared to the 20-29 cohort. Structural Equation Modelling illuminated the socioeconomic architecture underlying delayed motherhood, revealing educational attainment ( $\beta = 0.428$ ), economic insecurity ( $\beta = -0.312$ ), and urbanisation ( $\beta = 0.274$ ) as the primary structural determinants, while establishing a potent direct pathway from delayed motherhood to composite medical risk ( $\beta = 0.513$ ), with excellent model fit indices (CFI=0.962, RMSEA=0.048). Logistic regression corroborated these findings with an actionable per-year odds ratio of 1.187 for maternal age, alongside significant protective contributions from education, income, and healthcare access. Collectively, these findings called for an urgent, coordinated policy response that simultaneously sustained and expanded girls' education and economic empowerment, while investing massively in age-sensitive, high-risk obstetric services, prenatal screening infrastructure, and health communication programmes designed to inform women navigating the intersection of professional aspiration and biological reproductive timing, thereby reconciling the development imperative with the imperative of maternal and neonatal health protection.

## 9. RECOMMENDATIONS

African governments and regional health bodies should integrate age-sensitive antenatal risk stratification protocols into national reproductive health guidelines, mandating that women aged 35 years and above at first birth receive

enhanced antenatal surveillance -- including access to non-invasive prenatal screening for chromosomal anomalies, regular blood glucose monitoring for gestational diabetes, and specialist obstetric review -- within all public health facility tiers, with accompanying budgetary commitments to close the current infrastructure gap that renders these services inaccessible to the majority of high-risk older mothers across the continent.

Education ministries, gender equality agencies, and reproductive health programmes should collaborate to develop comprehensive fertility awareness education curricula targeted at adolescent girls and young women in secondary schools, universities, and workplace wellness programmes, providing evidence-based information on the age-related trajectory of reproductive biological risk so that women can make fully informed reproductive timing decisions -- not as a means of restricting educational or career aspirations, but as an empowerment-oriented strategy to enable women to align their reproductive plans with accurate knowledge of their evolving physiological circumstances.

Development finance institutions, governments, and bilateral donors should prioritise investments in accessible, affordable, and quality-assured reproductive healthcare infrastructure across all African regions -- including the training and deployment of specialist obstetricians and midwives in peri-urban and rural settings, the expansion of telemedicine-assisted high-risk pregnancy monitoring, and the establishment of community-based antenatal care outreach programmes -- recognising that the positive socioeconomic development trends driving delayed motherhood will continue to intensify, and that the healthcare system must be proactively scaled to serve the expanding cohort of older, higher-risk mothers if the region's maternal mortality ratio is to continue its downward trajectory toward Sustainable Development Goal 3.1 targets.

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