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Regular Article

# Male fertility patterns in Nigeria, South Africa, and Uganda: How many marital unions and children?

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ABSTRACT

Men's marital trajectories are important for understanding fertility dynamics but have received limited attention in demographic research, particularly in sub-Saharan Africa. This study examined the association between the number of marital unions and the total number of biological children fathered among men in Nigeria, South Africa, and Uganda. A cross-sectional secondary analysis was conducted using harmonized IPUMS-DHS datasets from the three countries. The weighted sample consisted of 11,437 men aged 15–59 years. Descriptive statistics, and country-specific multivariable linear regression models were employed to examine the relationship between number of marital unions and fertility outcomes. Men in multiple marital unions fathered significantly more children than those in a single marital union in Nigeria ($\beta = 1.55$, 95% CI: 1.38–1.72) and Uganda ($\beta = 1.04$, 95% CI: 0.85–1.24), while no statistically significant association was observed in South Africa ($\beta = 0.17$, 95% CI: −0.14–0.48). Older age groups, rural residence, and higher ideal number of children were positively associated with fertility across the three countries. Conversely, higher education and later age at first marital union were associated with lower fertility. Working status, wealth index, contraceptive use, and exposure to family planning messages showed inconsistent associations across the countries. The findings demonstrated that number of marital unions played an important but context-specific role in shaping male fertility outcomes. Policies promoting delayed marital union formation, increased educational attainment, rural reproductive health access, and greater male involvement in family planning programmes are essential for fertility transition and control in the region.

## 1. Introduction

Women have historically been the primary focus of fertility research worldwide. The reproductive behaviour and fertility outcomes of men have largely been disregarded. However, men play a central role in fertility decision-making, marital union formation, and reproductive outcomes within households and communities (Adebowale & Palamuleni, 2024; World Health Organization, 2025a). Understanding male fertility patterns is therefore essential for developing comprehensive demographic analyses and effective reproductive health policies (Gottert et al., 2025; Nsobya et al., 2024). One important but underexplored dimension of male fertility is the number of marital unions that men enter during their reproductive life course. This is important because the number of marital unions that men enter during their life course, particularly during their reproductive age of 15–59 years, may impact their total number of biological children fathered (Candia & Kisangala, 2021; Cervi & Knights, 2022; Ku et al., 2025).

In many sub-Saharan African (SSA) societies, marital unions remain the primary social context within which childbearing occurs (John & Nitsche, 2022). Cultural expectations surrounding masculinity, lineage continuation, and family formation often encourage men to father children within marital unions (Chae & Agadjanian, 2022). These marital unions may be monogamous or polygynous and may occur sequentially following divorce, separation, or widowhood (Treleaven & Banchoff, 2024). As a result, men may experience multiple marital unions across their life course. Previous demographic evidence suggests that such marital trajectories can substantially shape cumulative fertility outcomes because each additional union may expand reproductive opportunities (Fukuda, 2020; Isiugo-Abanihe et al., 2022; Kizza & Wasswa, 2024). Beyond fertility, stable marital unions have broader implications for men's well-being, household stability, and social cohesion. At the population level, imbalances in partnership formation may contribute to a 'marriage squeeze', with potential consequences for social instability, crime, and reduced welfare in some SSA settings (De Swardt & Hartwig, 2025). Understanding men's marital trajectories is therefore important not only for fertility research but also for broader demographic and

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social policy.

Available statistics suggest that multiple marital unions are not uncommon in parts of SSA. For example, Demographic and Health Survey data indicate that approximately 12% of Nigerian men and 13% of South African men have experienced more than one marital union, while the proportion is substantially higher in Uganda at about 31% (National Department of Health (NDoH) et al., 2019; National Population Commission (NPC) [Nigeria] & ICF, 2019; Uganda Bureau of Statistics (UBOS) & ICF, 2018). These patterns highlight substantial cross-country variation in marital union trajectories and suggest that marital histories may play different roles in shaping fertility outcomes across countries.

Nigeria, South Africa, and Uganda provide useful comparative contexts for examining male fertility patterns. Nigeria is characterized by relatively high fertility levels and widespread acceptance of polygyny in some regions (Michael & Ekpenyong, 2018). South Africa has experienced declining fertility and increasing prevalence of non-marital childbearing, partly influenced by socioeconomic inequality and historical structural factors (Ngubane et al., 2022; World Bank, 2023). Uganda continues to exhibit relatively high fertility rates, with strong community influences and persistent traditional marital practices in many areas (Ariho & Kabagenyi, 2020; Kwabaho et al., 2023). These diverse demographic contexts provide an opportunity to examine how marital union histories interact with fertility outcomes across different sociocultural environments.

Previous studies in Nigeria have largely focused on male fertility intentions (Abbani, 2023), attitudes toward family planning (FP) (Olaide et al., 2022), and polygyny as a cultural practice (Michael & Ekpenyong, 2018). Research in South Africa has examined issues such as the absence of fathers (Nell & Lesch, 2024), household socio-economic inequality (Van den Berg et al., 2024), and non-marital fertility (Ngubane et al., 2022). Ugandan studies have frequently focused on fertility preferences, adolescent childbearing, and polygynous marital systems (Chae & Agadjanian, 2022; Kizza & Wasswa, 2024). However, comparative evidence examining how the number of marital unions influences the total number of biological children fathered by men across these countries remains limited. This study therefore aimed to examine the association between the number of marital unions and the total number of biological children fathered among men in Nigeria, South Africa, and Uganda using harmonized IPUMS-DHS data.

## 2. Literature review

### 2.1. Fertility, marital union dynamics, and patriarchal expectations in Nigeria

Nigeria, South Africa, and Uganda are key countries that are located within the SSA and represent a diverse socio-cultural and policy context. Polygynous practices and high fertility are prevalent in Nigeria (Akinyemi & Odimegwu, 2021; Ibrahim et al., 2023). The country is characterized by a high level of patriarchy. The primary objective of the majority of marriages is to produce children (Abbani, 2023). Couples who are experiencing difficulties in conceiving children are frequently observed visiting religious centres to petition for the blessing of a child. In the event that they are unable to conceive, some individuals seek solutions from traditional medicine practitioners, while others visit hospitals (Naab et al., 2025). The couple prioritizes their biological children over adoption (Nwokocha & Michael, 2015). Adoption is common among the elderly in Nigeria, particularly those whose biological offspring have grown up and are now living in separate locations, in order to prevent loneliness (United Nations, 2025). This explains why child fostering is more prevalent than adoption. In Nigeria, certain couples divorced due to childlessness, to marry another individual with whom they believed they could have children. Some men marry multiple wives due to the fact that their first wife is either not pregnant, has not given birth to children, or has not given birth to the preferred sex of the children, which is typically males (Federal Ministry of Health and Social Welfare of Nigeria (FMoHSW), 2024; Ibrahim et al., 2023).

A strong preference for sons, often rooted in expectations of lineage continuity and inheritance, fuels this gender bias. In some cases, extended family members subject women to verbal or physical abuse for failing to bear children, particularly sons, and may even forcefully eject them from the marital home (Michael et al., 2024). Families that are impoverished and unable to support their existing number of children are observed celebrating the birth of their newborns, sometimes borrowing money to hold grand parties for child naming ceremonies (Kayode, 2022). Members of religious bodies frequently mark such births with joyous singing, dancing, and thanksgiving, often without consideration for the family's financial capacity to support the child (Adebowale & Palamuleni, 2024). The most recent national survey report conducted among women in Nigeria indicates that the total fertility rate is 4.8 children per woman, which is significantly higher than the commonly cited replacement-level fertility of approximately 2.1 children per woman (Federal Ministry of Health and Social Welfare of Nigeria (FMoHSW), 2024).

### 2.2. Marital union instability and non-marital fertility in South Africa

In contrast, South Africa has a unique fertility and marital circumstance that is distinct from that of certain other African countries. Urbanization, socioeconomic inequality, and the legacy of the apartheid era are all widely recognized as factors that influence fertility in South Africa (Garenne & Stiegler, 2024). Although South Africa is more developed than the majority of other sub-Saharan countries, there is still a significant disparity in access to livelihoods and inequality. Family life in South Africa has been significantly disrupted by these factors. Non-marital fertility is relatively prevalent (Ngubane et al., 2022). There is a high incidence of marital union instability. In addition, South Africa's long-standing HIV/AIDS epidemic, together with mortality associated with HIV/AIDS and other causes, has contributed to widowhood, union dissolution, and remarriage among some adults (Niehaus, 2017). These demographic processes may increase the likelihood of individuals entering multiple marital or cohabiting unions over the life course, thereby influencing men's cumulative fertility trajectories (Republic of South Africa, 2025). It has been observed that the impact of delayed formal marital unions on male fertility in South Africa is distinct from that of West or East Africa, where Nigeria and Uganda are located, respectively (Aref et al., 2023). In fact, the national survey indicates that South Africa has a comparatively low total fertility rate of 2.2 children per women (World Bank, 2023). Research conducted in South Africa also indicates that women frequently have children outside of stable marital unions (Biney et al., 2021). It also demonstrates that males frequently participated in multiple marital unions, particularly serial marital unions (Republic of South Africa, 2025).

### 2.3. Persistent high fertility and community influence in Uganda

There is a blend of traditional and transitional demographic characteristics in Uganda. A number of the characteristics that are present in Nigeria and South Africa are also present in Uganda, though in a different context and at a different space (Mare et al., 2024; Nsobya et al., 2024). It is noted that Uganda maintains high fertility rates. Polygyny and sequential marital unions are common in the nation (Candia & Kisangala, 2021). According to the Uganda National Survey, the country's total fertility rate is 4.3 births per woman (Uganda Bureau of Statistics, 2023). In Uganda, communities have a greater influence on fertility than households and families in the majority of cases (Bwambale et al., 2022). Women in Uganda have limited to no control over their fertility outcomes, even though women may prefer to have fewer children than men (Kibonire & Mphuthi, 2023).

## 3. Methodology

### 3.1. Study design and data source

A cross-sectional, secondary data analysis design was used in this study. It employed the harmonized data of men from the Integrated Public Use Microdata Series–Demographic and Health Surveys (IPUMS-DHS). The datasets from the most recent available surveys were employed: Nigeria 2018, South Africa 2016; Uganda 2016. The DHS are surveys that are nationally representative and capture standardized data on reproductive behaviour, health, and population (DHS Program, 2024) This enabled the establishment of robust cross-country comparisons. Consistency in variable definitions and classification across the three countries was ensured by the Harmonized variables from IPUMS-DHS (Boyle et al., 2022).

### 3.2. Study setting

The three countries selected for this study: Nigeria (West Africa), South Africa (Southern Africa), and Uganda (East Africa) represent diverse demographic, cultural, and fertility contexts within SSA. Nigeria is the most populous country in Africa with an estimated population of over 230 million people (Worldometer, 2025). The country is characterized by relatively high fertility rates and the persistence of polygynous marital systems in several regions (Federal Ministry of Health and Social Welfare of Nigeria (FMoHSW) et al., 2025). South Africa has an estimated population of over 63 million people, and has experienced substantial fertility decline and increasing prevalence of non-marital childbearing within a context shaped by urbanization and socioeconomic inequality (South African Government, 2026). Uganda remains one of the countries with relatively high fertility levels in SSA, with strong community influences on reproductive behaviour and continued prevalence of polygyny in some communities. Uganda has an estimated population of over 52 million people (Worldometer, 2026). Examining these three countries together provides an opportunity to understand how marital union trajectories interact with fertility outcomes under different demographic regimes.

### 3.3. Study participants

The study participants consisted of men aged 15–59 years who participated in the men's questionnaire component of the DHS surveys in Nigeria, South Africa, and Uganda. The DHS men's survey collects detailed information on men's reproductive behaviour, fertility preferences, marital histories, contraceptive knowledge and use, socioeconomic characteristics, and exposure to reproductive health information. Only male respondents who reported having ever been in a marital or cohabiting union and who provided valid responses to the fertility outcome variables were included in the analytical dataset.

### 3.4. Sample size

The pooled weighted sample consisted of 11,437 male respondents aged 15–59 years across the three countries. Country-specific weighted samples were Nigeria (7141 men), South Africa (1461 men), and Uganda (2835 men). Sampling weights provided in the DHS datasets were applied during all analyses to account for the complex survey design, including stratification, clustering, and unequal probability of selection. This ensured that the estimates were nationally representative and addressed biases.

### 3.5. Sampling procedure

The DHS surveys employ a two-stage stratified cluster sampling design. In the first stage, enumeration areas (EAs) were selected from national census sampling frames using probability proportional to size. In the second stage, households were systematically selected within each enumeration area. All eligible men aged 15–59 residing in selected households were invited to participate in the men's survey. This sampling procedure ensured that the survey samples were representative of the national population across urban and rural areas and across administrative regions (DHS Program, 2024).

### 3.6. Selection criteria

**Inclusion Criteria:** Respondents were included in the analysis if they were men aged 15–59 years, had ever entered a marital or cohabiting union, reported the number of biological children ever fathered, and had complete data on the key explanatory variables, including marital union history, education, age at first marital union, contraceptive use, and fertility preferences.

**Exclusion Criteria:** Respondents were excluded if they had never entered any marital or cohabiting union, had missing or incomplete responses for the number of biological children fathered, and had missing values on key explanatory variables used in the regression analysis.

### 3.7. Data collection procedure

The DHS data were collected by trained field enumerators through face-to-face structured interviews using standardized questionnaires. Interviews were conducted after obtaining informed consent from respondents. For this study, the datasets were accessed through the IPUMS-DHS database, which provides harmonized and de-identified datasets for research purposes. The researcher downloaded the datasets after obtaining authorization from the DHS programme. Data management procedures included extraction of relevant variables, recoding and harmonization of variables across countries, handling of missing values, application of sampling weights, and preparation of analytical datasets. All data management procedures were conducted using IBM SPSS Statistics version 27.

### 3.8. Variables and data management

**Outcome Variable:** The outcome variable was the total number of biological children fathered. This was quantified as a continuous variable that represented the total number of biological children, both alive and deceased, that a male respondent had fathered at the time of the survey.

**Independent Variable:** The number of marital unions was the primary independent variable. This variable was derived from the DHS variable indicating the number of marital or cohabiting unions a respondent had experienced. In the dataset used for this study, the number of marital unions variable was provided as a harmonized categorical variable (UNION1MOREMN), coded as 1 = one union and 2 = more than one union, rather than as a count of the exact number of unions. For the main regression analysis, this variable was recoded into a binary variable: men who reported only one marital or cohabiting union were coded as "0," while men who reported more than one marital union (either sequential or simultaneous) were coded as "1." This coding allowed the analysis to examine differences in fertility outcomes between men who experienced a single marital union and those who experienced multiple marital unions (either sequentially or simultaneously). All variables, including the covariates (age, education, working status, etc.), were measured in detail as shown in Table 1. In particular, the age at the time of the first marital union was recoded into a binary variable. This was done in accordance with the established demographic cut-offs, distinguishing between men who entered their first marital union at $\leq$24 years and those who did so at $\geq$25 years (World Health Organization, 2025b). Furthermore, ideal number of children represented the number of children a respondent considered ideal for himself over his lifetime, based on the DHS question: *"If you*

**Table 1**
Summary of variables and measurement.

| Variable | Type | Coding/ Specification | Source (IPUMS-DHS Variable) |
|---|---|---|---|
| Outcome Variable | | | |
| Total biological children fathered | Continuous | Number of biological children fathered (count) | CHEBMN |
| **Main Independent Variable** | | | |
| Number of marital unions | Binary | 0 = One marital union, 1 = More than one marital union | UNION1MOREMN (recoded) |
| **Socio-Demographic Covariates** | | | |
| Age group (years) | Categorical | 15–29, 30–39, 40–49, 50–59 years | AGE5YEARMN (grouped) |
| Age at first marital union | Binary | ≤24 years = 0; 25+ years = 1 | AGE1STMARMN (recoded) |
| Educational attainment | Binary | 0 = No education/ Primary, 1 = Secondary/ Higher | EDUCLVLMN (recoded) |
| Working status | Binary | 0 = Not working, 1 = Working | CURRWORKMN (recoded) |
| **Reproductive Health Covariates** | | | |
| Ideal number of children | Continuous | Ideal number (numeric value) | IDEALKIDMN |
| Contraceptive method use | Categorical | 0 = No method, 1 = Traditional, 2 = Modern | FPTYPNOWMN (recoded) |
| Exposure to FP media | Binary | 0 = No exposure, 1 = Any exposure (Radio/TV/Print) | Combined from FPRADIOHRMN, FPTVHRMN, FPNEWSHRMN |
| **Household/Community Covariates** | | | |
| Wealth index | Binary | 0 = Bottom 60% (Poorest, Poorer, Middle), 1 = Top 40% (Richer, Richest) | WEALTHQMN (recoded) |
| Place of residence | Binary | 0 = Urban, 1 = Rural | URBANMN |
| Country of residence | Categorical | Nigeria, South Africa, Uganda | COUNTRY |

**Note:** IPUMS-DHS = Integrated Public Use Microdata Series–Demographic and Health Surveys.

*could choose exactly the number of children to have in your whole life, how many would that be?"*. Responses were treated as a continuous numeric variable.

### 3.9. Statistical analysis

Weighted frequencies, percentages, means, and standard deviations were calculated during the descriptive analysis level. This aids in the description of the socio-demographic characteristics of respondents by country. For continuous variables such as number of biological children fathered and ideal number of children, both mean and median values were examined to account for potential skewness in the distribution. More so, the sample composition was illustrated through the presentation of differences between countries. At the bivariate analysis level, independent samples t-tests were employed to examine the association between the number of biological children fathered and binary predictors. The categorical predictors with more than two categories were compared using the One-way Analysis of Variance (ANOVA). The relationship between continuous variables was evaluated using Pearson correlation analysis. Prior to conducting parametric analysis, the normality assumption was assessed using histograms and normal probability (P–P) plots. Visual inspection showed that the distributions and standardized residuals were approximately normally distributed. The histogram of standardized residuals approximated a normal distribution (mean = $2.12 \times 10^{-16}$, SD = 0.999), while the normal P–P plot showed that the residuals closely followed the diagonal reference line, with only minor deviations at the distribution tails. These findings indicated that the normality assumption was adequately satisfied.

The country-stratified linear regression models were estimated during the multivariable analysis. The objective was to examine the independent relationship between the number of marital unions and the total number of biological children fathered. Socio-demographic, reproductive health, and household/community covariates were accounted for in the analysis. R-squared, adjusted R-squared, and F-statistics were utilized to evaluate model fit. Prior to estimating the regression models, the assumptions of linear regression were evaluated. Scatterplots of standardized residuals against standardized predicted values showed no evident curvilinear pattern, supporting the assumption of linearity. The same plots also showed that the residuals were reasonably randomly dispersed around zero with approximately constant variance across predicted values, indicating that the assumption of homoscedasticity was adequately met. Multicollinearity was not a concern, with tolerance values ranging from 0.490 to 0.977 and variance inflation factor (VIF) values ranging from 1.023 to 2.064, well below the commonly accepted threshold of 10. Because IBM SPSS does not compute the Durbin–Watson statistic for weighted regression models, independence of residuals was assessed using the corresponding unweighted regression model, which yielded a Durbin–Watson statistic of 1.898, indicating no evidence of autocorrelation. Overall, the regression diagnostics indicated that the assumptions for linear regression were adequately satisfied. Statistical significance was determined for p-values less than 0.05, and all tests were two-tailed. All regression estimates were reported with confidence intervals (95%). As such, the regression models satisfied the key assumptions required for linear regression analysis and adjusted for measured covariates that may confound the association. The composition of this manuscript was informed by the STROBE statement, which was intended to enhance the reporting of observational studies in epidemiology (Vandenbroucke et al., 2014).

### 3.10. Ethical considerations

This study was based on the secondary analysis of publicly available DHS data. The DHS datasets are de-identified and made available to researchers upon request at: https://www.idhsdata.org/idhs/. Ethical approval for the original data collection was obtained by the ICF Institutional Review Board (IRB No: FWA00000845) and the respective country-specific institutional review boards responsible for approving the DHS surveys in Nigeria (NHREC/01/01/2007-18/03/2018), South Africa (EC008-2/2015), and Uganda (UNCST/UBOS-2016). Further ethical clearance for this analysis was not required.

## 4. Results

Table 2 presents the socio-demographic characteristics of the male respondents included in the study across the three countries. In Nigeria and South Africa, the largest proportion of respondents were aged 30–39 years, accounting for 39.8% (2845) and 32.4% (473) respectivel

y. In Uganda, a higher proportion of respondents were younger, with 32.3% (916) aged 15–29 years. Overall, 68.1% of Ugandan respondents were below the age of 40 years. South Africa had the highest proportion of men with secondary or higher education (78.0%), followed by Nigeria (60.7%). Uganda had the highest proportion of respondents with primary education (56.6%), while only 5.7% reported having no formal education. Employment levels were high among respondents in Nigeria and Uganda, where 98.0% and 98.3% of men respectively reported currently working. In contrast, 69.0% of South African respondents reported being employed.

Regarding marital union timing, 71.5% of men in Uganda entered their first marital union at age 24 years or younger, compared with 38.7% in Nigeria and 39.6% in South Africa. The average number of biological children fathered also differed across countries. Ugandan men reported the highest average fertility (mean = 4.4 children, SD = 3.4),

**Table 2**
Socio-demographic characteristics of male respondents by country.

| Variable | Nigeria Weighted n = 7141 (%) | South Africa Weighted n = 1461 (%) | Uganda Weighted n = 2835 (%) | Total Weighted N = 11,437 (%) |
|---|---|---|---|---|
| Age group (years) | | | | |
| 15-29 | 1011 (14.2) | 191 (13.1) | 916 (32.3) | 2118 (18.5) |
| 30-39 | 2845 (39.8) | 473 (32.4) | 1015 (35.8) | 4333 (37.9) |
| 40-49 | 2198 (30.8) | 451 (30.9) | 669 (23.6) | 3318 (29.0) |
| 50-59 | 1087 (15.2) | 346 (23.7) | 235 (8.3) | 1668 (14.6) |
| **Education** | | | | |
| No education | 1570 (22.0) | 71 (4.9) | 163 (5.7) | 1804 (15.8) |
| Primary | 1238 (17.3) | 250 (17.1) | 1604 (56.6) | 3092 (27.0) |
| Secondary | 2942 (41.2) | 931 (63.7) | 662 (23.3) | 4535 (39.6) |
| Higher | 1391 (19.5) | 209 (14.3) | 407 (14.4) | 2007 (17.5) |
| **Currently working** | | | | |
| Not working | 146 (2.0) | 452 (31.0) | 49 (1.7) | 647 (5.7) |
| Working | 6995 (98.0) | 1008 (69.0) | 2787 (98.3) | 10790 (94.3) |
| **Age at 1st marital union** | | | | |
| ≤24 | 2763 (38.7) | 579 (39.6) | 2028 (71.5) | 5370 (47.0) |
| 25+ | 4378 (61.3) | 882 (60.4) | 807 (28.5) | 6067 (53.0) |
| **Total biological children fathered** | | | | |
| Mean ± SD: | 3.9 ± 3.0 | 2.8 ± 2.3 | 4.4 ± 3.4 | 3.9 ± 3.1 |
| Median: | 3.0 | 2.0 | 4.0 | 3.0 |
| **Ideal number of children** | | | | |
| Mean ± SD: | 7.0 ± 3.0 | 3.5 ± 2.4 | 5.0 ± 3.0 | 6.5 ± 3.5 |
| Median: | 6.0 | 3.0 | 5.0 | 5.0 |
| **Number of marital unions** | | | | |
| One | 6309 (88.3) | 1278 (87.5) | 1954 (68.9) | 9541 (83.4) |
| More than one | 832 (11.7) | 183 (12.5) | 882 (31.1) | 1897 (16.6) |
| **Contraceptive method uses** | | | | |
| No method | 6078 (85.1) | 761 (52.1) | 1630 (57.5) | 8499 (74.3) |
| Traditional | 206 (2.9) | 33 (2.3) | 149 (5.3) | 358 (3.1) |
| Modern | 857 (12.0) | 666 (45.6) | 1057 (37.3) | 2580 (22.6) |
| **Media exposure via FP messages** | | | | |
| No exposure | 3438 (48.1) | 606 (41.5) | 597 (21.1) | 4641 (40.6) |
| Any exposure (Radio/TV/ Print) | 3704 (51.9) | 855 (58.5) | 2239 (78.9) | 6798 (59.4) |
| **Household wealth index** | | | | |
| Poorest | 1090 (15.3) | 257 (17.6) | 520 (18.3) | 1867 (16.3) |
| Poorer | 1150 (16.1) | 279 (19.1) | 540 (19.1) | 1969 (17.2) |
| Middle | 1375 (19.3) | 300 (20.5) | 565 (19.9) | 2240 (19.6) |
| Richer | 1607 (22.5) | 286 (19.6) | 631 (22.3) | 2524 (22.1) |
| Richest | 1919 (26.9) | 339 (23.2) | 578 (20.4) | 2836 (24.8) |
| **Residence** | | | | |
| Urban | 3511 (49.2) | 1109 (76.0) | 683 (24.1) | 5303 (46.4) |
| Rural | 3630 (50.8) | 351 (24.0) | 2153 (75.9) | 6134 (53.6) |

followed by Nigerian men (mean = 3.9 children, SD = 3.0), while South African men reported the lowest fertility (mean = 2.8 children, SD = 2.3). Similarly, the median results show that half of the men had fathered three or fewer children overall, with lower fertility in South Africa (median = 2) compared with Nigeria (median = 3) and Uganda (median = 4), while the median ideal number of children was five overall. Also, the ideal number of children varied substantially across countries. Nigerian men reported the highest fertility preference (mean = 7.0 children), followed by Ugandan men (mean = 5.0 children) and South African men (mean = 3.5 children). With respect to marital union history, 31.1% of Ugandan men had experienced more than one marital union, compared with 11.7% in Nigeria and 12.5% in South Africa. South Africa had the highest proportion of men reporting modern contraceptive use (45.6%), while Nigeria had the highest proportion of men reporting no contraceptive use (85.1%). Exposure to FP messages through media sources was highest in Uganda (78.9%) and lowest in Nigeria (51.9%). Approximately 24.8% of respondents were in the richest wealth quintile, while 16.3% were in the poorest quintile. More so, 53.6% of respondents lived in rural areas, while 46.4% lived in urban areas.

Fig. 1 shows cross-country differences in fertility patterns among men in Nigeria, South Africa, and Uganda. South Africa ranked highest in the low fertility category, with more than half of men (53.6%) having 0–2 children. Only a smaller proportion of men in Nigeria (39.1%) and Uganda (34.1%) felled within this category. While there was some similarity across the three countries in the proportion of men fathering 3–4 children, Ugandan men led in fathering five or more children (41.2%), followed by Nigerian men (32.5%). South Africa recorded the lowest proportion of men fathering five or more children (15.8%).

Table 3 presents the bivariate associations between selected predictor variables and the number of biological children fathered among men for the three countries (Nigeria, South Africa, and Uganda) pooled data analysis at $p < 0.05$. Men who had experienced more than one marital union reported a higher mean number of children (mean = 6.1, SD = 3.1) compared with men who had experienced one marital union (mean = 3.4, SD = 2.6). This difference was statistically significant ($t = -26.83$, $p < 0.001$). Age was significantly associated with fertility outcomes (ANOVA $p < 0.001$). Men aged 15–29 years reported the lowest mean number of children (mean = 1.6), while men aged 50–59 years reported the highest mean number of children (mean = 6.3). Educational attainment was also significantly associated with the number of children fathered (ANOVA $p < 0.001$). Men with no formal education reported the highest mean number of children (mean = 4.9), while those with higher education reported the lowest (mean = 3.1). Working status was associated with fertility outcomes ($p < 0.001$). Men who reported being currently employed had a mean of 3.9 children, compared with 3.3 children among men who were not working.

Men who entered their first marital union at age 24 years or younger reported a higher average number of children (mean = 4.2) compared with those who entered their first marital union at age 25 years or older (mean = 3.5). The ideal number of children was positively correlated with the total number of children fathered ($r = 0.35$, $p < 0.001$). Contraceptive method use showed statistically significant differences in fertility outcomes (ANOVA $p < 0.001$). Men reporting traditional contraceptive use had a mean of 4.1 children, compared with 3.6 children among modern method users and 3.9 among men reporting no contraceptive use. Household wealth status was also significantly associated with fertility outcomes (ANOVA $p < 0.001$). Men in the poorest households reported the highest average number of children (mean = 4.6), while those in the richest households reported the lowest (mean = 3.1). Residence was significantly associated with fertility outcomes ($p = 0.043$). Men living in rural areas reported a higher mean number of children (mean = 4.3) compared with men living in urban areas (mean = 3.3).

Table 4 shows the country-stratified linear regression predicting the number of biological children fathered among men. Across the socio-demographic and reproductive variables entered into the model, the strength of associations varied across the three countries. Having more than one marital union was significantly associated with fathering a higher number of children in Nigeria and Uganda ($p < 0.001$). Nigerian men with more than one marital union fathered, on average, an additional 1.55 children (95% CI: 1.38, 1.72) compared with those in one marital union (reference group). Similarly, Ugandan men with more than one marital union fathered an additional 1.04 children (95% CI: 0.85, 1.24) compared with those in one marital union. In South Africa, this association was not statistically significant ($\beta = 0.17$, 95% CI: −0.14, 0.48). Age was positively associated with fertility across the three countries. Being aged 50–59 years was associated with fathering significantly more children than being aged 15–29 (reference group), as expected. For example, men aged 50–59 in Nigeria fathered 5.58 more children, those in South Africa fathered 2.84 more children, and those in Uganda fathered 6.08 more children than men aged 15–29 ($p < 0.001$). The results indicate that Uganda recorded the highest fertility outcomes among the three countries.

Having secondary education or higher was significantly associated with fewer children across the three countries. The association between educational attainment and fertility was strongest in Uganda ($\beta = -0.40$, $p < 0.01$), followed by South Africa ($\beta = -0.35$, $p < 0.01$) and Nigeria ($\beta = -0.29$, $p < 0.001$). Employment status was

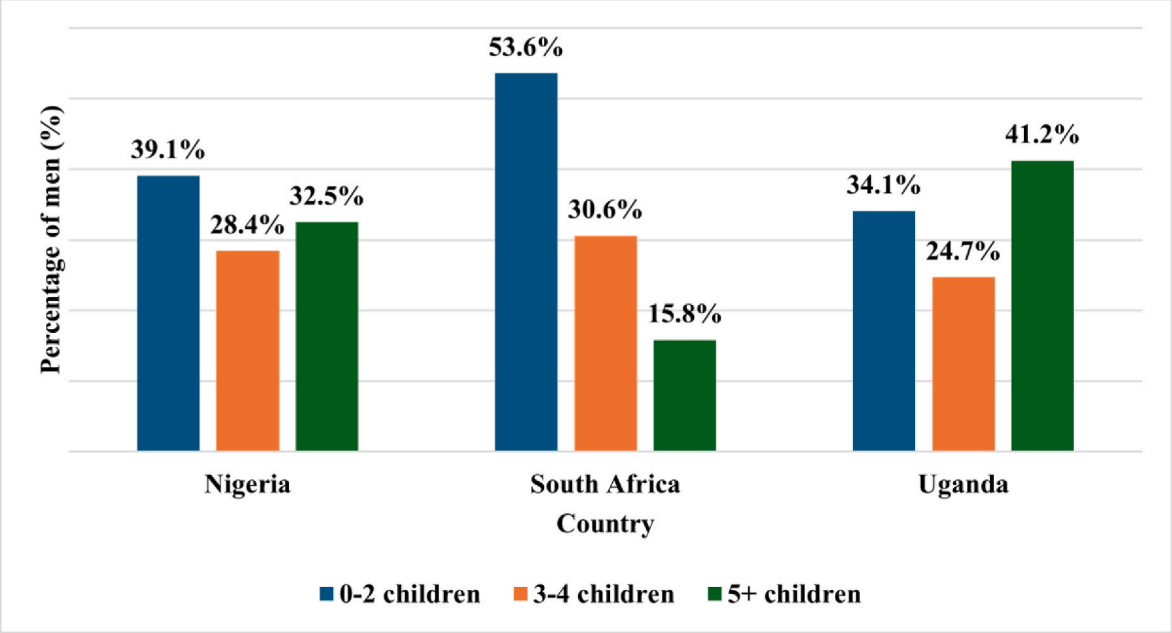


**Fig. 1.** Distribution of the number of biological children ever fathered among men aged 15–59 years by country.

**Table 3**
Bivariate associations with number of biological children fathered.

| Predictor Variable | Weighted N = 11,437 | Mean Children (SD) | Test Type | p-value |
|---|---|---|---|---|
| **Number of marital unions** | | | *t*-test | <0.001 |
| One | 9540 | 3.4 (2.6) | | |
| More than one | 1897 | 6.1 (3.1) | | |
| **Age group (years)** | | | ANOVA | <0.001 |
| 15-29 | 2117 | 1.6 (1.3) | | |
| 30-39 | 4333 | 3.2 (2.1) | | |
| 40-49 | 3318 | 4.9 (3.1) | | |
| 50-59 | 1669 | 6.3 (4.0) | | |
| **Education** | | | ANOVA | <0.001 |
| No education | 1803 | 4.9 (4.0) | | |
| Primary | 3092 | 4.6 (3.3) | | |
| Secondary | 4535 | 3.29 (2.4) | | |
| Higher | 2007 | 3.1 (2.5) | | |
| **Currently working** | | | *t*-test | <0.001 |
| Not working | 647 | 3.3 (2.9) | | |
| Working | 10790 | 3.9 (3.1) | | |
| **Age at 1st marital union** | | | *t*-test | <0.001 |
| ≤24 | 5370 | 4.2 (3.3) | | |
| 25+ | 6067 | 3.5 (2.8) | | |
| **Ideal number of children** | 11437 | r = 0.35 | Correlation | <0.001 |
| **Contraceptive method uses** | | | | |
| No method | 8500 | 3.9 (3.1) | ANOVA | <0.001 |
| Traditional | 358 | 4.1 (2.7) | | |
| Modern | 2580 | 3.6 (2.8) | | |
| **Media exposure via FP messages** | | | | |
| No exposure | 4640 | 3.8 (3.0) | *t*-test | 0.043 |
| Any exposure | 6797 | 3.9 (3.1) | | |
| **Wealth index** | | | | |
| Poorest | 1868 | 4.6 (3.7) | ANOVA | <0.001 |
| Poorer | 1970 | 4.3 (3.3) | | |
| Middle | 2239 | 4.1 (3.1) | | |
| Richer | 2525 | 3.7 (3.0) | | |
| Richest | 2836 | 3.1 (2.1) | | |
| **Residence** | | | | |
| Urban | 5303 | 3.3 (2.5) | *t*-test | 0.043 |
| Rural | 6134 | 4.3 (3.4) | | |

Note: t-tests compare means between two groups; ANOVA compares means across three or more groups. SD = Standard Deviation; r = Pearson correlation coefficient; p-values <0.05 considered statistically significant.

significantly associated with fertility in Nigeria and Uganda ($p < 0.05$). In Nigeria, being currently employed was associated with fathering 0.37 more children than not being employed. Similarly, in Uganda, men who were currently employed were associated with fathering 0.71 more children than those who were not employed. The association between employment and fertility was not statistically significant in South Africa. Age at first marital union was significantly associated with fertility across the three countries, although the magnitude of the effect varied. Men who entered their first marital union at age 25 or older had fewer children than those who entered the union at age 24 or younger. This association was stronger in Nigeria ($\beta = -1.33$) and Uganda ($\beta = -1.27$) than in South Africa ($\beta = -0.28$).

Having a higher ideal number of children was significantly associated with fathering more children, although the magnitude of the effect varied across countries. The association was strongest in South Africa ($\beta = 0.24$, $p < 0.001$). In South Africa, men with higher ideal numbers of children fathered 0.24 more children. In Nigeria, men with higher ideal numbers of children fathered 0.15 more children ($\beta = 0.15$, $p < 0.001$), while in Uganda the increase was 0.06 children ($\beta = 0.06$, $p < 0.001$). Media exposure to family planning (FP) messages was significantly associated with fertility outcomes only in Uganda among the three countries. The results show that Ugandan men who were exposed to FP messages through the media fathered 0.25 more children ($p < 0.05$). The wealth index was significantly associated with fertility in Nigeria and South Africa but not in Uganda. Men in the top 40% of the wealth index in Nigeria ($\beta = -0.41$, $p < 0.001$) and South Africa ($\beta = -0.24$, $p < 0.05$) had fewer children compared with those in the bottom 60% of the wealth index. Across the three countries, rural residence was significantly associated with a higher number of children. The largest rural–urban difference in predicted fertility was observed in Uganda ($\beta = 0.68$, $p < 0.001$), followed by South Africa ($\beta = 0.34$), and then Nigeria ($\beta = 0.19$).

## 5. Discussion

This study examined the association between the number of marital unions and the number of biological children fathered among men in Nigeria, South Africa, and Uganda. These three countries represent Western, Southern, and Eastern Africa, respectively (United Nations, 2025). The findings confirmed a strong association between the

**Table 4**
Country-stratified linear regression predicting total number of children fathered.

| Predictor Variable | Nigeria β (95% CI) | South Africa β (95% CI) | Uganda β (95% CI) |
|---|---|---|---|
| Number of marital unions | | | |
| One (Ref) | | | |
| More than one | 1.55 (1.38, 1.72) *** | 0.17 (−0.14, 0.48) | 1.04 (0.85, 1.24) *** |
| **Age group (years)** | | | |
| 15-29 (Ref) | | | |
| 30-39 | 2.20 (2.04, 2.37) *** | 1.12 (0.78, 1.46) *** | 2.55 (2.33, 2.77) *** |
| 40-49 | 3.99 (3.82, 4.17) *** | 2.09 (1.75, 2.44) *** | 4.90 (4.64, 5.15) *** |
| 50-59 | 5.58 (5.38, 5.78) *** | 2.84 (2.46, 3.21) *** | 6.08 (5.72, 6.44) *** |
| **Education** | | | |
| None/Primary (Ref) | | | |
| Secondary or higher | −0.29 (−0.42, −0.17)*** | −0.35 (−0.62, −0.08)** | −0.40 (−0.59, −0.20)** |
| **Currently working** | | | |
| Not working (Ref) | | | |
| Working | 0.37 (0.01, 0.72)* | −0.13 (−0.36, 0.09) | 0.71 (0.03, 1.38) * |
| **Age at 1st marital union** | | | |
| ≤24 (Ref) | | | |
| 25+ | −1.33 (−1.45, −1.21)*** | −0.28 (−0.49, −0.05)** | −1.27 (−1.48, −1.07)*** |
| **Ideal number of children** | 0.15 (0.14, 0.16) *** | 0.24 (0.19, 0.28) *** | 0.06 (0.05, 0.07) *** |
| **Contraceptive method uses** | | | |
| No method (Ref) | | | |
| Traditional | 0.54 (0.23, 0.84) *** | 1.26 (−0.84, 3.36) | 0.12 (−0.27, 0.52) |
| Modern | 0.24 (0.08, 0.39) ** | 0.21 (0.00, 0.42) | 0.05 (−0.14, 0.24) |
| **Media exposure via FP messages** | | | |
| No exposure (Ref) | | | |
| Any exposure | 0.09 (−017, 0.20) | 0.08 (−0.13, 0.29) | 0.25 (0.03, 0.47) * |
| **Wealth index** | | | |
| Bottom 60% (Ref) | | | |
| Wealth Index (Top 40%) | −0.407 (−0.54, −0.27)*** | −0.24 (−0.47, −0.02)* | −0.14 (−0.34, 0.06) |
| **Residence** | | | |
| Urban (Ref) | | | |
| Rural | 0.19 (0.7, 0.31)** | 0.34 (0.8, 0.60) ** | 0.68 (0.45, 0.91) *** |
| **Model Fit:** | | | |
| *R-squared* | *0.499* | *0.276* | *0.512* |
| *Adjusted R-squared* | *0.498* | *0.270* | *0.509* |
| *F-statistic* | *520.638* | *41.511* | *226.789* |
| *p-value* | *< 0.001* | *< 0.001* | *< 0.001* |

Significant at $p < 0.05$*, $p < 0.01$**, $p < 0.001$***.

number of marital unions a man entered and the number of children he fathered in Nigeria and Uganda, but not in South Africa. In Nigeria, for instance, men with more than one marital union fathered 1.55 additional children, while in Uganda they fathered 1.04 additional children compared with those in a single marital union. This association was not statistically significant in the South African context. The findings demonstrate multiple fertility pathways and divergent determinants across sub-Saharan African countries (Candia & Kisangala, 2021; Nsobya et al., 2024). They also highlight country-specific cultural norms surrounding marital union formation, marriage duration, fertility preferences, and fertility outcomes within SSA contexts (Treleaven & Banchoff, 2024).

Consistent with previous studies in Nigeria (Church et al., 2023) and Uganda (Candia & Kisangala, 2021), polygyny and sequential marital unions remain common and are often accompanied by fewer constraints on reproductive behaviour. In South Africa, however, unstable marital unions, multiple union formations, non-marital childbearing, and declining fertility patterns shape male fertility behaviour (Republic of South Africa, 2025). Our analysis revealed that the average number of children fathered by South African men aged 15–59 was 2.8, which is lower than that observed in many African countries. This indicates the importance of understanding the interplay of socioeconomic, demographic, and reproductive health factors shaping men's fertility outcomes (Abbani, 2023; Akinyemi & Odimegwu, 2021; Menashe-Oren & Sánchez-Páez, 2023). It further highlights the importance of examining how these factors intersect with the number of children fathered by men to inform fertility management strategies, policy relevance, and targeted interventions aligned with country-specific marital and fertility trajectories (United Nations, 2025).

One of the variables consistently associated with reduced male fertility across the three countries was education. Men with secondary or higher education fathered significantly fewer children. This finding reinforces global evidence that education delays marital union formation, increases contraceptive knowledge, and reduces fertility preferences and outcomes (Kizza & Wasswa, 2024; Menashe-Oren & Sánchez-Páez, 2023). Similarly, entering the first marital union at age 25 or older was negatively associated with higher fertility. This suggests that delayed age at marriage reduces the number of children fathered by men, particularly in culturally conservative societies such as Nigeria and Uganda, where childbearing outside marital unions is often discouraged (World Bank, 2025). Previous research has also confirmed an inverse relationship between age at first marriage and fertility outcomes, particularly among women in Zambia (Nkuye et al., 2022).

The ideal number of children was positively correlated with actual fertility and was particularly strongly associated in South Africa. Men with lower fertility preferences correspondingly fathered fewer children. This finding supports previous research indicating that fertility preference is a strong predictor of fertility outcomes (Otieno et al., 2020). It further suggests that the ideal number of children may be a stronger predictor of actual fertility in contexts with lower fertility levels, such as South Africa, compared with higher-fertility contexts like Nigeria and Uganda (Phiri et al., 2023; Wildeman et al., 2023). However, the relatively weak correlation observed between ideal fertility and actual fertility in Uganda suggests a disconnect between men's fertility preferences and realised fertility. This may indicate that fertility outcomes in Uganda are influenced more strongly by other factors, such as contraceptive access, partner dynamics, cultural norms, and structural constraints (Kwabaho et al., 2023).

Contrary to expectations, contraceptive use and exposure to FP messages showed limited or inconsistent influence on the number of children fathered. In Uganda, for example, media exposure to FP messages was significantly associated with higher fertility. This may reflect reverse causality, whereby men with larger numbers of children are more likely to encounter FP messages as part of efforts to reduce or space additional births, particularly during interactions with health care services (Holt et al., 2025). This finding aligns with existing research suggesting that exposure to FP messages does not necessarily translate into behavioural change due to the influence of individual preferences, cultural norms, structural inequalities, and access to FP services (Ibrahim et al., 2023; Kibonire & Mphuthi, 2023).

The weak but statistically significant association between modern contraceptive use and the number of children fathered in South Africa and Nigeria may reflect post-facto adoption. This occurs when men who have already achieved their desired family size adopt contraception to limit or space subsequent births. This finding demonstrates the need to engage men earlier in family planning discourse and policy frameworks (Naidoo et al., 2024). It also suggests that men should be more actively involved in fertility and family planning discussions before and during marital union formation to better manage fertility outcomes (Afachung et al., 2024; Kriel et al., 2019). Addressing culturally specific norms, misconceptions about modern contraception, and the socioeconomic

and physiological consequences of uncontrolled fertility for men, their spouses, children, and communities is therefore essential (Akinyemi et al., 2023; Dwomoh et al., 2022).

The persistently higher fertility observed in rural areas across the three countries reflects longstanding rural–urban disparities in access to family planning services, educational opportunities, and policy implementation. In Nigeria and South Africa, the wealth index acted as a protective factor against higher fertility, with men in the top 40% wealth quintile fathering fewer children than those in the bottom 60%. However, this association was not statistically significant in Uganda. These findings illustrate how varying demographic transitions and contextual determinants shape fertility trajectories across the three countries (Menashe-Oren & Sánchez-Páez, 2023). They also suggest that in Uganda, fertility norms linked to marital union histories may offset the moderating influence of wealth, reinforcing the wealth–fertility paradox often observed in high-fertility contexts (Assaf & Davis, 2019; Olaide et al., 2022). Overall, the study findings highlighted the importance of considering marital union trajectories when examining male fertility patterns in SSA. While marital union history plays an important role in shaping fertility outcomes, the study revealed that the strength of this relationship varies depending on broader demographic, cultural, and socioeconomic contexts across countries.

### 5.1. Implications for policy and research

This study offers important implications for both policy and research. On the impact on policy development and implementation, this study suggests that marital trajectories in male fertility regimes should be integrated into family and reproductive health policy programmes in SSA. In countries such as Nigeria and Uganda, where multiple marital unions are strongly associated with higher fertility, much attention should be given to addressing the high fertility outcomes associated with polygyny and serial marital unions. In doing so, policy interventions should be designed to target men who are either in multiple marital unions or transiting into various marital unions. Adequate counselling and fertility implications awareness programmes should be integrated into the process, with priority given to male involvement. Male-friendly FP services should also be institutionalised in policy intervention frameworks. Steps should include training reproductive healthcare providers, providing safe and private counselling space for men, and adopting a community-based approach that encourages men to participate in FP uptake and decision-making. Fertility communication messages should incorporate masculine identities.

On implications for the research aspect, the study suggests that future research may consider examining fertility outcomes by marital union types (formal/informal) and the duration/time spent in such marital unions. Since cross-sectional studies limit causal inferences, future research should consider employing a longitudinal study approach to follow through on the marital union and fertility experiences of men over time to record changes. Future research may also consider a qualitative approach to capture in-depth information, explaining why some men prefer higher fertility despite their exposure to education, wealth, FP knowledge and urbanization. Future research may also assess male fertility outcomes in non-marital unions.

### 5.2. Strengths and limitations

The strengths of this study include, first, its meaningful contribution to the literature on marital unions and male fertility in SSA. Fertility research in SSA has traditionally focused on women, while male fertility behaviour has remained underexplored. Second, the use of nationally representative, harmonized DHS datasets from three countries (Nigeria, South Africa, and Uganda), selected across three major regions of SSA, provides a broad range of cultural diversity that supports cross-country comparisons and contextual generalizations of the findings. Third, the use of a stratified regression analysis approach provides country-specific insights, allowing the study to avoid masking heterogeneity that may occur in pooled estimates. Fourth, the intersectional analysis of a wide range of variables, including sociodemographic and reproductive health predictors alongside the number of marital unions, enriches the understanding of male fertility determinants. This approach also extends beyond the conventionally female-centred perspective commonly used in fertility research.

However, some limitations should be acknowledged. First, the use of cross-sectional DHS data limits the ability of this study to establish temporal and causal relationships between the explanatory variables and men's fertility outcomes. To mitigate this limitation, the study focuses on theoretically and empirically justified variables, such as age at first marital union and educational level, and applies multivariable regression modelling to adjust for measured covariates that may confound the association between marital unions and male fertility. However, as with observational cross-sectional studies, residual confounding due to unmeasured or unknown factors cannot be completely ruled out. Second, the datasets used in the analysis were derived from surveys conducted in Nigeria (2018), South Africa (2016), and Uganda (2016). Although these were the most recent harmonized datasets available through IPUMS-DHS at the time of the study, fertility patterns and marital behaviours may have evolved since the surveys were conducted. To address this limitation, recent literature and contextual evidence were incorporated to reflect current realities. Third, because IPUMS-DHS data are self-reported, the findings may be subject to recall bias and potential underreporting or overreporting, particularly on issues related to fertility within or outside marital unions. To mitigate this limitation, the analysis emphasised biologically fathered children and examined their relationships with fertility preferences, number of marital unions, and respondents' age. Fourth, important qualitative dimensions, such as the quality and duration of marital unions and the lived contexts surrounding fertility outcomes, were not captured in the quantitative datasets. These aspects could be better explored through qualitative approaches such as in-depth interviews. Nonetheless, variables such as the number of marital unions, age at first marital union, and number of children were incorporated into the analysis as proxies for marital timing and union transitions. Notwithstanding, this study provides meaningful contributions to the body of knowledge and policy relevance regarding male fertility and marital union histories in SSA contexts. Future longitudinal or quasi-experimental studies would be valuable for establishing causal relationships.

## 6. Conclusion

This study provides evidence that the number of marital unions is associated with cumulative male fertility in SSA, although the strength and statistical significance of this association vary across countries. In Nigeria and Uganda, for instance, men with more than one marital union father significantly more children than their counterparts in a single marital union. The study highlights the consistent systemic role of polygynous and sequential marital unions in shaping fertility trajectories within these countries. In contrast, the absence of a statistically significant association between marital union history and fertility in South Africa reflects divergent fertility trajectories driven by unstable marital unions, non-marital childbearing norms, and declining fertility levels. Beyond marital unions, some moderating factors were consistently associated with fertility outcomes. Older age groups, rural residence, and a higher ideal number of children were linked to higher fertility, while higher educational attainment and entering the first marital union at older ages were associated with lower fertility. Household wealth status was associated with fertility outcomes in Nigeria and South Africa but not in Uganda, indicating that economic factors may influence fertility behaviour differently across contexts.

In sum, the study demonstrates that fertility behaviour in SSA is not accidental but reflects complex demographic dynamics, fertility transitions, and cultural and structural diversity. If the policy

recommendations proposed in this paper - such as targeted engagement of men in multiple marital unions, expansion of male-friendly reproductive health services, educational empowerment, and the strategic reframing of fertility norms through community-based co-creation approaches - are effectively implemented, substantial and positive transformations could be achieved in SSA. Conversely, failure to address the critical role of men in marital union formation and fertility outcomes may undermine progress toward key sustainable development goals, including universal health coverage, gender equality, and the attainment of demographic dividends. Therefore, repositioning men as central actors, rather than peripheral figures, in fertility research and policy is no longer optional; it is essential.

## CRediT authorship contribution statement

Turnwait Otu Michael: Conceptualization, Methodology, Investigation, Data curation, Formal analysis, Software, Validation, Visualization, Resources, Project administration, Writing – original draft, Writing – review & editing.

## Data availability statement

The data used in this study are publicly available through the IPUMS Demographic and Health Surveys (IPUMS-DHS) database. Access to the datasets can be obtained upon reasonable request and registration at https://www.idhsdata.org/idhs/. The authors do not have permission to share the data directly; however, all data are accessible to qualified researchers following approval by the DHS Program.

## Ethics statement

This study is based on a secondary analysis of publicly available Demographic and Health Survey (DHS) data. The datasets are fully anonymized and accessible to researchers upon request via the DHS Program (https://www.idhsdata.org/idhs/). Ethical approval for the original data collection was obtained from the ICF Institutional Review Board (IRB No: FWA00000845) as well as relevant country-specific institutional review boards, including Nigeria (NHREC/01/01/2007-18/03/2018), South Africa (EC008-2/2015), and Uganda (UNCST/UBOS-2016). As the present study involved analysis of de-identified secondary data, ethical approval is not applicable to this manuscript.

## Declaration on the use of AI

During the preparation of this manuscript, the author used Grammarly to improve the readability and language of the text. The author takes full responsibility for the content of this manuscript and has reviewed and edited the output as necessary.

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## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ssaho.2026.103312.

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