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Descriptive Finding

Education, religion, and male fertility in sub-Saharan Africa: A descriptive analysis

Afua Durowaa-Boateng

Contents

Education, religion, and male fertility in sub-Saharan Africa: A descriptive analysis

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Abstract

BACKGROUND
Male fertility remains under-studied in sub-Saharan Africa, particularly in terms of how education, religion, and relationship status influence fertility patterns. While female fertility is well documented, male fertility trends are less understood.

OBJECTIVE
This study investigates how education, religious affiliation, and relationship status shape changes in the mean number of children for men across birth cohorts in sub-Saharan Africa.

METHODS
The study uses a Poisson regression to find the relationship between various parameters of interest and the mean number of children ever born for males using Demographic and Health Surveys (DHS) data for 36 sub-Saharan African countries.

RESULTS
The mean number of children changed significantly across cohorts, with men in polygamous relationships having more children than others. However, education and religion have varying effects on male fertility across countries, with relationship status playing a much stronger role.

CONCLUSION
Relationship status and birth cohort play a more significant role in determining the number of children men have than the interaction between education and religion.

CONTRIBUTION
This study expands on male fertility research by highlighting the interplay of education, religion, and relationship status on a country-specific level, emphasising the need for targeted policies.

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1. Introduction

Despite high fertility rates in sub-Saharan Africa, male fertility remains under-researched due to data limitations, with few studies exploring the role of education and religion (for example, Butame 2019; Bietsch 2015; Turner and Götmark 2023). While female fertility declines with education, male fertility patterns are more complex (Schoumaker 2019; Dudel and Klüsener 2021; Bratsberg, Kotsadam, and Walther 2021). In sub-Saharan Africa, where female fertility rates are among the highest globally, male total fertility rates (TFR) are often even higher, with countries like Niger reporting a male TFR of around 12 children per man (Schoumaker 2019). Results such as those seen in Niger appear in countries where polygamy is prevalent, given that men can father more children at a time than women, because men face fewer biological constraints on simultaneous childbearing (Schoumaker 2017). In many sub-Saharan African countries, especially in the context of polygyny and in high-fertility contexts, the fertility desires of women reflect men's desire for more children (Doepke and Tertilt 2018; Speizer and Calhoun 2022; Bankole and Audam 2011). Moreover, contraceptive use is prevalent in households where the husband is in favour across various sub-Saharan African countries (Blackstone, Nwaozuru, and Iwelunmor 2017; Nkonde, Mukanga, and Daka 2023; Demeke, Legese, and Nigussie 2024). In addition, when couples disagreed on the desired family size, men typically had a higher preference than their wives (Bankole et al. 2007; Church et al. 2023). Consequently, studying male fertility across sub-Saharan Africa could help better understand and provide a broader overview of fertility and family formation dynamics.

While the role of education in reducing female fertility is well established even in high-fertility contexts like sub-Saharan Africa (Goujon, Lutz, and KC 2015; Bongaarts 2010; Grant 2015), very few studies examine its impact on male fertility (Menashe-Oren and Sánchez-Páez 2023). Since education reduces female fertility in the region, the existing relationship may likely exist for male fertility. The mechanisms through which education reduces female fertility are extensive and well documented, ranging from years spent in school increasing the age at first birth to labour force participation, among others (Asongu et al. 2021; Lutz et al. 2018; Kim 2023; Adhikari, Lutz, and Kebede 2024). However, such extensive channels are yet to be explored for men. Furthermore, formal education, in particular, reduces the likelihood of women joining polygamous unions (Fenske 2015), a trend that may apply to men, with better-educated men potentially being less likely to engage in polygamous unions (Menashe-Oren and Sánchez-Páez 2023). Furthermore, male education has a positive relationship with contraceptive use (Bietsch 2015), potentially translating to lower fertility rates for men with higher education.

Religious beliefs shape norms on marriage, contraception, and ideal family size, which may moderate the effect of education on fertility. In more conservative religious groups, education may not lower fertility as much due to restrictions on contraception and strong pronatalist values (McQuillan 2004). Some religious groups discourage con-

traceptive use, while others promote delayed marriage (Choi and Hamilton 2016; Hill, Siwatu, and Robinson 2014; Kan 2024). Recent studies on female fertility, education, and religion show that the role of education in reducing fertility levels persists irrespective of religious affiliation. However, there are some variations by country (Berger and Dasré 2024). Given that religious beliefs influence attitudes toward contraception, marriage, and ideal family size, it is plausible that the effect of education on fertility may vary by religious affiliation. These factors may moderate how education affects fertility, with more religious groups potentially resisting fertility reductions associated with schooling.

This study contributes to the literature by examining male fertility patterns by education, relationship status, and broad religious affiliations. The study focuses on changes in children ever born to men using data from the Demographic and Health Surveys (DHS) (DHS program 2023). This study investigates how education, religious affiliation, relationship status, and birth cohort shape male fertility patterns across sub-Saharan African countries. Given that polygamous men can father children at a much higher rate, this study differentiates fertility patterns by relationship status to provide a clearer picture of male fertility trends. The study employs a country-specific approach in investigating these relationships as sub-Saharan Africa presents a broad array of diversity in terms of social norms, polygyny prevalence (Chae and Agadjanian 2022), different proportions of the population by religion (Stonawski et al. 2015), and male fertility rates (Schoumaker 2017), among others. Given the wide variation in the variables of interest, pooling data could obscure key country-specific patterns in male fertility determinants.

2. Data and methods

The study uses data from 36 sub-Saharan African countries within the DHS men recode file from 1991 to 2023, including countries with only one survey (DHS program 2023). Since the interest of the study lies in children ever born, the data collected focuses only on males born between 1940 and 1979, as these groups of men should be nearing the end of their reproductive ages. Furthermore, the study excludes men who reported only one partner but recorded more than 30 children, as these values are implausible. The study classifies men's birth cohorts into 10-year groups from 1940 to 1979 for the analysis and data description. Religious affiliations are Catholic, Protestant, Universal, Jehovah's Witness (JW), Muslim, and none. The umbrella group, Protestant, joins all other Christian groups aside from Catholic and Jehovah's Witnesses, while the Universal group entails other spiritual/traditional/religious belief systems. Due to the differences in teachings and beliefs surrounding abortion and the use of contraceptives, Catholics, Jehovah's Witnesses, and Protestants are separated even though they fall under Christianity (McQuillan 2004). Since the study aims to expand knowledge on the mean number of children men have in different relationship types, the variable "relationship" reflects

how many wives/partners men have. The categories are "single" (for men currently without partners), "monogamous" (men with only one wife/partner), and "polygamous" (men with two or more wives/partners). In the educational categories, following the DHS, the groupings are "none," "primary," and "secondary+," which combines secondary and higher education levels. Events grouped by cohort, education, relationship, and number of children with fewer than two observations are removed from the sample, as these small events might lead to biased results, especially when calculating the means. Table 1 shows the unweighted sample used in the study by education level, religious affiliations, birth cohorts, and relationship status.

Table 1: **Sample by religious affiliation, education, relationship status, and cohort**

Religion	Education	Relationship	1940–1949	1950–1959	1960–1969	1970–1979	Total
Catholic	None	Monogamous	1,151	4,181	8,618	9,893	23,843
		Polygamous	729	2,217	3,571	2,516	9,033
		Single	68	256	455	501	1,280
	Primary	Monogamous	662	3,514	7,373	10,246	21,795
		Polygamous	150	706	1,148	1,063	3,067
		Single	110	402	785	1,024	2,321
	Secondary+	Monogamous	366	2,792	7,650	9,624	20,432
		Polygamous	80	559	1,081	936	2,656
		Single	32	293	797	1,395	2,517
JW	None	Monogamous	66	324	542	658	1,590
		Polygamous	18	69	97	75	259
		Single	9	37	50	53	149
	Primary	Monogamous	78	558	1,345	2,034	4,015
		Polygamous	26	132	270	228	656
		Single	10	57	118	175	360
	Secondary+	Monogamous	54	413	1,237	2,075	3,779
		Polygamous	6	46	141	179	372
		Single	4	36	91	205	336
Muslim	None	Monogamous	37	160	250	282	729
		Polygamous	24	85	114	91	314
		Single	5	23	32	21	81
	Primary	Monogamous	16	146	299	395	856
		Polygamous	12	38	74	63	187
		Single	3	17	34	54	108
	Secondary+	Monogamous	18	128	277	465	888
		Polygamous	7	31	50	35	123
		Single	1	15	35	87	138
None	None	Monogamous	6	24	70	87	187
		Polygamous	2	6	16	24	48
		Single		5	15	15	35
	Primary	Monogamous	3	29	114	168	314
		Polygamous		6	35	40	81
		Single		8	23	53	84
	Secondary+	Monogamous		49	214	423	686
		Polygamous		14	46	44	104
		Single	1	9	54	105	169
Protestant	None	Monogamous	622	2,455	5,250	6,465	14,792
		Polygamous	332	1,150	2,123	1,972	5,577
		Single	58	203	381	433	1,075
	Primary	Monogamous	911	3,857	8,650	12,362	25,780
		Polygamous	204	709	1,468	1,575	3,956
		Single	137	501	964	1,349	2,951
	Secondary+	Monogamous	426	3,181	9,949	13,972	27,528
		Polygamous	82	463	1,278	1,268	3,091
		Single	48	319	1,056	1,780	3,203
Universal	None	Monogamous	222	790	1,486	1,797	4,295
		Polygamous	119	313	454	322	1,208
		Single	29	74	82	84	269
	Primary	Monogamous	110	487	1,213	1,830	3,640
		Polygamous	27	127	241	230	625
		Single	15	59	122	142	338
	Secondary+	Monogamous	57	368	1,030	1,554	3,009
		Polygamous	17	54	116	112	299
		Single	5	43	107	208	363
Total			**7,175**	**32,538**	**73,091**	**92,787**	**205,591**

Table 2 shows the unweighted sample by each country.

Table 2:   **Sample by country**

Country	N (unweighted)
Angola	2,914
Benin	4,417
Burkina Faso	4,812
Burundi	3,851
Cameroon	8,417
Central African Republic	991
Chad	4,093
Comoros	774
Congo	3,024
Congo Democratic Republic	2,246
Cote d'Ivoire	2,254
Ethiopia	13,331
Gabon	3,355
Gambia	2,218
Ghana	7,058
Guinea	5,723
Kenya	9,245
Lesotho	1,833
Liberia	5,692
Madagascar	7,323
Malawi	8,379
Mali	9,244
Mozambique	5,954
Namibia	3,979
Niger	3,905
Nigeria	18,073
Rwanda	7,901
Sao Tome and Principe	975
Senegal	12,965
Sierra Leone	6,892
Swaziland	1,430
Tanzania	3,454
Togo	1,937
Uganda	4,994
Zambia	13,601
Zimbabwe	8,337
Total	**205,591**

Figures 1 and 2 show the mean number of children men have by country, reli-gion, 10-year birth cohort, religious affiliation, and education for the 1940–1959 and 1960–1979 birth cohorts, respectively, after accounting for survey weights.

Figure 1: **Mean number of children by relationship, religion, and education, 1940 to 1959**
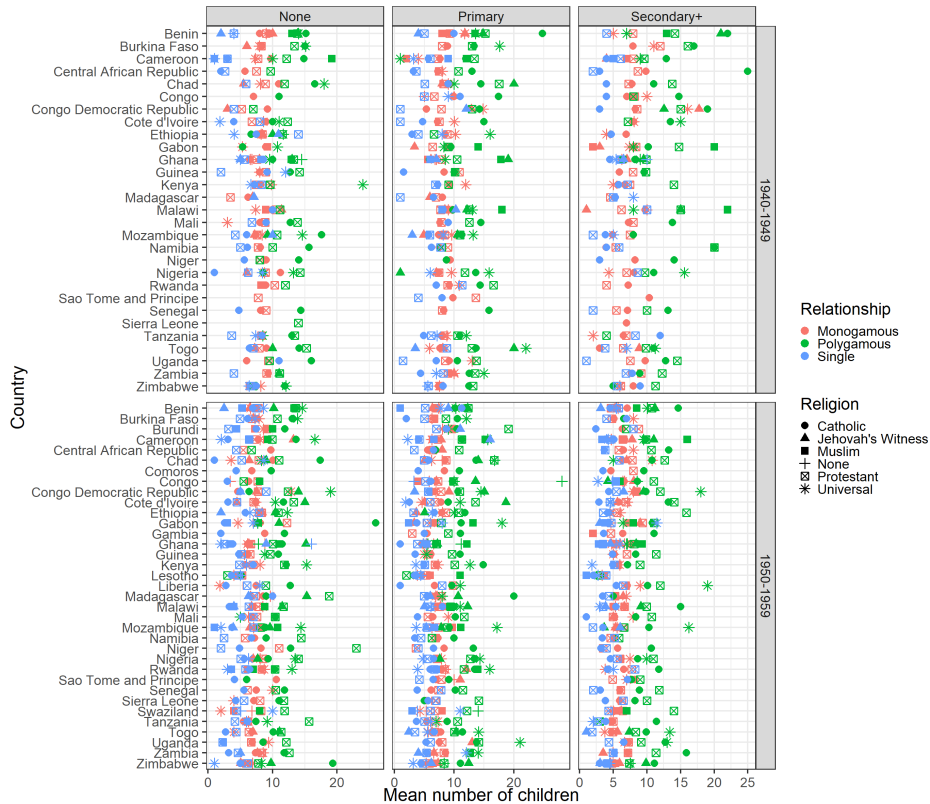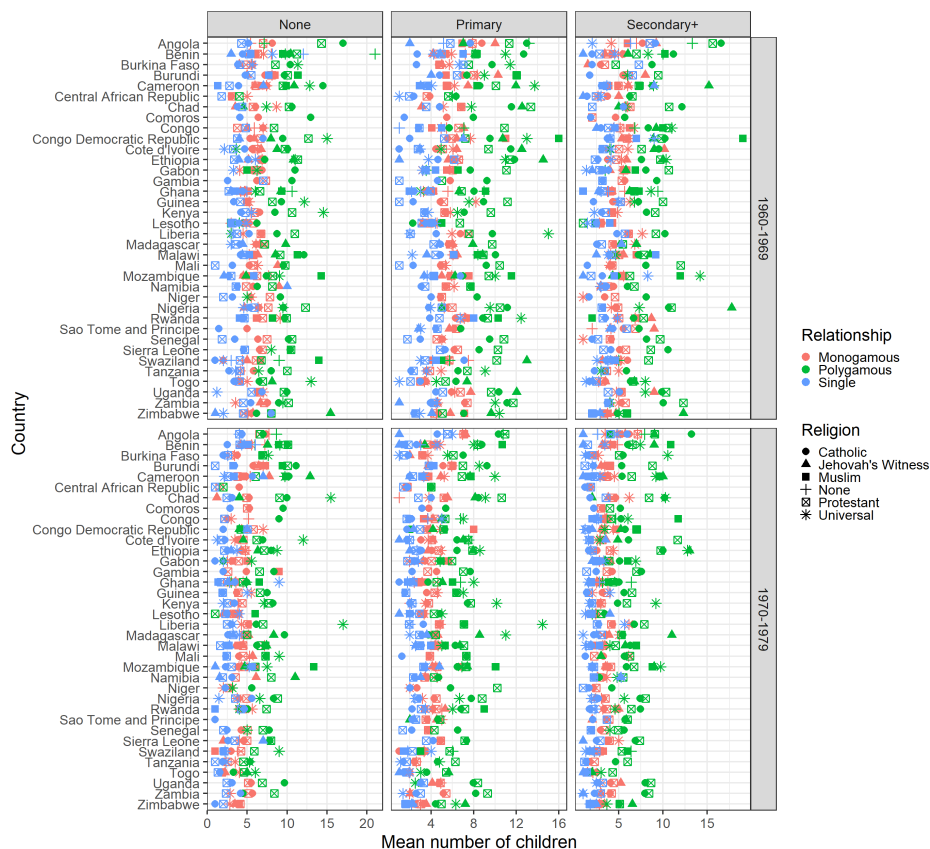
Figure 2: **Mean number of children by relationship, religion, and education, 1960 to 1979**

In all countries, men in polygamous relationships have more children on average than single and monogamous men. Furthermore, men born between 1970 and 1979 have fewer children than other birth cohorts. Similarly, men with secondary and higher education experience fewer children ever born on average than other categories. Regarding religion, no specific religious affiliation records the highest mean number of children ever born across all countries. For this reason, the proposed model focuses on each country to explore how the interaction between religion and education influences male fertility levels, considering variations in relationship status and birth cohort.

3. Model

Since this study focuses on the mean number of children men have in sub-Saharan Africa, the first step in the analysis involved calculating the mean number of children from the sample reported in Table 1 by country, religious affiliation, relationship, education, and 10-year birth cohort considering the survey weights using the svyby function from the survey package in R statistical software (Lumley 2020). The Poisson regression is most suited for this type of analysis, given that the variable of interest, children ever born, is a count variable that does not take on negative values (Cameron and Trivedi 2013). Given the substantial heterogeneity in fertility norms, educational attainment, and religious compositions across sub-Saharan Africa, this study estimates separate models for each country to capture country-specific patterns more accurately. Aggregating countries may obscure important country-specific dynamics, particularly given the varying prevalence of polygamy, contraception access, and socioeconomic conditions (Schoumaker 2019). For example, polygamous marriage rates, which strongly influence male fertility, vary widely by country (e.g., approximately 34% in Chad vs. approximately 2% in South Africa) (Garenne 2022), making a single pooled model less appropriate. By estimating separate models, the study ensures that observed effects are not driven by a few high-fertility or low-fertility countries. The collected means undergo a simple Poisson regression performed for each country, defined as

$$
\begin{aligned}
log(\lambda_i) = \quad & \beta_0 + \beta_j Cohort_j + \beta_k Religion_k + \beta_l Education_l \\
& + \beta_m Relationship_m + \beta_{kl} Religion_k Education_l,
\end{aligned}
$$

where β_0 is the coefficient of the intercept, β_j represents the coefficients of each cohort group j, β_k corresponds to the coefficients of each religious affiliation k, β_l is the coefficient to each education group l, β_m is the coefficient to each relationship status m, and β_{kl} is the respective coefficient to the interaction between each religious affiliation k and education level l. Due to small sample sizes in some education–religion subgroups, estimates should be interpreted cautiously. Additionally, the study runs three supplementary models – one without the interaction term, one without relationship status but including the interaction, and one excluding both – to assess the relationship of men's education to their number of children. In the models without marital status, the mean number of children is collected without relationship status.

4. Results

Table 3 presents the estimated coefficients with 95% confidence intervals. The reference categories are denoted as RC, and other abbreviations are noted below the table.

Table 3: **Log coefficients of Poisson regression for each country**

Parameter	Variable	Angola	Benin	Burkina Faso	Burundi	Cameroon	CAR
Birth cohort	Intercept	2.19 [4.38–0]	2.19 [4.37–0]	2.24 [4.48–0]	2.21 [4.42–0]	2.03 [4.06–0]	2.07 [4.14–0]
	1940–1949	RC	RC	RC	RC	RC	RC
	1950–1959		–0.20 [–0.40–0]	–0.34 [–0.68–0]		0.11 [0.22–0]	–0.17 [–0.34–0]
	1960–1969		–0.42 [–0.84–0]	–0.50 [–1–0]	–0.16 [–0.31–0]	–0.12 [–0.24–0]	–0.81 [–1.62–0]
	1970–1979	–0.27 [–0.55–0]	–0.69 [–1.37–0]	–1.01 [–2.02–0]	–0.42 [–0.85–0]	–0.37 [–0.74–0]	–1.22 [–2.45–0]
Religion	Catholic	RC	RC	RC	RC	RC	RC
	Protestant	–0.14 [–0.28–0]	0.03 [0.06–0]	–0.11 [–0.22–0]	–0.08 [–0.16–0]	–0.25 [–0.49–0]	–0.27 [–0.55–0]
	JW	–0.37 [–0.74–0]	–0.17 [–0.34–0]	–0.25 [–0.5–0]	–0.18 [–0.37–0]	0.24 [0.49–0]	–0.09 [–0.18–0]
	Muslim	–0.71 [–1.42–0]	0 [0–0]		–0.02 [–0.03–0]	–0.19 [–0.38–0]	
	Universal	–0.77 [–1.55–0]	0.06 [0.12–0]	0.06 [0.12–0]	0.03 [0.07–0]	–0.13 [–0.27–0]	0.35 [0.69–0]
	None	–0.26 [–0.51–0]	0.49 [0.98–0]				
Education	None	RC	RC	RC	RC	RC	RC
	Primary	0.05 [0.10–0]	0.14 [0.27–0]	–0.16 [–0.32–0]	–0.07 [–0.15–0]	–0.23 [–0.46–0]	–0.05 [–0.10–0]
	Secondary+	0.18 [0.36–0]	0.01 [0.02–0]	–0.22 [–0.44–0]	–0.55 [–1.10–0]	–0.30 [–0.59–0]	0.21 [0.41–0]
Religion: Education	Catholic: None	RC	RC	RC	RC	RC	RC
	Catholic: Primary	RC	RC	RC	RC	RC	RC
	Catholic: Secondary+	RC	RC	RC	RC	RC	RC
	Protestant: None	RC	RC	RC	RC	RC	RC
	Protestant: Primary	0.08 [0.16–0]	–0.27 [–0.54–0]	0.12 [0.24–0]	0.27 [0.54–0]	0.28 [0.56–0]	0.24 [0.49–0]
	Protestant: Secondary+	0.03 [0.07–0]	–0.31 [–0.62–0]	0.10 [0.19–0]	0.47 [0.94–0]	0.24 [0.48–0]	0.03 [0.06–0]
	JW: None	RC	RC	RC	RC	RC	RC
	JW: Primary	–0.04 [–0.09–0]	–0.10 [–0.20–0]	0.15 [0.29–0]	0.39 [0.79–0]	0.05 [0.10–0]	0.32 [0.64–0]
	JW: Secondary+		–0.05 [–0.10–0]	–0.84 [–1.68–0]	0.51 [1.02–0]	–0.05 [–0.10–0]	
	Muslim: None	RC	RC	RC	RC	RC	RC
	Muslim: Primary	0.41 [0.81–0]	–0.25 [–0.50–0]	0.13 [0.25–0]	0.09 [0.17–0]	0.24 [0.49–0]	
	Muslim: Secondary+		–0.16 [–0.31–0]	0.32 [0.65–0]	0.17 [0.33–0]	0.25 [0.50–0]	
	Universal: None	RC	RC	RC	RC	RC	RC
	Universal: Primary	0.78 [1.57–0]	–0.18 [–0.36–0]		–0.08 [–0.15–0]	0.08 [0.17–0]	–0.34 [–0.69–0]
	Universal: Secondary+		–0.36 [–0.72–0]		–0.09 [–0.17–0]	0.11 [0.23–0]	–0.43 [–0.85–0]
	None: None	RC	RC	RC	RC	RC	RC
	None: Primary	0.21 [0.42–0]	–0.58 [–1.16–0]				
	None: Secondary+	–0.02 [–0.05–0]	–0.58 [–1.15–0]				
Relationship status	Monogamous	RC	RC	RC	RC	RC	RC
	Single	–0.41 [–0.82–0]	–0.26 [–0.52–0]	–0.20 [–0.41–0]	–0.38 [–0.77–0]	–0.38 [–0.75–0]	–0.67 [–1.34–0]
	Polygamous	0.38 [0.75–0]	0.59 [1.18–0]	0.57 [1.15–0]	0.33 [0.67–0]	0.60 [1.20–0]	0.53 [1.05–0]

Notes: RC – Reference category
JW – Jehovah's Witness
CAR – Central African Republic

Table 3: **(Continued)**

Parameter	Variable	Chad	Comoros	Congo	Congo DR	Cote d'Ivoire	Ethiopia
Birth cohort	Intercept	2.25 [4.50–0]	2.14 [4.28–0]	2.06 [4.12–0]	2.10 [4.20–0]	2.05 [4.10–0]	1.96 [3.93–0]
	1940–1949	RC	RC	RC	RC	RC	RC
	1950–1959	-0.1 [-0.21–0]		-0.25 [-0.51–0]	-0.18 [-0.37–0]	-0.07 [-0.15–0]	-0.10 [-0.2–0]
	1960–1969	-0.36 [-0.72–0]	-0.29 [-0.57–0]	-0.41 [-0.83–0]	-0.33 [-0.66–0]	-0.35 [-0.71–0]	-0.22 [-0.43–0]
	1970–1979	-0.51 [-1.02–0]	-0.49 [-0.99–0]	-0.80 [-1.60–0]	-0.97 [-1.95–0]	-0.68 [-1.37–0]	-0.49 [-0.99–0]
Religion	Catholic	RC	RC	RC	RC	RC	RC
	Protestant	-0.14 [-0.28–0]	-0.04 [-0.07–0]	-0.14 [-0.29–0]	0.09 [0.17–0]	0.06 [0.12–0]	0.18 [0.36–0]
	JW	-0.65 [-1.30–0]		-0.04 [-0.08–0]	0.04 [0.07–0]	-0.03 [-0.05–0]	0.04 [0.07–0]
	Muslim			-0.23 [-0.46–0]	0.44 [0.87–0]		RC
	Universal	-0.04 [-0.08–0]		0.14 [0.27–0]	0.63 [1.26–0]	-0.09 [-0.19–0]	0.12 [0.25–0]
	None	-0.47 [-0.93–0]		-0.02 [-0.04–0]			0.04 [0.09–0]
Education	None	RC	RC	RC	RC	RC	RC
	Primary	0.01 [0.02–0]	-0.21 [-0.41–0]	0.11 [0.22–0]	0 [0–0]	-0.05 [-0.11–0]	0.07 [0.15–0]
	Secondary+	-0.18 [-0.35–0]	-0.43 [-0.86–0]	-0.05 [-0.09–0]	0.08 [0.17–0]	-0.05 [-0.1–0]	-0.18 [-0.35–0]
Religion: Education	Catholic: None	RC	RC	RC	RC	RC	RC
	Catholic: Primary	RC	RC	RC	RC	RC	RC
	Catholic: Secondary+	RC	RC	RC	RC	RC	RC
	Protestant: None	RC	RC	RC	RC	RC	RC
	Protestant: Primary	0.16 [0.32–0]		0.06 [0.13–0]	-0.09 [-0.17–0]	0 [-0.01–0]	-0.25 [-0.49–0]
	Protestant: Secondary+	0.18 [0.36–0]	-0.04 [-0.07–0]	0.16 [0.31–0]	-0.04 [-0.07–0]	-0.04 [-0.08–0]	0.02 [0.03–0]
	JW: None	RC	RC	RC	RC	RC	RC
	JW: Primary	0.58 [1.15–0]		0.12 [0.24–0]	0.27 [0.54–0]	0.23 [0.46–0]	-0.28 [-0.56–0]
	JW: Secondary+	0.25 [0.51–0]		-0.06 [-0.11–0]	0.04 [0.08–0]	0.14 [0.28–0]	0.27 [0.53–0]
	Muslim: None	RC	RC	RC	RC	RC	RC
	Muslim: Primary			-0.03 [-0.06–0]	0.07 [0.14–0]		
	Muslim: Secondary+			0.37 [0.74–0]			
	Universal: None	RC	RC	RC	RC	RC	RC
	Universal: Primary	-0.16 [-0.31–0]		-0.13 [-0.25–0]	-0.26 [-0.52–0]	0.03 [0.07–0]	-0.02 [-0.05–0]
	Universal: Secondary+	-0.03 [-0.05–0]		0.02 [0.04–0]	-0.33 [-0.65–0]	0.04 [0.09–0]	0.06 [0.12–0]
	None: None	RC	RC	RC	RC	RC	RC
	None: Primary			0.16 [0.33–0]			
	None: Secondary+			0.01 [0.01–0]			
Relationship status	Monogamous	RC	RC	RC	RC	RC	RC
	Single	-0.46 [-0.91–0]	-0.59 [-1.18–0]	-0.31 [-0.62–0]	-0.35 [-0.70–0]	-0.64 [-1.28–0]	-0.31 [-0.63–0]
	Polygamous	0.53 [1.05–0]	0.43 [0.86–0]	0.50 [1–0]	0.40 [0.80–0]	0.53 [1.06–0]	0.52 [1.04–0]

Notes: RC – Reference category
JW – Jehovah's Witness

Table 3: (Continued)

Parameter	Variable	Gabon	Gambia	Ghana	Guinea	Kenya	Lesotho
Birth cohort	Intercept	2.12 [4.23–0]	1.9 [3.8–0]	2.05 [4.11–0]	2.14 [4.27–0]	2.2 [4.4–0]	1.65 [3.31–0]
	1940–1949	RC	RC	RC	RC	RC	RC
	1950–1959	0.05 [0.09–0]	-0.1 [-0.19–0]	-0.21 [-0.41–0]	-0.26 [-0.52–0]	-0.25 [-0.51–0]	-0.09 [-0.18–0]
	1960–1969	-0.34 [-0.68–0]	-0.41 [-0.82–0]	-0.48 [-0.95–0]	-0.34 [-0.68–0]	-0.48 [-0.96–0]	-0.33 [-0.66–0]
	1970–1979	-0.71 [-1.43–0]		-0.83 [-1.67–0]	-0.68 [-1.36–0]	-0.79 [-1.59–0]	
Religion	Catholic	RC	RC	RC	RC	RC	RC
	Protestant	0.17 [0.35–0]	0.07 [0.15–0]	-0.12 [-0.23–0]	-0.08 [-0.17–0]	-0.06 [-0.13–0]	-0.22 [-0.44–0]
	JW	0.02 [0.04–0]		0.09 [0.19–0]			-0.63 [-1.26–0]
	Muslim	-0.23 [-0.45–0]	0.71 [1.41–0]	0.04 [0.08–0]			0.02 [0.04–0]
	Universal	-0.29 [-0.58–0]		-0.13 [-0.26–0]	0.14 [0.29–0]	0.18 [0.35–0]	-0.05 [-0.09–0]
	None			0.2 [0.41–0]		-0.68 [-1.37–0]	
Education	None	RC	RC	RC	RC	RC	RC
	Primary	-0.15 [-0.3–0]	-0.03 [-0.06–0]	-0.42 [-0.84–0]	-0.19 [-0.39–0]	-0.03 [-0.06–0]	-0.23 [-0.45–0]
	Secondary+	-0.12 [0.24–0]	-0.07 [-0.13–0]	-0.24 [-0.48–0]	-0.29 [-0.57–0]	-0.29 [-0.59–0]	-0.57 [-1.15–0]
Religion: Education	Catholic: None	RC	RC	RC	RC	RC	RC
	Catholic: Primary	RC	RC	RC	RC	RC	RC
	Catholic: Secondary+	RC	RC	RC	RC	RC	RC
	Protestant: None	RC	RC	RC	RC	RC	RC
	Protestant: Primary	-0.2 [-0.39–0]	-0.49 [-0.98–0]	0.35 [0.7–0]	0.19 [0.37–0]	-0.04 [-0.09–0]	0.34 [0.68–0]
	Protestant: Secondary+	-0.07 [-0.15–0]	-0.22 [-0.43–0]	0.15 [0.3–0]	0.31 [0.62–0]	0.18 [0.37–0]	0.31 [0.62–0]
	JW: None	RC	RC	RC	RC	RC	RC
	JW: Primary	-0.41 [-0.83–0]		0.3 [0.59–0]			0.05 [0.11–0]
	JW: Secondary+	-0.3 [-0.59–0]		-0.03 [-0.07–0]			1.14 [2.29–0]
	Muslim: None	RC	RC	RC	RC	RC	RC
	Muslim: Primary	0.32 [0.65–0]	-1.85 [-3.7–0]	0.41 [0.82–0]			0.31 [0.62–0]
	Muslim: Secondary+	0.22 [0.43–0]		-0.07 [-0.13–0]			0.15 [0.3–0]
	Universal: None	RC	RC	RC	RC	RC	RC
	Universal: Primary	0.27 [0.55–0]		0.21 [0.41–0]	-0.09 [-0.19–0]	-0.15 [-0.31–0]	0.22 [0.44–0]
	Universal: Secondary+	0.16 [0.32–0]		0.14 [0.28–0]	0 [0–0]	-0.18 [-0.36–0]	0.03 [0.05–0]
	None: None	RC	RC	RC	RC	RC	RC
	None: Primary			0.26 [0.53–0]			
	None: Secondary+			0.12 [0.24–0]			
Relationship status	Monogamous	RC	RC	RC	RC	RC	RC
	Single	-0.42 [-0.84–0]	-0.54 [-1.08–0]	-0.21 [-0.43–0]	-0.38 [-0.77–0]	-0.3 [-0.6–0]	-0.19 [-0.38–0]
	Polygamous	0.39 [0.77–0]	0.56 [1.11–0]	0.48 [0.97–0]	0.46 [0.92–0]	0.58 [1.16–0]	0.03 [0.06–0]

Notes: RC – Reference category
JW – Jehovah's Witness

Table 3: **(Continued)**

Parameter	Variable	Liberia	Madagascar	Malawi	Mali	Mozambique	Namibia
Birth cohort	Intercept	1.90 [3.81–0]	1.97 [3.95–0]	2.27 [4.55–0]	2.17 [4.34–0]	2.01 [4.02–0]	2.15 [4.29–0]
	1940–1949	RC	RC	RC	RC	RC	RC
	1950–1959		0.12 [0.23–0]	−0.28 [−0.56–0]	−0.29 [−0.58–0]	−0.16 [−0.33–0]	−0.34 [−0.67–0]
	1960–1969	−0.18 [−0.35–0]	−0.21 [−0.42–0]	−0.46 [−0.91–0]	−0.49 [−0.98–0]	−0.34 [−0.67–0]	−0.58 [−1.15–0]
	1970–1979	−0.34 [−0.68–0]	−0.44 [−0.87–0]	−0.87 [−1.74–0]	−0.73 [−1.46–0]	−0.52 [−1.04–0]	−0.91 [−1.82–0]
Religion	Catholic	RC	RC	RC	RC	RC	RC
	Protestant	−0.02 [−0.04–0]	−0.04 [−0.09–0]	−0.05 [−0.11–0]	0.01 [0.03–0]	−0.01 [−0.02–0]	−0.07 [−0.14–0]
	JW		0.05 [0.10–0]	−0.02 [−0.04–0]	0.41 [0.83–0]	−0.13 [−0.26–0]	0.59 [1.18–0]
	Muslim			−0.06 [−0.12–0]	−0.22 [−0.44–0]	0.29 [0.58–0]	
	Universal	−0.04 [−0.08–0]	0.02 [0.05–0]	0.04 [0.07–0]		0.15 [0.31–0]	0.12 [0.24–0]
	None						
Education	None	RC	RC	RC	RC	RC	RC
	Primary	−0.08 [−0.17–0]	0.03 [0.07–0]	−0.07 [−0.13–0]	−0.04 [−0.09–0]	0.05 [0.09–0]	−0.07 [−0.15–0]
	Secondary+	−0.01 [−0.02–0]	−0.46 [−0.92–0]	−0.07 [−0.13–0]	−0.27 [−0.55–0]	−0.23 [−0.45–0]	−0.18 [−0.35–0]
Religion: Education	Catholic: None	RC	RC	RC	RC	RC	RC
	Catholic: Primary	RC	RC	RC	RC	RC	RC
	Catholic: Secondary+	RC	RC	RC	RC	RC	RC
	Protestant: None	RC	RC	RC	RC	RC	RC
	Protestant: Primary	0.15 [0.29–0]	−0.18 [−0.35–0]	0.03 [0.06–0]	−0.06 [−0.12–0]	0.02 [0.04–0]	−0.02 [−0.04–0]
	Protestant: Secondary+	0.08 [0.15–0]	0.14 [0.28–0]	−0.04 [−0.09–0]	0.17 [0.34–0]	−0.01 [−0.02–0]	0.12 [0.24–0]
	JW: None	RC	RC	RC	RC	RC	RC
	JW: Primary		−0.16 [−0.32–0]	0.05 [0.09–0]	−0.61 [−1.22–0]	−0.03 [−0.06–0]	−0.49 [−0.97–0]
	JW: Secondary+		0.36 [0.72–0]	−0.20 [−0.40–0]		0.06 [0.11–0]	−0.43 [−0.86–0]
	Muslim: None	RC	RC	RC	RC	RC	RC
	Muslim: Primary			0.14 [0.28–0]	0.45 [0.91–0]	−0.07 [−0.14–0]	
	Muslim: Secondary+			0.28 [0.57–0]	0.61 [1.22–0]	0.03 [0.06–0]	
	Universal: None	RC	RC	RC	RC	RC	RC
	Universal: Primary	0.29 [0.57–0]	−0.17 [−0.35–0]	−0.09 [−0.17–0]		−0.02 [−0.05–0]	0.21 [0.43–0]
	Universal: Secondary+	0.45 [0.89–0]	0.44 [0.88–0]	−0.4 [−0.79–0]		0.34 [0.68–0]	
	None: None	RC	RC	RC	RC	RC	RC
	None: Primary						
	None: Secondary+						
Relationship status	Monogamous	RC	RC	RC	RC	RC	RC
	Single	−0.36 [−0.73–0]	−0.26 [−0.52–0]	−0.24 [−0.48–0]	−0.45 [−0.89–0]	−0.36 [−0.73–0]	−0.22 [−0.44–0]
	Polygamous	0.54 [1.07–0]	0.49 [0.99–0]	0.46 [0.92–0]	0.56 [1.11–0]	0.46 [0.92–0]	0.55 [1.09–0]

Notes: RC – Reference category
JW – Jehovah's Witness

Table 3:　　　**(Continued)**

Parameter	Variable	Niger	Nigeria	Rwanda	Sao Tome and Principe	Senegal	Sierra Leone
	Intercept	2.06 [4.12–0]	2 [4–0]	2.23 [4.46–0]	2.15 [4.30–0]	2.18 [4.35–0]	2.08 [4.16–0]
Birth cohort	1940–1949	RC	RC	RC	RC	RC	RC
	1950–1959	0.07 [0.15–0]	–0.06 [–0.12–0]	–0.17 [–0.33–0]	–0.25 [–0.49–0]	–0.13 [–0.27–0]	–0.20 [–0.41–0]
	1960–1969	–0.33 [–0.65–0]	–0.25 [–0.50–0]	–0.35 [–0.71–0]	–0.54 [–1.07–0]	–0.38 [–0.75–0]	–0.27 [–0.54–0]
	1970–1979	–0.78 [–1.57–0]	–0.64 [–1.28–0]	–0.78 [–1.55–0]	–1 [–1.99–0]	–0.77 [–1.54–0]	–0.57 [–1.13–0]
Religion	Catholic	RC	RC	RC	RC	RC	RC
	Protestant	0.06 [0.11–0]	0.20 [0.40–0]	0.03 [0.05–0]	–0.10 [–0.20–0]	–0.05 [–0.10–0]	0.08 [0.15–0]
	JW		–0.23 [–0.45–0]	0.42 [0.85–0]	0.11 [0.22–0]		0.09 [0.18–0]
	Muslim			–0.26 [–0.52–0]			
	Universal	–0.47 [–0.94–0]	0.10 [0.20–0]	0.03 [0.06–0]	–0.30 [–0.59–0]	0.02 [0.04–0]	–0.27 [–0.54–0]
	None			0.15 [0.29–0]	–1.16 [–2.33–0]		
Education	None	RC	RC	RC	RC	RC	RC
	Primary	–0.07 [–0.13–0]	0.08 [0.17–0]	0.01 [0.02–0]	0.23 [0.47–0]	–0.10 [–0.20–0]	–0.12 [–0.24–0]
	Secondary+	–0.23 [–0.46–0]	–0.08 [–0.16–0]	–0.18 [–0.37–0]	0.24 [0.48–0]	–0.26 [–0.52–0]	–0.14 [–0.29–0]
Religion: Education	Catholic: None	RC	RC	RC	RC	RC	RC
	Catholic: Primary	RC	RC	RC	RC	RC	RC
	Catholic: Secondary+	RC	RC	RC	RC	RC	RC
	Protestant: None	RC	RC	RC	RC	RC	RC
	Protestant: Primary	–0.08 [–0.15–0]	–0.22 [–0.43–0]	0.07 [0.13–0]	0.08 [0.16–0]	0.06 [0.12–0]	0.14 [0.28–0]
	Protestant: Secondary+	–0.27 [–0.54–0]	–0.13 [–0.27–0]	–0.02 [–0.04–0]	0.13 [0.27–0]	0.01 [0.01–0]	–0.01 [–0.02–0]
	JW: None	RC	RC	RC	RC		RC
	JW: Primary		–0.55 [–1.11–0]	0.42 [0.83–0]	–0.15 [–0.30–0]		–1.25 [–2.51–0]
	JW: Secondary+		0.70 [1.40–0]	0.06 [0.12–0]			
	Muslim: None	RC	RC	RC			RC
	Muslim: Primary						
	Muslim: Secondary+						
	Universal: None	RC	RC	RC	RC	RC	RC
	Universal: Primary	–0.05 [–0.09–0]	–0.10 [–0.20–0]	0.10 [0.19–0]	0.30 [0.61–0]	–0.11 [–0.22–0]	0.51 [1.02–0]
	Universal: Secondary+	–1.03 [–2.06–0]	–0.14 [–0.28–0]	–0.08 [–0.16–0]		–0.72 [–1.44–0]	
	None: None	RC	RC	RC	RC	RC	RC
	None: Primary			–0.16 [–0.32–0]	1.33 [2.65–0]		
	None: Secondary+						
Relationship status	Monogamous	RC	RC	RC	RC	RC	RC
	Single	–0.60 [–1.19–0]	–0.31 [–0.63–0]	–0.30 [–0.60–0]	–0.48 [–0.97–0]	–0.61 [–1.21–0]	–0.21 [–0.41–0]
	Polygamous	0.54 [1.07–0]	0.52 [1.04–0]	0.37 [0.75–0]	0.07 [0.14–0]	0.53 [1.07–0]	0.49 [0.98–0]

Notes: RC – Reference category
JW – Jehovah's Witness

Table 3: **(Continued)**

Parameter	Variable	Swaziland	Tanzania	Togo	Uganda	Zambia	Zimbabwe
Birth cohort	Intercept	1.33 [2.66–0]	2.11 [4.22–0]	2.05 [4.10–0]	2.18 [4.35–0]	2.13 [4.26–0]	2.23 [4.45–0]
	1940–1949	RC	RC	RC	RC	RC	RC
	1950–1959		-0.27 [-0.53–0]	-0.30 [-0.60–0]	-0.05 [-0.10–0]	-0.05 [-0.09–0]	-0.24 [-0.49–0]
	1960–1969	-0.25 [-0.50–0]	-0.56 [-1.12–0]	-0.74 [-1.48–0]	-0.28 [-0.56–0]	-0.29 [-0.57–0]	-0.47 [-0.95–0]
	1970–1979	-0.72 [-1.44–0]	-1.02 [-2.05–0]	-1.30 [-2.61–0]	-0.63 [-1.26–0]	-0.65 [-1.31–0]	-0.90 [-1.80–0]
Religion	Catholic	RC	RC	RC	RC	RC	RC
	Protestant	0.55 [1.10–0]	0.04 [0.08–0]	0.06 [0.13–0]	-0.13 [-0.26–0]	0.01 [0.02–0]	-0.25 [-0.51–0]
	JW	0.53 [1.06–0]		-0.04 [-0.07–0]	0.25 [0.50–0]	-0.07 [-0.14–0]	-0.04 [-0.09–0]
	Muslim	0.47 [0.95–0]					-0.17 [-0.33–0]
	Universal	0.61 [1.21–0]	-0.05 [-0.10–0]	0.34 [0.68–0]	-0.09 [-0.19–0]	-0.15 [-0.30–0]	-0.28 [-0.55–0]
	None	0.50 [1–0]					
Education	None	RC	RC	RC	RC	RC	RC
	Primary	0.65 [1.31–0]	-0.18 [-0.36–0]	0.03 [0.07–0]	-0.03 [-0.05–0]	0.05 [0.11–0]	-0.18 [-0.35–0]
	Secondary+	0.45 [0.91–0]	-0.06 [-0.13–0]	-0.28 [-0.56–0]	-0.03 [-0.06–0]	0 [-0.01–0]	-0.34 [-0.68–0]
Religion: Education	Catholic: None	RC	RC	RC	RC	RC	RC
	Catholic: Primary	RC	RC	RC	RC	RC	RC
	Catholic: Secondary+	RC	RC	RC	RC	RC	RC
	Protestant: None	RC	RC	RC	RC	RC	RC
	Protestant: Primary	-0.62 [-1.25–0]	0.09 [0.17–0]	-0.11 [-0.23–0]	0.13 [0.25–0]	0.06 [0.12–0]	0.16 [0.32–0]
	Protestant: Secondary+	-0.48 [-0.95–0]	-0.38 [-0.76–0]	-0.03 [-0.07–0]	0.01 [0.02–0]	0.03 [0.05–0]	0.22 [0.44–0]
	JW: None	RC	RC	RC	RC	RC	RC
	JW: Primary	-0.29 [-0.58–0]		0.04 [0.08–0]	-0.05 [-0.10–0]	-0.24 [-0.49–0]	0.25 [0.50–0]
	JW: Secondary+	-0.64 [-1.29–0]		0.09 [0.18–0]		-0.56 [-1.11–0]	0.28 [0.57–0]
	Muslim: None	RC	RC	RC	RC	RC	RC
	Muslim: Primary	-0.83 [-1.66–0]					0.24 [0.47–0]
	Muslim: Secondary+	-0.56 [-1.12–0]					0.03 [0.06–0]
	Universal: None	RC	RC	RC	RC	RC	RC
	Universal: Primary	-0.55 [-1.09–0]	0.22 [0.45–0]	-0.31 [-0.62–0]	0.27 [0.54–0]	0.18 [0.37–0]	0.25 [0.49–0]
	Universal: Secondary+	-0.64 [-1.27–0]	-0.14 [-0.29–0]	-0.09 [-0.18–0]	-0.40 [-0.80–0]	0.18 [0.36–0]	RC
	None: None	RC	RC	RC	RC	RC	RC
	None: Primary	-0.64 [-1.28–0]					
	None: Secondary+	-0.60 [-1.20–0]					
Relationship status	Monogamous	RC	RC	RC	RC	RC	RC
	Single	-0.21 [-0.42–0]	-0.22 [-0.45–0]	-0.34 [-0.69–0]	-0.45 [-0.90–0]	-0.42 [-0.84–0]	-0.30 [-0.60–0]
	Polygamous	0.59 [1.19–0]	0.44 [0.88–0]	0.65 [1.31–0]	0.46 [0.93–0]	0.43 [0.86–0]	0.49 [0.98–0]

*Notes*: RC – Reference category
JW – Jehovah's Witness

Figure 3 shows the coefficients and 95% confidence intervals of the alternative models (without interaction, without relationship status, and without relationship status or interaction) with their associated p-values in colour, blue for p-value <0.05 and red for other. In Figure 3, "JW" is the religion Jehovah's Witness and "Sec+" is the education level "secondary or more."
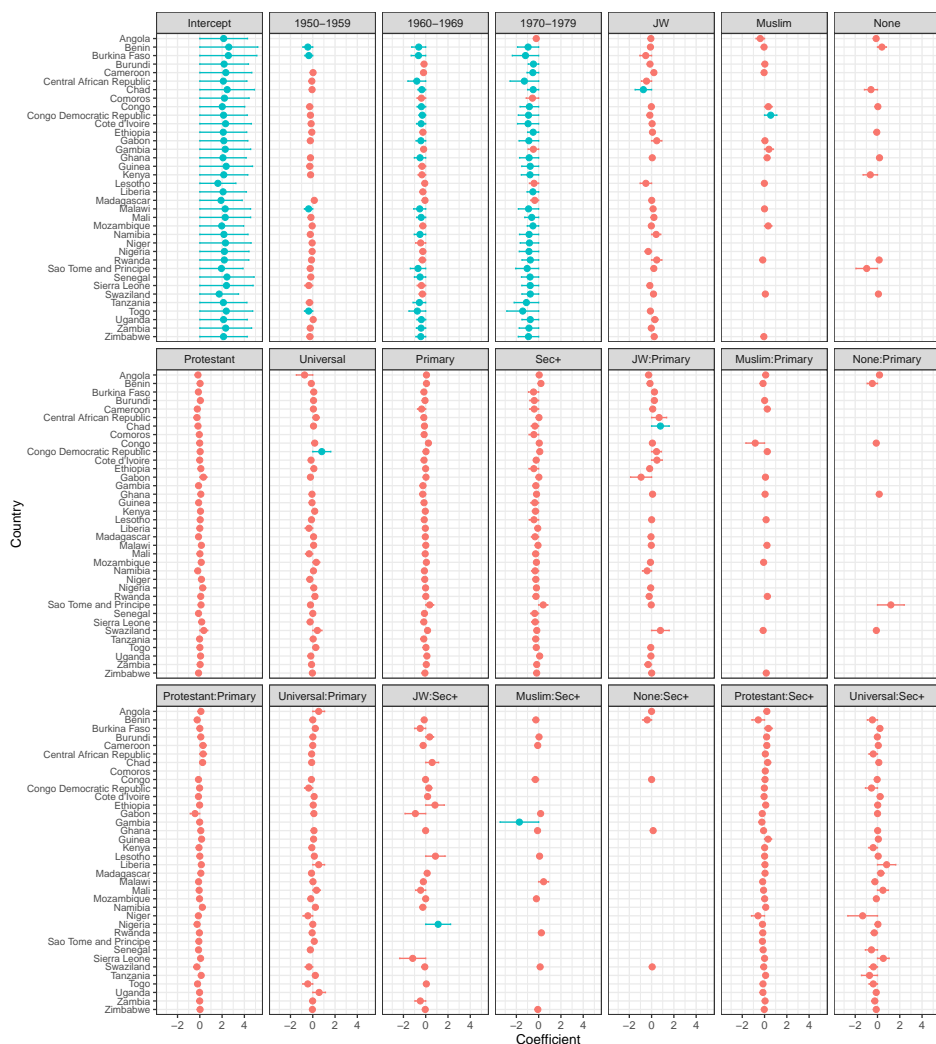
Figure 3: **Coefficients of additional Poisson models**
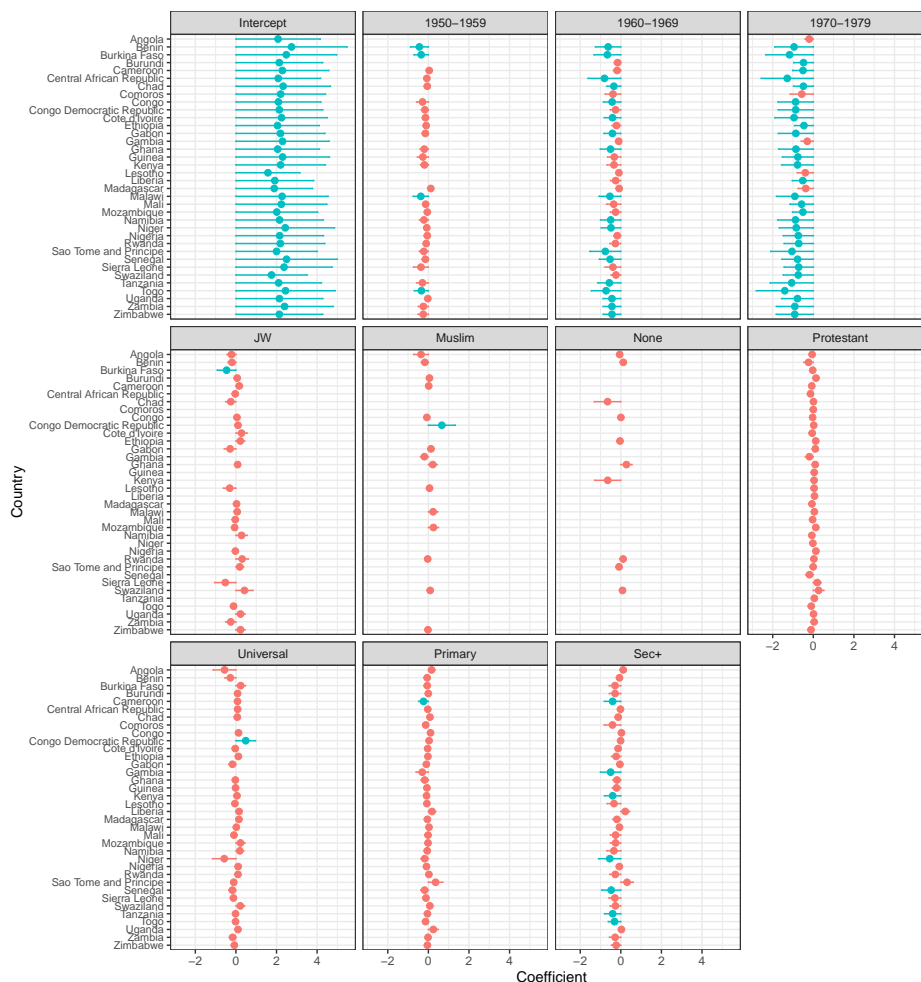
Note: Poisson regression: Coefficients by country and variable, without interaction or marital status.

Figure 3: **(Continued)**
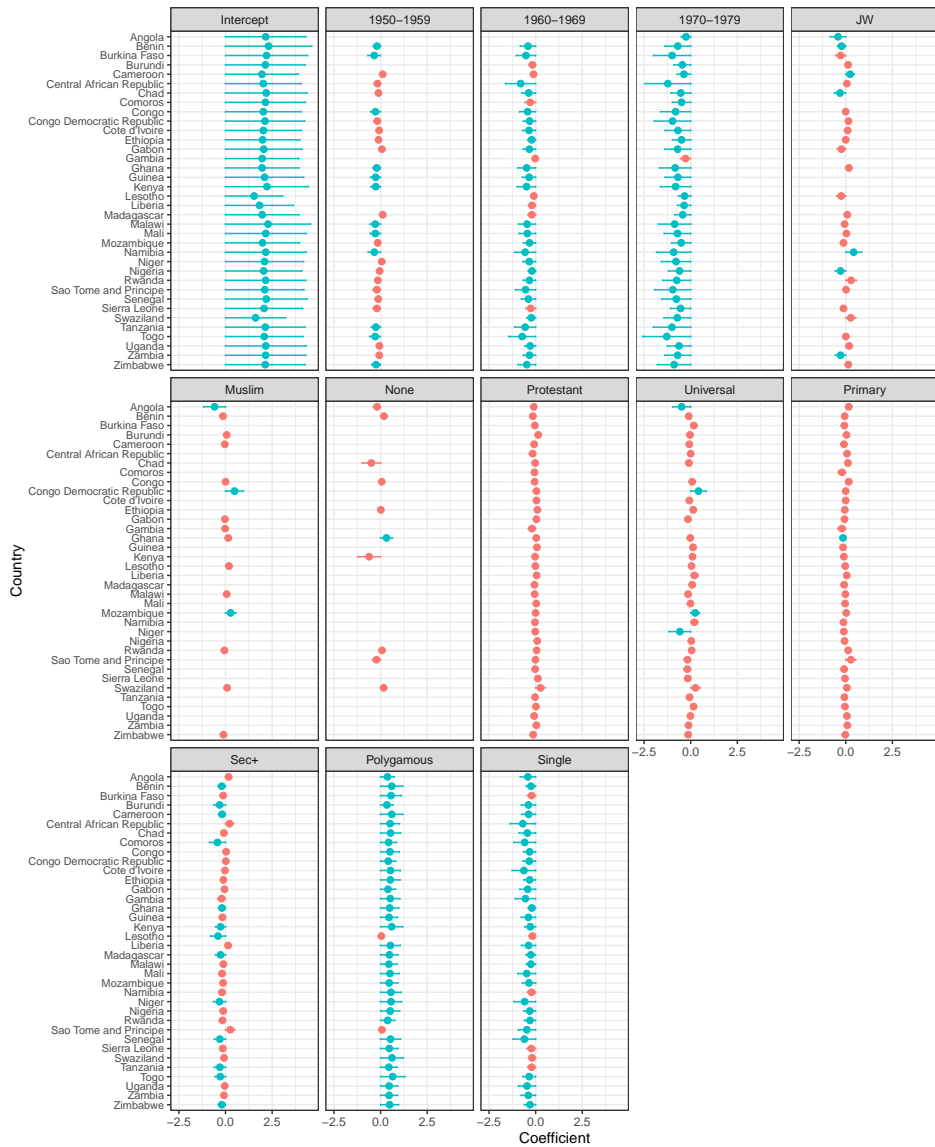
Note: Poisson regression: Coefficients by country and variable, without interaction term.

Figure 3: **(Continued)**

Note: Poisson regression: Coefficients by country and variable, with interaction but without marital status.

There are no differences in the mean number of children between Catholic and Protestant men across countries; however, men in the youngest cohorts (1970–1979) have, on average, fewer children than men born between 1940 and 1949 across coun-

tries. Polygamy consistently has a strong positive effect on fertility across all countries, while the effect of education is weaker and varies across contexts. In most countries, men with primary or secondary education do not have significantly fewer children than those with no education. In some countries like Lesotho and Zimbabwe, secondary or more education marginally reduces fertility, but in others, such as Angola and Benin, no significant difference compared to men with no education is observed. The interaction between education and religion largely does not yield substantial variations in fertility outcomes. While some country-specific effects exist, overall, the role of religion does not significantly alter the relationship between education and fertility. Similarly, the effects of education and religion individually are reduced for almost all countries. These findings suggest that other contextual factors, such as economic conditions, social norms, and policy environments, may play a larger role in shaping male fertility trends. The Poisson regression results indicate that relationship status plays a more significant role in male fertility than education or religion. This association is further observed in the other models, where education still has a relatively weak association with children ever born.

5. Discussion and conclusion

This study examined the mean number of children men have by education, religious affiliation, relationship status, and birth cohort across 36 sub-Saharan African countries. Across all countries, men in polygamous unions have significantly more children than their monogamous or single counterparts, aligning with previous findings (Schoumaker 2017). Conversely, single men are generally likely to have fewer children than men in monogamous relationships. Furthermore, men born in later cohorts, specifically 1970–1979, report a lower mean number of children than those in earlier cohorts, likely reflecting the impacts of accelerated modernisation and urbanisation over time. As Menashe-Oren and Sánchez-Páez (2023) point out, men in urban areas typically have fewer children than their rural counterparts, suggesting that processes associated with modernisation, such as increased access to family planning and shifting social norms, may be driving this trend. The study finds a weak association between education and male fertility, likely reflecting counteracting forces: While education delays marriage and childbearing, higher-educated men may have greater access to resources that facilitate larger families and may delay marriage but maintain relatively high fertility within unions. Higher education is associated with social and economic advantages, such as increased income (Nnyanzi and Kilimani 2018) and better marriage prospects for men (Pesando 2021), which may counteract fertility-reducing effects. Thus, highly educated men may be better positioned to support larger families, maintaining relatively high fertility despite delayed marriage. Additionally, the persistence of polygamy and traditional family structures may weaken the direct effect of education on fertility outcomes. Lastly, male fertility is less biologically

constrained by age than female fertility, reducing the direct impact of schooling years on childbearing.

Furthermore, religion, as with education, had an inconsistent relationship with the mean number of children, although variations exist on a country-specific level. For instance, while Muslims had more children in Congo DR than Catholics, in Angola, Muslim men have fewer children. In addition, results suggest that education's impact on fertility is inconsistent across religious groups. The interaction effects in most countries are not strong, suggesting that education's effect on male fertility is largely independent of religious affiliation. Future research should examine how specific religious doctrines influence male fertility decisions, particularly regarding contraception, ideal family size, and polygamous unions. Longitudinal studies could also help determine whether changing socioeconomic conditions alter these relationships over time. Additionally, in some religious groups, men with secondary or more education constitute a small proportion of the sample. As a result, statistical power is limited in detecting differences in fertility patterns for these subgroups. This limitation should be kept in mind when interpreting results.

Despite the strengths of this study, several limitations should be acknowledged. A key limitation of this study is the reliability of male fertility data, as recall bias and under-reporting are common in surveys (Rendall et al. 2006; Zhang 2008). Men tend to under-report fertility due to social desirability bias and recall errors, which may affect our estimates. Under-reporting of children by men, especially in polygamous settings, may mean that actual male fertility is higher than reported. This should be considered when interpreting results. Additionally, we did not control for partners' education or residence (rural/urban), which may influence fertility outcomes. Considering the interaction between religion and relationship status could also provide a more nuanced understanding of male fertility in sub-Saharan Africa. Some religious groups themselves, such as Jehovah's Witnesses and Universal believers, and the subgroup of highly educated men in some religious groups have small sample sizes, which may contribute to unstable estimates and reduce statistical power. As a result, findings for these groups should be interpreted with caution, and future research should consider larger pooled samples. Future research should explore these dynamics using alternative datasets with more robust male fertility reporting.

While the findings of the main model suggest that the association between education and the number of children ever born is relatively weak, it may be partially explained by the inclusion of relationship status in the main model. In models without relationship status, a weak association is still observed, albeit a stronger association than in the main model. This suggests that part of education's influence on male fertility may operate through union patterns. As noted in prior literature, education may reduce the likelihood of entering polygamous unions, which are consistently associated with higher fertility. In this context, relationship status could act as a mediator of the effect of education.

By controlling for relationship status, the main model likely estimates the direct effect of education on fertility rather than its total effect. Moreover, the model without the interaction showed a stronger relationship in many more countries, although still a weak association overall. This observation is evident in only some countries and mostly for men with secondary and higher education levels.

Overall, the study suggests that, within many sub-Saharan African countries, factors such as relationship status and birth cohort play a more decisive role in male fertility than education and religion. This finding underscores the importance of focusing on country-specific relationship dynamics and the influence of modernisation across birth cohorts when considering high-fertility settings. Furthermore, policy interventions should consider relationship norms and the cultural context of male fertility in sub-Saharan Africa. Male fertility data in DHS surveys, as with other surveys, is subject to recall bias and under-reporting, particularly among older respondents (Schoumaker 2017; Rendall et al. 2006). This limitation should be considered when interpreting findings. These findings highlight the need to engage men more actively in fertility-related policies. The fact that male education does not strongly reduce fertility suggests that economic stability and social expectations may outweigh educational influences. Policies aimed at reducing high fertility should not only focus on female education and contraception access but also address male reproductive decision-making and how men's reproductive choices are influenced by economic stability, marriage timing, and religious values. Given the significant fertility differences between monogamous and polygamous men, interventions targeting family planning among polygamous households could be particularly effective. Additionally, future policies should consider how religious institutions shape male fertility norms, integrating faith-based approaches to promote balanced fertility behaviours. Future research should explore how changes in employment and urbanisation affect male fertility intentions over time.

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