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AccScience Publishing
9 Raffles Place, Republic Plaza 1 #06-00 Singapore 048619.

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RESEARCH ARTICLE

Exploring the contribution of changes in nuptiality patterns to fertility transition among Ethiopian women

Dame Kedir[1,2]*, Tariku Dejene[1], and Terefe Degefa[1]

[1]Center for Population Studies, College of Development Studies, Addis Ababa University, Addis Ababa, Ethiopia

[2]Department of Mathematics, College of Applied Natural Science, Adama Science and Technology University, Adama, Ethiopia

Abstract

Fertility changes in sub-Saharan Africa are intricately tied to the institution of marriage. In this context, marriage is often depicted as the primary framework for childbearing, reflecting deeply rooted cultural norms and societal expectations. A woman's age at the first childbirth is crucial for shaping future life and is directly connected to her lifetime fertility. Despite the substantial body of research central to fertility in Ethiopia, the specific role of changes in the nuptiality patterns in driving lifetime fertility transitions has received comparatively less attention. To address this gap, this study utilized data from the Ethiopian Demographic and Health Surveys conducted in 2000 and 2016. A Poisson-based multivariate decomposition for the non-linear response model was employed to identify, quantify, and decompose the changes in lifetime fertility over time. The lifetime fertility experienced a statistically significant decline between the two survey periods. Early marriage and marital instability are highly prevalent in Ethiopia. Marriage stability showed improvement in the two surveys. Regardless of early or late marriage, it contributes to an increase in lifetime fertility if showing stability and decreases lifetime fertility in the case of instability. The changes in nuptiality patterns have statistically significantly contributed to lifetime fertility transition. The observed statistically significant decline in lifetime fertility is primarily linked to the reduction in the average number of deceased children. Furthermore, women with no formal education, those with secondary or higher education, women from households with the poorest and middle wealth indices, and those residing in communities with high literacy levels were key contributors to the lifetime fertility transition. The complex and dynamic shifts in nuptiality patterns among women aged 35 and older, along with contraceptive use, contributed nearly equally to the lifetime fertility transition. Nuptiality patterns should be factored in the reproductive health policies and targeted interventions to the fluctuating nuptiality patterns. With an understanding of the complexities of nuptiality patterns and their contributions to fertility transitions, governments and non-governmental organizations can foster improved family planning and reproductive health outcomes.

Keywords: Nuptiality patterns; Lifetime fertility; Children ever born; Contraceptive; Decomposition analysis; Ethiopia

***Corresponding author:**
Dame Kedir
(dame.kedir@astu.edu.et)

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1. Introduction

The idea that changes in nuptiality are part of a demographic transition was conceptualized in the 1960s (Muhoza, 2022). The nuptiality patterns of any country influence the level of fertility (Erulkar, 2022). Fertility changes in sub-Saharan Africa are intricately tied to the institution of marriage. In this context, marriage is often depicted as the primary framework for childbearing, reflecting deeply rooted cultural norms and societal expectations (John & Adjiwanou, 2022). Fertility rates represent that the average number of children a woman is expected to have over her lifetime, offering valuable insights into population trends (Taye *et al*., 2024). The number of children born is a critical indicator in population studies, influencing a country's population size, age structure, and overall demographic composition. It refers to the total number of live births of women within a specified age group, calculated as the average number of live births per woman in that cohort (Kiser & Hossain, 2019). Fertility serves as a vital demographic indicator for any country, and the focus on the number of children ever born is central to understanding fertility transitions in depth.

Marriage among women in most Sub-Sahara Africa is often characterized as early and nearly universal. The rising age at first marriage, in turn, has played an important role in the ongoing fertility transition (Shapiro & Gebreselassie, 2014). The age at which the women marry is one of the primary determinants of fertility. Women who marry early, on average, are more likely to have their first child at a young age and give birth to many children, obviously contributing to high fertility (Shakya & Gubhaju, 2016). A decline in fertility is linked to the transition from marrying early to marrying later in life. The percentage of people getting married at various ages varies significantly across countries and changes over time, exerting notable influences on fertility rates. It has been reported that delaying the age of marriage is a viable strategy to lower fertility, particularly in populations with limited contraceptive usage or access to induced abortion services (Muhoza, 2022).

The process and timing of marriage differed by economic and social demographics. The age of a woman at initial childbirth is a crucial factor in shaping her future life and is directly connected to her lifetime fertility (Chernet *et al*., 2019). While marriage is still regarded as a prerequisite for childbearing in Italy (Vitali & Billari, 2017), the revised Ethiopian Family Code Proclamation of 2000 has set the minimum legal age for marriage at 18 for both genders. However, the country still experiences one of the highest rates of early marriage among sub-Saharan Africans (Gazeta, 2000). There has been a slight decrease in the proportion of women marrying before the age of 18, dropping from 63% in 2011 to 58% in 2016 among those of reproductive age (Central Statistical Agency [CSA] [Ethiopia] and ICF, 2011; 2016). The age at which someone gets married influences fertility in two manners. First, marrying at a young age is directly linked to having children early, which results in bigger family size because of an extended period of potential childbearing. Second, postponing marriage directly impacts the overall fertility within marriage by reducing the number of years couples can have children (Palameleni, 2011).

The contribution of shifts in nuptiality patterns to the fertility transition among Ethiopian women is significant and multifaceted (Kedir *et al*., 2024). Marriage and fertility are institutions that comprise a fundamental part of life. The universality and early marriage ensured that women spent most of their reproductive lives married, and marriage was the central pillar of childbearing. However, while both institutions have transformed in recent decades, changes in relationships between marriage and fertility have not yet been explored (Sayi, 2015). Further, the existing studies have examined fertility determinants, but few have focused explicitly on how shifts in marriage age and patterns influence overall fertility rates (Hertrich, 2017; Shapiro & Gebreselassie, 2014). Thus, this study aims to fill this gap by exploring the relationship between changing nuptiality patterns and fertility transition among Ethiopian women, with the hope of providing updated evidence of how changes in nuptiality patterns contribute to fertility transition.

1.1. Theoretical grounding of the study

Diffusion theory provides a valuable framework for understanding how changes in nuptiality patterns influenced the lifetime fertility transition in Ethiopia between 2000 and 2016. This theory explains how new ideas, innovations, technologies, or practices spread within a society or from one society to another across time. The shift from early marriage to later marriage, as well as the increasing acceptance of cohabitation and singlehood, represents an innovation in social norms regarding marriage (Pandey *et al*., 2018). Different segments of the population adopt new marriage patterns at varying rates. Early adopters, often more educated women, led the way in delaying marriage and having fewer children, setting examples for others. The changing cultural and economic landscape, including increased educational opportunities for women and improved access to family planning resources, created a conducive environment for these changes in nuptiality patterns (Zabak *et al*., 2023). As nuptiality patterns became more widespread, they contributed to significant changes in reproductive behaviors, leading to a notable decline in lifetime fertility rates (Gatera, 2021).

The relationship between nuptiality and fertility has garnered significant attention in demographic research, mainly through diffusion theory. This theory posits that changes in social norms and behaviors, such as marriage patterns, spread through populations and influence fertility rates. Nuptiality patterns contributing to fertility changes are particularly relevant in various global regions, where shifts in marriage practices have been observed alongside fertility transitions. Schneider's findings (Schneider, 2015) showed that economic conditions have a significant impact on family formation and fertility behaviors, reinforcing that socioeconomic factors are integral to understanding the diffusion of nuptiality patterns. As societies evolve, the diffusion of new norms surrounding marriage and family formation continues to reshape fertility landscapes.

Increased access to education is an innovation that empowers women with knowledge about reproductive health, family planning, and the benefits of smaller family sizes. As more women access education, the flow of information increases, leading to broader acceptance of contraceptive use. Women who adopt contraceptives would share their use experiences with peers, further accelerating the diffusion of this practice within communities. With the rise in the levels of education and the contraceptive use becoming more common, societal norms around marriage and family size may shift. Over time, as more women observe the benefits of education and contraceptive use, these practices may become normalized, leading to widespread adoption across various demographics. A 2017 study by Hertrich (2017) examined trends in age at marriage and their impact on fertility transitions in sub-Saharan Africa. The study found that increases in the age at first marriage were associated with the onset of fertility decline. The combined effects of nuptiality patterns, socioeconomic factors and contraceptive use are likely to lead to a measurable decline in fertility rates by 2016.

2. Data and methods

This study used the Ethiopia Demographic and Health Surveys (DHSs) that were carried out in 2000 and 2016. These nationally representative surveys collected information on geographic, socioeconomic, demographic, health, and nutrition-related characteristics of individuals and households from women aged 15 to 49 years. The study used a repeated cross-sectional comparative study design and pooled data from the 2000 to 2016 DHS. The data were obtained using a stratified two-stage cluster sampling approach. In the first stage, 645 enumeration areas (EAs) from 2016 and 539 clusters for the 2000 survey were selected with probability proportional to EA size (based on the 2007 PHC) and independent sample selection in each sampling stratum. Because of its design, which is highly comparable across settings and time, DHSs are recognized as an important source for monitoring population indicators and vital statistics in middle- and low-income countries (Central Statistical Agency [CSA] [Ethiopia] and ICF, 2016; CSA [Ethiopia] and ORC Macro, 2001). The DHS data is freely available, and the public can access it with a formal request (http://www.measuredhs.com/data/available-datasets.cfm). This study is based on the analysis of data from women aged 35 and above collected in 2000 and 2016. In other words, individuals aged 35 and above were examined to evaluate changes in the extent of lifetime fertility and its influencing factors. This age range was chosen because their impact on overall fertility is negligible, making it a suitable approximation for completed fertility.

2.1. Variables and measurements

In this study, the primary outcome variable was measured as a discrete count of the number of children ever born alive (CEB) among married a woman aged 35 and above in the 2000 and 2016 surveys at the time of the survey data collection. The CEB assesses the actual fertility of a woman. At the same time, the total fertility rate (TFR) relies on recent behavior (typically over the last 3 or 5 years), excluding consideration for children born earlier. CEB includes all live-born children and excludes stillbirths. The choice of CEB over TFR is based on the recognition that TFR, though widely used, has limitations. TFR projects the number of children a woman would have starting from childbirth at age 15 to the end of her reproductive life span if the age-specific fertility patterns remain constant. The assessment of how the change in nuptiality patterns contributes to fertility transition incorporates individual- and group-level characteristics as the predictors. The descriptions of many variables are available in the standard recode manual of DHS (ICF, 2018), and the specific descriptions of the variables and their measurements utilized for this study are shown in (Table 1).

2.1.1. Operational definitions

The total number of CEB: This parameter refers to the number of children born to women during a specific age classification and the average number of children born to a given reproductive age group. Until the time of data collection, the CEB is treated as an indicator and measure of a woman's lifetime fertility.

Nuptiality patterns: This parameter encompasses magnitude of marriage (proportion of married women), timing of marriage (early and late marriage), and marital instability (stable and unstable marriage).

Lifetime fertility: The total number of births during the lifetime was measured.

Table 1. Description of variables and their measurement used in the analysis

Type	Name and label	Description and measurement	Source
Outcome (numerical)	Children ever born (v201)	Lifetime fertility of women	Individual interview data
Independent (numerical)	Age at first marriage (v511)	Age at the start of the first marriage or union is calculated from the start date of the first marriage or union and the date of birth of the respondent.	Individual interview data
Independent (numerical)	Age at first birth of baby (v212)	All respondents with one or more births had a record of this variable. The respondent's age at first birth is calculated from the date of first birth and the date of birth of the respondent.	Individual interview data
Independent (numerical)	Age at first sex (v531)	Age at first sexual intercourse - imputed. This variable was chosen because it had a complete record in that data editions were made on it, and inconsistent records were avoided.	Individual interview data
Independent (categorical)	Region (V224)	The place resident of each respondent along with the regional state (1=Agrarian, 2=Emerging, 3=Mainly urban)	Computed
Independent (categorical)	Place of residence (v102)	Type of place of residence where the respondent was interviewed, as either urban or rural (1=Urban, 2=Rural)	Individual interview data
Independent (categorical)	Educational level (v106)	Highest education level attended. This variable shows the level of education in the following categories: 0=No education, 1=Primary, 2=Secondary, and 3=Higher.	Individual interview data
Independent (categorical)	Occupation (v717)	Respondents' occupation group classified as 0=Not working (student and pensioner), 1=Agricultural employee, 2=Industry employee	Computed from individual interview data
Independent (categorical)	Religion (v130)	The religious affiliation of respondents coded as 1=Christians (Orthodox, Protestant, and Catholic), 2=Muslim, 3=Others	Computed from individual interview data
Independent (categorical)	Contraceptive use (v302)	Ever use of any modern contraceptive use. It will be computed from interview data and recoded as 0=No (never used a modern method), 1=Yes (used a modern method).	Computed from individual interview data
Independent (categorical)	Household wealth (hv271)	A composite measure of a household's cumulative living standard. It is calculated using the household's ownership of selected assets. It is generated using a statistical procedure known as principal components analysis. It places individual households on a continuous scale of relative wealth and all interviewed households into five wealth quintiles (1=Lowest, 2=Lower, 3=Middle, 4=Richer, 5=Richest).	Household interview data
Independent (numerical)	Community affluence	Percentage of population living in a well-off household in a community (enumeration area)	Computed from household data
Independent (numerical)	Community literacy	Percentage of population (age-appropriate) with at least a secondary level of education in a community (enumeration area)	Computed from household data

Lifetime fertility transition: The lifetime fertility transition typically involves a decline in the average number of children born to women, often influenced by factors such as increased educational level, economic opportunities, and access to family planning.

Early marriage: This parameter refers to marriage occurring before the age of 18 without prior engagement in premarital sexual activity (PMS).

Premarital sex: This parameter refers to instances where girls engaged in sexual activity outside the context of marriage.

Marital stability: PMS reflects number of marital unions a woman experienced, distinguishing between stable single-marriage trajectories and those involving multiple unions due to remarriage or marital dissolution.

2.2. Data processing and analysis

The data were cleaned and analyzed using the STATA version 16 software. A multivariate Poisson decomposition model was employed. This model aimed to separate the change in the average number of children born into components attributable to the evolving characteristics of women and changes in women's reproductive behavior. Poisson regression has the advantage of fitting nonlinear models over linear regression models, including situations involving the number of occurrences of an event. Poisson regression with situations in which the dependent variable is counted. Changes in the proportion of the population have changing characteristics in specific social, economic, and demographic features, whereas changes in the population's behavior are referred to as changing behaviors resulting from changing characteristics. Decomposition

analysis was selected because it is a valuable approach that identifies the primary sources of change in an outcome. The method also divides the two elements into segments that illustrate the distinct contribution of each predictor to both components through a detailed decomposition process. Finally, a Poisson-based multivariate decomposition model for nonlinear responses (mvdcmp in Stata version 17) was performed to identify factors contributing to the change in the lifetime fertility between 2000 and 2016 to identify the sources of changes in the CEB among married women aged 35 and above (Daniel and Myeong, 2009; Powers *et al*., 2011). The general decomposition equation is as follows:

$$\bar{Y}_{2016} - \bar{Y}_{2000} \doteq \overline{F\left(X_{2000}\beta_{2000}\right)} - \overline{F\left(X_{2016}\beta_{2016}\right)} \quad \text{(I)}$$

Equation I will further decompose to Equation II:

$$\bar{Y}_{2016} - \bar{Y}_{2000} = \left\{\overline{F\left(X_{2000}\beta_{2000}\right)} - \overline{F\left(X_{2016}\beta_{2000}\right)}\right\} + \left\{\overline{F\left(X_{2016}\beta_{2000}\right)} - \overline{F\left(X_{2016}\beta_{2016}\right)}\right\} \quad \text{(II)}$$

where $\bar{Y}_{2016} - \bar{Y}_{2000}$ is the mean difference in CEB between the 2016 and 2000; F (·) is a logarithmic function mapping a linear combination of X (Xβ) to Y; X represents predictors; and β represents regression coefficients.

The year 2000 was the comparison group, and the year 2016 was the reference group. The compositional characteristics reflect the expected difference if 2016 was given the year 2000's distribution of covariates. The coefficient reflects the expected difference if 2016 experienced the year 2000's behavioral responses to X. This study is based on secondary data of women aged 35 and above collected in the 2000 and 2016 DHSs. The women aged 35 years and above in both the 2000 and 2016 surveys were asked about their birth histories, and this provided information on the total number of CEB since we were interested in examining the contribution of change in nuptiality pattern to fertility transition.

A Poisson-based multivariate decomposition for the non-linear response model was employed to identify, quantify, and decompose the changes in fertility levels over time. This method is particularly suited for analyzing count data, such as the number of CEB. It allows for a robust decomposition of observed changes into contributions from different explanatory factors. By leveraging this approach, we could isolate and measure the relative contributions of shifts in nuptiality patterns, such as age at marriage, PMS, and marital stability, as well as other covariates, to the overall fertility transition. In all our analyses, sampling weights were applied to both descriptive and decomposition analyses.

2.3. Ethical considerations

The study was conducted using secondary data from the DHSs Program. The ICF/ORC Institutional Review Board has examined and approved the procedures and questionnaires for routine DHSs. In addition, the Ethiopian Health and Nutrition Research Institute and the Institutional Review Board offices of the Ministry of Science and Technology of Ethiopia granted ethical approval to the study methods. After the respondents' oral agreement, interviews were undertaken. To safeguard respondents' anonymity, the names of respondents and personal identifiers were not included in the final data.

3. Results

Table 2 shows the distribution of women by selected demographic and socio-economic variables in Ethiopia. The weighted sample constituted a total sample of 8610

Table 2. CEB by the percentages of Ethiopian women aged 35 and above by selected characteristics and survey year

Variables and categories	Survey years			CEB	
	2000	2016	*p*	2000	2016
Educational level					
No education	91.51	73.37	0.001	6.6	6.3
Primary	5.76	18.92	0.001	5.1	5.4
Secondary+	2.73	7.72	0.001	4.1	2.5
Place of residence					
Urban	14.88	18.64	0.001	5.1	3.7
Rural	85.12	81.36	0.001	6.7	6.3
Agrarian region	91.99	89.22	0.001		
Tigray	6.65	7.63	0.077	6.3	5.7
Amhara	28.19	25.58	0.006	6.3	5.7
Oromiya	34.84	35.06	0.831	6.8	6.1
SNNP	22.31	20.95	0.125	6.3	5.7
Emerging region	3.67	4.91	0.005		
Affar	1.33	0.67	0.002	5.9	6.4
Somali	1.15	2.97	0.001	7.0	7.2
Benishangul-Gumuz	0.99	1.02	0.001	6.4	6.2
Gambela	0.20	0.25	0.001	5.6	4.7
Mainly urban region	4.34	5.87	0.001		
Harari	0.25	0.24	0.925	6.1	4.2
Addis Ababa	3.66	5.14	0.001	4.2	2.2
Dire Dawa	0.43	0.49	0.6807	5.0	4.7
Religious affiliation					
Christians	67.16	68.75	0.114	6.4	5.5
Non-Christian	32.84	31.25	0.114	6.6	6.5

(Contd...)

Table 2. ***(Continued)***

Variables and categories	Survey years			CEB	
	2000	2016	*p*	2000	2016
Occupation					
Not working	32.81	46.29	0.001	6.5	6.2
Agricultural employee	42.10	26.77	0.001	6.8	6.3
Industry employee	25.09	26.94	0.050	5.8	4.8
Community affluence					
Low	28.25	24.75	0.001	6.8	6.4
Medium	43.25	49.68	0.001	6.7	6.0
High	28.50	25.56	0.002	5.7	5.0
Community education					
Low	50.86	22.51	0.001	6.7	6.5
Medium	34.33	46.66	0.001	6.7	6.3
High	14.81	30.83	0.001	5.0	4.6
Contraceptive use					
No method and traditional	94.89	74.38	0.001	6.4	5.8
Modern method	5.11	25.62	0.001	6.7	5.9
Wealth index					
Lowest quintile	22.50	20.11	0.007	7.1	6.6
Second quintile	17.64	18.90	0.130	6.8	6.3
Middle quintile	17.59	20.17	0.002	6.4	6.1
Fourth quintile	20.17	21.90	0.049	6.6	6.2
Highest quintile	19.62	22.17	0.001	5.4	4.2
Number of deceased children	1.6	0.8	0.001		
Number of children ever born	28230	24757	0.001		
Number of women aged 35+	4371	4238	0.2128		
Overall CEB			0.001	6.46	5.84

Abbreviation: CEB: Number of children ever born alive;
SNNP: Southern Nations, Nationalities, and Peoples' Region.

women aged 35 and above, whereas 4371 were from 2000 and 4238 were from the 2016 survey. The total number of CEB was 28230 in 2000 and 24757 in 2016. Three regions, Amhara, Oromiya, and Southern Nations, Nationalities, and Peoples' Region (SNNP), contributed more than four in five samples in both surveys. A sizable portion of the samples was from rural residents. Between the two survey years, there was a decrease in the percentage of women living in rural areas from 85.52% to 81.36%. In terms of educational attainment, there was a slight increase in literacy. For instance, there was a 13.18% rise in primary education among women aged 35 and above. Similarly, there was a slight increase (5%) in secondary-level education achievement among women aged 35 and above.

The proportion of women with no work has increased between the two surveys (from 32.81 to 46.29%), whereas the average level of engagement in agricultural activity as livelihood has sharply dropped between the two surveys. The decline from 42.25 to 26.77% signifies a major transition in the occupational landscape for women over 16 years. The makeup of the women in terms of religion remained unchanged between the two survey periods with nearly two-thirds of women being affiliates of Christianity religion. Community affluence has shown a slight decrease in the percentage of women in both low- and high-wealth categories. At the same time, a significant increase was observed in the medium-wealth category between the two surveys. By 2000, half of the women surveyed lived in communities with low levels of education. However, in 2016, this percentage dropped to 22.51%. The proportion of women who lived in well-informed communities significantly improved over the course of a 16-year period (Table 2).

All wealth index quintiles, except for the lowest one, increased during the period between the two surveys. In the 2000, a large number of women (94.89%) relied on no or traditional methods of contraception, while 5.11% used modern methods. By 2016, a quarter of women (25.62%) used modern methods, indicating a shift toward increased use of modern methods among women. The average number of deceased children was 1.6 per women in 2000 and 1 in 2016. The average child survival increased by 50% among women aged 35 and above during the period between the two surveys (Table 2).

Although the percentage of illiterate women has decreased, the average number of children born to these groups of women remained relatively unchanged across the two surveys. Among women with that achieved a secondary and above level of education, nearly a 40% drop in the average CEB was observed, from 4.1 to 2.5. The average number of CEB significantly decreased among urban dwellers (27%), and slightly decreased among rural residents. The average number of CEB among women living in Tigray, Amhara, Oromia, Benishangul-Gumuz, SNNP, Gambela, and Dire Dawa regions slightly decreased. Particularly, the average number of CEB in Addis Ababa and Harari region decreased almost by two children during the period between the two surveys. However, the average number of CEB in Affar and Somali region increased. Collectively, the average number of CEB in agrarian regions and the mainly urban areas decreased by 0.6 and 1.9, respectively, whereas the CEB number in emerging regions increased by 0.5 during the period between the two surveys (Table 2).

The average number of CEB among Christian religious followers decreased by 0.9. No significant reduction in the average number of CEB was observed among women without work between the two surveys. On the contrary, the average number of CEB was reduced by one child between the two surveys. Similarly, the average number

of CEB was reduced by 0.5 among women engaged in agricultural means of livelihood. The average number of CEB for women living in medium and high community affluence equally decreased by the same quantum (0.7 birth/woman). While the decline was 0.4 birth/woman for women residing in low community affluence between the two surveys. Both the women groups living in low and medium or high affluence communities' education had lower average number of CEB. Among modern contraceptive users, the average number of CEB reduced by 0.8. Likewise, the average number of CEB was reduced by 0.6 among non-users or traditional method users. Women in all wealth categories faced a decline in CEB spanning the two surveys. More noticeably, the women with the highest wealth indexes had the highest reduction in the average number of CEB, one birth per woman, during the period between the two surveys (Table 2).

3.1. Nuptiality and sexual union patterns

The percentage of never-married women increased from 0.68% in 2000 to 2.28% in 2016. A unique characteristic of Ethiopian women in both surveys is that early marriage is highly prevalent. Although the magnitude of early marriage has shown a reduction from 87.93% in 2000 to 75.17% in 2016. Regardless of the high prevalence of early marriage, marital unions among early-married women showed marital stability across the two survey periods. In addition, the two groups of women significantly differed in terms of postponing marriage to age beyond 20 years, from 11.39% in 2000 to 22.56% in 2016. In 2000, only 7.93% of marriages were considered "late and stable," characterized by long-term commitment. In contrast, the recent survey showed that this percentage has increased to 17.54%. In 2000, 3.46% of marriages were late and unstable, while in the 2016 survey, it rose to 5.02% (Table 3).

Regarding the combined patterns of nuptiality and sexual union, a significantly higher proportion of women who postponed marriage to late age practiced premarital sex in recent years as compared to their predecessors (1.10% in 2000 vs. 6.46% in 2016). In addition, the marital relationship of this group of women was stable. Further, women in the recent survey group showed a varying and complex type of behavior in terms of sexual and nuptial unions. The percentages of women with such nuptiality patterns and sexual unions indicated as "Others," increased from 3.70% in 2000 to 7.79% in 2016 (Table 3).

Table 3. CEB by nuptiality patterns and sexual union among Ethiopian women aged 35 and above

Characteristics	Survey year		CEB	
	2000	2016	2000	2016
Nuptiality patterns				
Never married	0.68	2.28	1.62	0.65
Early and stable	46.47	53.79	7.31	6.59
Early but unstable	41.46	21.38	5.98	5.78
Late and stable	7.93	17.54	5.42	4.61
Late but unstable	3.46	5.02	4.17	4.75
Nuptiality Patterns and Sexual Union				
Never married	0.62	2.28	0.78	0.65
Early stable	46.41	51.53	7.32	6.61
Early unstable	41.35	20.96	5.97	5.81
PMS and LSM	1.10	6.46	5.24	5.26
Late stable	6.82	10.99	5.47	4.27
Others	3.70	7.79	4.24	5.08

Abbreviations: CEB: Number of children ever born alive; LSM: Late stable marriage; PMS: Premarital sex.

3.2. Decomposition results

3.2.1. Decomposition of lifetime fertility among all women

The decomposition of lifetime fertility showed an average difference of 617 CEB/1,000 women between the two surveys. This difference was attributed to variations in characteristics or endowments alone. All of the difference in the lifetime fertility was attributed to changes in the demographic and socioeconomic condition of the women. The detailed decomposition analysis revealed differences in characteristics of the women including educational achievement, region of residence, religion affiliation, household wealth, community education, community wealth, contraception, nuptiality and sexual union patterns, and number of deceased children significantly contributed to the lifetime fertility differential across the period between the two surveys (Table 4).

The detailed decomposition analysis showed that 16% of the differences in lifetime fertility were attributed to differences in the composition of educational attainment across the survey periods. Of these, 77/1,000 women's lifetime fertility (12.5%) was a result of the reduction in the proportion of women with no formal schooling. While 21/1,000 women's lifetime fertility difference was attributed to changes in women's achievement of education beyond the primary level of schooling, the analysis also revealed that the reduction in the proportion of women residing in agrarian regions across the survey period resulted in reduction of 5 births lifetime per 1,000 women between the survey periods. In addition, the decrease in the percentage of non-Christian religious affiliation and an increase in Christian religious affiliation across the survey period resulted in an increase in lifetime fertility by 4/1,000 women. Further, the reduction in the percentage of households with the poorest wealth indexes across the

Table 4. Decomposition of lifetime fertility among all women aged 35 and above

Decomposition	Coef.	p>|Z|	95% CI		Pct.					
Endowments	644.93	0.00	530.92	758.94	104.57					
Coefficients	−28.17	0.71	−179.28	122.93	−4.57					
Difference	617	0.00								
	Difference in Characteristics (E)					Difference in coefficients (C)				
Variables	Coef.	p	95% CI		%	Coef.	p	95% CI		%
Place of residence										
Urban	−3.77	0.45	−13.57	6.02	−0.61	−81.05	0.81	−753.61	591.5	−13.14
Rural	−3.77	0.45	−13.57	6.02	−0.61	353.05	0.81	−2581.84	57.36	57.36
Educational level										
No education	76.58	0.05	37.50	115.65	12.42	67.94	0.81	−487.85	623.74	11.02
Primary	1.49	0.92	−31.09	34.08	0.24	54.37	0.81	−395.64	504.40	8.82
Secondary+	20.48	0.05	3.42	37.53	3.32	−29.32	0.81	−270.46	211.80	−4.76
Region										
Agrarian	5.34	0.05	0.33	10.33	0.87	70.44	0.81	−523.37	664.27	11.42
Emerging	−1.01	0.53	−4.17	2.15	−0.16	12.38	0.81	−90.42	115.20	2.01
Mainly urban	4.21	0.06	−0.24	8.65	0.68	−19.48	0.81	−180.89	141.93	−3.16
Occupation										
Not working	−4.34	0.48	−16.44	7.76	−0.7	27.28	0.81	−202.23	256.80	4.42
Agricultural employee	7.48	0.30	−6.74	21.7	1.21	−2.61	0.86	−33.51	28.28	−0.42
Industry employee	1.50	0.13	−0.47	3.47	0.24	−13.24	0.81	−125.15	98.66	−2.15
Religion										
Christian	−2.01	0.05	−3.10	−0.92	−0.33	−128.39	0.81	−1184.8	928.02	−20.82
Non-Christian	−2.01	0.05	−3.10	−0.92	−0.33	58.37	0.81	−421.92	538.66	9.46
Wealth index										
Poorest	16.27	0.05	10.32	22.21	2.64	−36.11	0.81	−333.6	261.40	−5.86
Poorer	−1.64	0.32	−4.87	1.6	−0.27	−12.75	0.81	−119.18	93.67	−2.07
Middle	6.40	0.05	2.82	9.98	1.04	15.80	0.81	−117.41	149.10	2.57
Richer	0.58	0.61	−1.66	2.83	0.09	17.52	0.81	−129.35	164.40	2.84
Richest	0.58	0.83	−4.89	6.06	0.09	25.05	0.81	−181.81	231.92	4.06
Community literacy										
Low	39.74	0.11	−9.23	88.71	6.44	−25.45	0.82	−244.54	193.64	−4.13
Medium	−41.21	0.05	−60.72	−21.69	−6.68	−67.85	0.81	−636.67	500.96	−11.00
High	76.00	0.05	28.00	123.99	12.32	79.69	0.81	−595.03	754.41	12.92
Community wealth										
Low	−1.16	0.57	−5.19	2.87	−0.19	46.70	0.81	−339.60	433.01	7.57
Medium	−5.93	0.05	−11.81	−0.05	−0.96	−9.61	0.82	−94.36	75.13	−1.56
High	−1.74	0.41	−5.87	2.4	−0.28	−43.28	0.81	−403.06	316.49	−7.02
Contraceptive use										
No method and traditional	−86.70	0.05	−113.76	−59.63	−14.06	147.44	0.80	−1042.7	1337.6	23.91
Modern method	−86.70	0.05	−113.76	−59.63	−14.06	−50.78	0.80	−460.6	359.12	−8.23
Nuptiality and sexual union										
Never married	123.77	0.05	98.68	148.86	20.07	3.81	0.86	−40.64	48.26	0.62
Early and stable	−128.83	0.05	−144.29	−113.36	−20.89	−82.28	0.82	−796.71	632.13	−13.33
Early and unstable	318.95	0.05	250.14	387.74	51.71	−4.88	0.90	−80.91	71.15	−0.79
Early PMS and SLM	−83.76	0.05	−117.09	−50.43	−13.58	−1.35	0.92	−29.98	27.26	−0.22
Late and stable	−65.84	0.05	−81.95	−49.72	−10.68	−50.48	0.81	−471.45	370.47	−8.19
Others	−9.96	0.33	−30.31	10.4	−1.61	38.62	0.81	−277.54	354.79	6.26
Number of deceased children	475.97	0.05	431.95	519.97	77.17	2.86	0.86	−30.08	35.81	0.46

Abbreviations: CI: Confidence interval; Coef.: Coefficient; LSM: Late stable marriage; PMS: Premarital sex.

survey period resulted in a reduction of lifetime fertility by 16/1,000 women (2.64%). However, the rise in the percentage of households with the middle wealth indexes across the survey periods resulted in the reduction of lifetime fertility by nearly 7/1,000 women (Table 4).

The significant increment in the proportion of women living in communities with medium education resulted in an increase in lifetime fertility by nearly 41/1,000 women (6.7%). Contrarily, the significant increment in the proportion of women living in communities with the highest education resulted in a reduction of lifetime fertility by 76/1,000 women (12.3%). The increase in percentage of women living in the communities with medium wealth significantly contributed to a rise in the lifetime fertility, which went up by 5/1,000 women between the two surveys, whereas the contraceptive use change between the two surveys was associated with an increase of lifetime fertility by 173/1,000 women. The change in the nuptiality patterns between the two surveys contributed to 26.57% of the change in lifetime fertility. Specifically, it is the combination of reduction in the proportion of married women (2%), reduction in early marriage and postponement of marriage, and increase in marital stability contributing to the reduction in the lifetime fertility (Table 4).

If early unstable marriages among women aged 35 and above in the year 2000 had persisted at the same level as in 2016, the average number of CEB would have decreased by 319/1,000 women. Conversely, if early stable marriages among women in this age group in the year 2000 had been consistent with the 2016 levels, the CEB would have increased by 129/1,000 women. In addition, the proportion of women aged 35 and above having early premarital sex with late stable marriages in the year 2000 remained the same as in 2016, and the average number of CEB had increased by 84/1,000 women. Similarly, if late marital stability among women aged 35 and above in the year 2000 had matched the levels observed in 2016, the CEB would have risen by 66/1,000 women. Finally, if the average number of deceased children among women aged 35 and above in 2000 had remained at the 2016 levels, the CEB would have increased by 476/1000 women (Table 4).

4. Discussion

This study sought to examine how changes in nuptiality patterns influence the lifetime fertility transition among Ethiopian women aged 35 and older between the years 2000 and 2016. A multivariate decomposition method was employed to quantify changes in lifetime fertility and identify the main factors driving these changes throughout the study period. The entire difference in lifetime fertility was explained by the endowments. The decomposition of lifetime fertility showed an average difference of 617 CEB/1,000 women between the two survey periods. On average, child survival rates among women aged 35 older increased by 50% between the two survey periods. The finding revealed that the change in lifetime fertility was explained mainly by shifts in the nuptiality patterns, improvement in socioeconomic conditions, contraceptive use dynamics, and changes in child survival. The result of the study generally revealed that the gain in child survival (77.71%), shifts in nuptiality patterns (27%), and socioeconomic factors (19.74%) contributed to lifetime fertility transition during the period between the two surveys.

4.1. The evolving nuptiality patterns have significantly driven the decline in lifetime fertility rates

In general, early marriage and marital instability are highly prevalent in Ethiopia (Kedir *et al*., 2024). However, the results of the study revealed that marriages were more stable in 2016 compared to the situation in 2000. Early marriage does not necessarily contribute to the increase in fertility. Rather it is the marital stability that positively contributed to the rise in fertility. In agreement with our findings, prior research indicates that many couples experience stability or even improving satisfaction levels, suggesting that marriages become more stable as couples navigate their relationships (Karney & Bradbury, 2020). This increase in the stability of marriage contributed to lifetime fertility increase (45%); however, this increase was counterweighted by the positive contribution of the decline in proportion married, the postponement of marriage to late age, and the high prevalence of marital instability to the lifetime fertility decline (72%). Thus, the evolving nuptiality patterns among Ethiopian women resulted in a net 27% decline in lifetime fertility between during the periods spanning the two survey years.

Women who marry early or maintain stable marriage are more likely to have longer reproductive years and give too many births, obviously contributing to high fertility rates (Shakya & Gubhaju, 2016). Those with multiple marriages typically experience diverse reproductive patterns and behaviors that facilitate lower fertility rates. Conversely, women married once may adhere more closely to traditional family structures, which results in higher fertility rates due to societal pressures and norms surrounding childbearing (Orwa *et al*., 2023; Tsegaye Negash, 2023). This complex interplay highlights how marital stability significantly influences fertility outcomes among women.

4.2. The desire to control childbearing among Ethiopian women significantly contributed to the shift in lifetime fertility

The study sheds light on the contribution of the rise in family planning among Ethiopian women between the two surveys to the fertility transition. The evidence indicates that if women from earlier survey periods had adopted modern family planning methods with the same intensity as those in more recent surveys, their lifetime fertility rates would likely have been lower. This finding highlights the substantial impact of the increased prevalence of modern contraceptive use on fertility trends. The analysis underscores the critical role that access to and utilization of effective family planning resources play in shaping reproductive outcomes over time. Premarital sex increases fertility in communities with limited access or knowledge of effective contraceptive methods. This lack of access leads to higher rates of unintended pregnancies and, consequently, increased lifetime fertility (Smith-Greenaway, 2016). However, communications and discussions about family planning and reproductive health exist between couples in stable marriages. This open dialog leads to the use of contraceptives and a mutual agreement to space or limit births, thus contributing to lower lifetime fertility (Walle, 2012).

4.3. Socioeconomic shifts also contributed to lifetime fertility transition

The reduction in the proportion of women with no formal education has significantly contributed to the decline in lifetime fertility compared to those receiving secondary and above education during the period between the surveys. Individuals who marry later tend to have higher educational attainment and career aspirations. This personal development leads to a preference for delayed childbearing, contributing to lower fertility (Gündoğdu & Bulut, 2022). In addition, women living in areas with medium levels of community education showed an increase in lifetime fertility. Conversely, women living in medium-community education had increased lifetime fertility. Between 2000 and 2016, the reduction in the number of women of the poorest wealth index significantly contributed to the decrease in lifetime fertility rates in Ethiopia. As economic conditions improved for many women, particularly those in lower wealth categories, there was a notable shift in fertility preferences and behaviors. Women with higher educational attainment and improved economic status were more likely to desire fewer children, leading to a decline in overall fertility rates (Alemu *et al*., 2024). Socioeconomic factors are important in shaping reproductive choices, underscoring the need for targeted interventions to support women's empowerment and health in Ethiopia.

4.4. The child replacement effect significantly shaped the lifetime fertility transition of Ethiopian women

The decline in lifetime fertility among women aged over 35 has been attributed to the child replacement effect. Higher overall fertility rates in this age range are the result of families having more children to compensate for those they have lost. The improvement in child survival across the 16-year periods has largely contributed to the drop in lifetime fertility (77%). In agreement with our findings, a study has found that improved child survival increases the size of the family supported and lowers the desire to have more children (N. & Simon, 2001). Higher child survival rates often lead to lower lifetime fertility rates. When parents are confident that their children will survive to adulthood, they may choose to have fewer children. The interplay between improved child survival and fertility decisions highlights the importance of health interventions in shaping demographic trends in Ethiopia. Focusing on lessening child mortality and improving maternal health are essential for accelerating the reduction of lifetime fertility rates.

4.5. Strengths and limitations

A prominent strength of this study is the utilization of robust datasets afforded by DHSs that capture factors influencing nuptiality and fertility. This study is not without any limitations. First, the study used partially completed fertility data of women aged 35 and above, assuming that the contribution of their lifetime fertility is <1 child. Second, postpartum insusceptibility, cohabitation, and abortion rates were excluded from the analysis. Third, the over-emphasis on women's experiences may lead to overlooking the role of men and broader family dynamics in shaping nuptiality and fertility patterns. Finally, data collection from women aged 35 and above relies on the respondents' ability to recall the timing of events, which may be influenced by memory lapses, potentially introducing reporting bias.

5. Conclusion

Ethiopia has seen a significant decline in lifetime fertility across the 16-year period between the two DHSs conducted in 2000 and 2016. The lifetime fertility transition is a result of changes in nuptiality patterns, socioeconomic shifts, improvement in child survival, and changes in modern contraceptive use. The observed statistically significant decline in lifetime fertility is primarily linked to the reduction in the average number of deceased children. Whether marriage occurs early or late if it remains stable, it contributes to an increase in lifetime fertility; similarly, if it remains unstable, it contributes

to a decrease in lifetime fertility. Women with no formal education, those with secondary or higher education, women from households with the poorest and middle wealth indices, and those residing in communities with high literacy levels were key contributors to the lifetime fertility transition. Along with the adoption of modern contraceptives, the complex and dynamic shifts observed in nuptiality patterns among Ethiopian women equally contributed to the lifetime fertility transition. Taken together, nuptiality patterns should be factored into the reproductive health policies and targeted interventions to address varying nuptiality patterns. Governments and non-governmental organizations should prioritize understanding the complexities of nuptiality patterns and their contributions to fertility transitions, with the goal of fostering improved family planning and reproductive health outcomes.

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Conflict of interest

The authors declare that they have no competing interests.

Author contributions

Conceptualization: All authors
Formal analysis: Dame Kedir, Tariku Dejene
Investigation: All authors
Methodology: Dame Kedir
Writing – original draft: Dame Kedir
Writing – review & editing: All authors

Ethics approval and consent to participate

Secondary data from the 2000 to 2016 EDHS were used in this study. The methodologies and questionnaires for Demographic and Health Surveys were reviewed and approved by the ICF/ORC Institutional Review Board. In addition, the study protocols were approved by the Ethiopian Ministry of Science and Technology's Institutional Review Board offices and the Ethiopian Health and Nutrition Research Institute. Interviews were conducted after gaining verbal consent from respondents.

Consent for publication

Not applicable.

Availability of data

DHS data are publicly available for use free of charge and can be obtained on request at the following web address: https://dhsprogram.com/data/available-datasets.cfm

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ACCSCIENCE PUBLISHING

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RESEARCH ARTICLE

Components of changes in nuptiality patterns among Ethiopian women: A decomposition analysis of demographic and health surveys

Dame Kedir[1,2], Tariku Dejene[1]*, and Terefe Degefa[1]

[1]Center for Population Studies, College of Development Studies, Addis Ababa University, Addis Ababa, Ethiopia

[2]Department of Mathematics, College of Applied Natural Science, Adama Science and Technology University, Adama, Ethiopia

Abstract

Analyzing shifts in nuptiality patterns plays a significant role in understanding how demographic variables respond to socioeconomic changes. However, there has been a lack of comprehensive research on the sources of changes in nuptiality patterns. This study examines how nuptiality patterns change and investigates the factors linked to changes in two birth cohorts. Data from the Ethiopian Demographic and Health Surveys conducted in 2000 and 2016 were used. Marriage was observed to be early and nearly universal in both birth cohorts. A large proportion of the difference in the cumulative incidence of first marriage between the cohorts was observed at age 15 and decreased after age 35. However, the age of entry into the first marriage was slightly delayed, with a 46% reduction in the rate of marital dissolution. In addition, the compositional and structural impacts of a covariate were responsible for initiating the cumulative incidence of transition to first marriage. Furthermore, women's education, occupation, and regional variation were identified as the main contributors to the reduction in the cumulative incidence of first marriage. Results show that the changes in nuptiality patterns were explained by a reduction in cumulative incidence of marriage, a shift in the timing of entry into the first marriage, and marital dissolution across the two birth cohorts. Moreover, socioeconomic factors, spatial drivers, and discriminatory effects between the two cohorts were the sources of changes in nuptiality patterns in Ethiopia.

Keywords: Nuptiality pattern; Birth cohort; Decomposition analysis; Ethiopia

***Corresponding author:**
Tariku Dejene
(tariku.dejene@aau.edu.et)

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1. Introduction

Fertility transition cannot be fully understood by examining fertility trends alone; the components of the transition need to be examined to gain a more nuanced and comprehensive understanding (Muhoza, 2022). In the 1960s, the concept of nuptiality change as a component of demographic change was developed. In developed nations, the strain on natural resources caused by continuous population growth was mitigated through various strategies. Aside from outmigration, one response among rural dwellers, although not a deliberate effort to reduce fertility, was delaying marriage (Davis, 1963; Hertrich, 2017). According to Coale (1967; 1974), nuptiality change was an initial step

in the fertility transition across a large part of the world, and the change in nuptiality acts as a regulator of general fertility and determines the onset of fertility change.

Marriage is a social institution deeply embedded in cultural norms, economic realities, and gender roles. For instance, during periods of economic prosperity, marriage rates may surge as individuals feel more secure establishing families (Parsons *et al.*, 2015). Similarly, cultural shifts regarding gender roles can influence marriage patterns. As women gain greater educational and economic independence, they may choose to prioritize careers or delay marriage for personal fulfillment (Alteneiji, 2023). Evidence shows that women are marrying later in life, and the percentage of women across all age groups who never marry is growing (Hamedanchi *et al.*, 2020). Rising educational levels, greater engagement in paid work outside the home, and the creation of roles for women outside marriage and motherhood are widely cited as the causes of shifts in union formation (Lindstrom & Woubalem, 2003).

A few decades ago, women around the world used to marry at a relatively young age. The percentage of married couples and the rate at which new couples enter marriages vary widely across nations. In many sub-Saharan African countries, marriage is still often seen as "early and near-universal." However, for many women, this is no longer the reality. There is a noticeable trend in several countries in the region toward delaying marriage, with early marriage becoming less common (Ayiga & Rampagane, 2013; Shapiro & Gebreselassie, 2014). Ethiopia stands out for its relatively slow decline in the percentage of young women in unions. The country has made significant progress in recent decades in increasing access to health and education services, allowing it to take advantage of demographic opportunities and accelerate its demographic transition (Sewnet, 2020).

Ethiopia has a longstanding cultural tradition of early marriage, driven by a complex web of societal norms, religious factors, economic considerations, and gender dynamics. Among sub-Saharan Africa, Ethiopia has one of the highest rates of early marriage, despite recent improvements. According to research by the National Committee on Harmful Traditional Practices of Ethiopia, 57% of women marry before turning 15. In northern Ethiopia, where early marriages are most prevalent, girls are married as young as 8 or 9 years old. Although common throughout the nation, early marriage rates in the Amhara and Tigray regions are significantly higher than the national average (82% in Amhara, 79% in Tigray, 64% in Benshangul, 64% in Gambella, and 46% in Afar) (Alazbih *et al.*, 2023).

This study focuses on examining marriage patterns among women in Ethiopia, referred to as nuptiality. Nuptiality patterns were assessed in terms of the timing, magnitude of marriage, and marital instability of women. The timing of marriage was measured by age at first marriage, and the magnitude of marriage was measured by the cumulative incidence function (CIF). Numerous studies have focused on the determinants of age at first marriage, but there is a lack of longitudinal studies that track individuals over time to understand how nuptiality patterns evolve across different life stages and historical contexts (Imron *et al.*, 2020; Khalajabadi & Rahimi, 2019; Makheti, 2008; Singh *et al.*, 2023). Gaining insights into the factors that influence shifts in nuptiality patterns is crucial for policymakers and researchers, as it aids in assessing social, economic, and demographic trends within a country.

To reduce the high number of early marriages, the Ethiopian government issued a revised family law proclamation, setting the minimum legal age for marriage for both sexes at 18 (The Revised Family Code of FDRE, 2000). In 2000, Ethiopia had one of the highest rates of early marriage in sub-Saharan Africa. Marital experiences of Ethiopian women were characterized as early and nearly universal; however, over time, the nuptiality pattern has deviated, with increased variability in age at first marriage and overall marriage prevalence across different regions (Shapiro & Gebreselassie, 2014). In Ethiopia, research has primarily focused on assessing the magnitude of marriage, examining the timing of marriage, and analyzing trends and regulators of age at first marriage (Dureti *et al.*, 2022; Gurmu & Etana, 2014). The elements of change in nuptiality patterns over time have not yet been fully understood. Consequently, this study assessed how nuptiality patterns have changed and identified the elements explaining the change in age at first marriage using the 1965 – 1969 and 1980 – 1984 synthetic birth cohorts of women.

1.1. Theoretical perspective

The life-course theory (LCT) offers a helpful framework for understanding how the age at first marriage and marriage patterns change over time. According to this theoretical perspective, the historical and social context in which a person lives profoundly shapes their life. The timing of important life events is influenced by an interplay of socioeconomic, cultural, and policy factors (Elder, 2008). From the LCT perspective, marriage patterns do not exist in isolation but rather reflect the broader social, economic, and institutional structures of a given time and place. For instance, changes in female labor force participation, education level, contraceptive access, and gender norms can impact the age at first marriage and the prevalence of marriage in a population (Bongaarts *et al.*, 2017; Geist, 2017; Liefbroer & Corijn, 1999). The LCT thus underscores

how individual lives are embedded within and shaped by the larger historical and institutional contexts. By adopting this theoretical lens, researchers can gain a more nuanced understanding of how and why marriage patterns evolve over time, rather than viewing them as isolated or ahistorical phenomena.

In 1993, Ethiopia introduced a formal population policy that acknowledged the relationship between development, the environment, resources, and population (Hailemariam *et al*., 2011). After the national population policy was formulated, several national and international policies and strategies were introduced, including the Ethiopian Revised Family Law Proclamation (Dejene & Gurmu, 2022; The Revised Family Code of FDRE, 2000). These reforms intended to align population dynamics with sustainable development goals, acknowledging the significant role of legal and policy frameworks in shaping demographic trends and social outcomes. This study borrowed the concept of the LCT to examine how the transition to first marriage differs between two birth cohorts that experienced distinctly different historical, policy, and socioeconomic conditions. The first group of women in this study, born between 1965 and 1969, lived their youth during a period without the policy and socioeconomic developments that the second cohort, born between 1980 and 1984, experienced.

Analyzing age at first marriage across different cohorts serves as a powerful lens to examine how marriage patterns have transformed over time. By examining how age at first marriage varies across cohorts, researchers can not only identify these correlations but also understand their historical contexts (Elder Jr. & George, 2016). Thus, transcending the limitations of cross-sectional studies and single-cohort studies, this study proposes a comparative cohort analysis to highlight the dynamic interplay between historical contexts and their impact on nuptiality trends. A comparative analysis allowed the researchers to document not only the changing landscape of marriage but also connect it to the historical forces that shaped it.

To thoroughly analyze the factors contributing to changes in nuptiality over time, this study uses data from the Ethiopia Demographic and Health Survey (EDHS) and employs a decomposition analysis methodology. This methodology enables researchers to isolate the effects of policy changes and socioeconomic developments on nuptiality trends, offering a robust framework for understanding the multifaceted nature of nuptiality patterns over time (Rahimi & Hashemi Nazari, 2021). Through this comprehensive approach, this study aims to uncover the underlying drivers of change in marriage patterns.

2. Data and methods

2.1. Data source

The EDHSs conducted in 2000 and 2016 were utilized for this study. These surveys provide estimates of significant demographic and health variables for the entire nation, including urban and rural areas, as well as each of the nine regions and the two city administrations. A two-stage cluster sampling technique, stratified by residence, was employed to collect data from 645 enumeration areas in the 2016 survey and 539 enumeration areas in the 2000 survey. Demographics and health are widely recognized as a key source for tracking population indicators and critical data in middle- and low-income nations due to their highly comparable design across settings and time (Central Statistical Agency (CSA) [Ethiopia] & ICF, 2016; Central Statistical Authority [Ethiopia] & ORC Macro, 2001).

Data on selected variables for the 1965 – 1969 and the 1985 – 1989 birth cohorts of women were obtained from the 2000 and 2016 EDHS, respectively. The selection of these cohorts allowed comparing cohort experiences. Comparing cohorts at similar ages helps isolate the effects of being born and coming of age in different eras, rather than conflating age and cohort effects (Aldy & Viscusi, 2008). The experiences of these groups of women are particularly relevant for identifying patterns in the timing and shifts in the volume of marriage over time and the sources of changes in the timing and magnitude of marriage, especially before and after the national population policy and the revised family code of Ethiopia were promulgated.

The information used in this study is freely accessible to the public at the following website: https://www.dhsprogram.com/data/dataset_admin/login_main.cfm (The DHS Program, 2023).

2.2. Variables and measurements

The response variable is the cumulative incidence of the first marriage. The CIF provides the percentage of women who experienced an event at any particular age, capturing both the timing and the magnitude of the event (Pintilie, 2006). In this analysis, marriage and union are used interchangeably. Age at first marriage is defined as the age at which a woman starts living in a consensual union or legally recognized marriage (ICF, 2018).

The EDHS employs rigorous data procedures to ensure the accuracy of important dates, such as those related to marriage. This includes conducting data checks, resolving inconsistencies in reports, and using methods to impute missing data (MacQuarrie & Juan, 2019).

The DHS standard recode manual provides descriptions of numerous variables (ICF, 2018), and

the specific descriptions of the variables and their measurements utilized for this study are shown in Table 1. The variables in this study are widely acknowledged in the relevant literature as key determinants influencing the complex relationship between individual characteristics, community variables, and the timing of the first marriage. The selection of these specific variables was guided by and grounded by the existing body of research on this topic (Dejene & Gurmu, 2022; Hertrich, 2017; Imron *et al*., 2020).

2.3. Data processing and analysis

STATA 16.0 was used for data management and analysis. Initially, the CIF for age at first marriage was computed using survival analysis. Before decomposing the change in age at first marriage, the difference in CIF between the two birth cohorts was tested (Sayers *et al*., 2018). Statistically significant differences were observed between the cohorts aged 15 – 25 (Figure 1). Therefore, the shift in the magnitude and timing of marriage between the two cohorts was evaluated at ages 15, 20, and 25.

Using Oaxaca decomposition, the degree and timing of marriage were broken down into components that could be attributed to variations in individual attributes and behavioral responses using multivariate decomposition analysis. In this context, changes in behavioral response refer to how individuals adjust their behaviors as a result of changing characteristics, whereas changes in the population's social, economic, and demographic qualities are referred to as changing characteristics (Rahimi & Hashemi Nazari, 2021).

For the Oaxaca decomposition, assuming the second cohort as the reference group, the model specification for the decomposition analysis and interpretation is as follows (Rahimi & Hashemi Nazari, 2021):

Table 1. Definitions of the variables and how they were measured for the analysis

Type	Name and label	Description and measurement	Source
Outcome (numeric)	Age at first marriage (v511)	Age at the start of the first marriage or union is calculated from the date of the start of the first marriage or union and the respondent's birthdate.	Individual interview data
Grouping (categorical)	Birth cohort	Two groups of birth cohorts (those born in the years 1965 – 1969 and 1980 – 1984) were used to identify changes in nuptiality patterns among groups of women. It was calculated using the respondents' birth dates (v011).	Computed
Independent (categorical)	Place of residence (v102)	The interviewee indicated whether they lived in an urban or rural area (1=urban; 2=rural).	Individual interview data
Independent (categorical)	Region (v024)	The region in which the respondent was interviewed.	Individual interview data
Independent (categorical)	Educational level (v106)	Highest degree of education attained. The following categories represent the level of education represented by this variable: 0=no education, 1=primary, 2=secondary, and 3=higher education.	Individual interview data
Independent (categorical)	Occupation (v717)	Respondents' occupation group was classified as 0=not working (student and pensioner), 1=agricultural employee, and 2=industry employee.	Computed from individual interview data
Independent (categorical)	Religion (v130)	The religious affiliation of respondents was recorded as 1=Christians (Orthodox, Protestant, and Catholic), 2=Muslim, and 3=Others.	Computed from individual interview data
Independent (categorical)	Household wealth (v271)	A combined indicator of the overall standard of living in a home computed by selected assets owned by the household. It is produced using principle components analysis, a statistical technique, and divides all interviewed homes into five wealth quintiles (1=lowest, 2=lower, 3=middle, 4=richer, and 5=richest) and sets each household on a continuous scale of relative wealth.	Household interview data
Independent (numeric)	Community affluence	Percentage of population living in a well-off household in a community (enumeration area).	Computed from household data
Independent (numeric)	Community literacy	Percentage of an enumerated community's (age-appropriate) population with at least a secondary education.	Calculated from household data

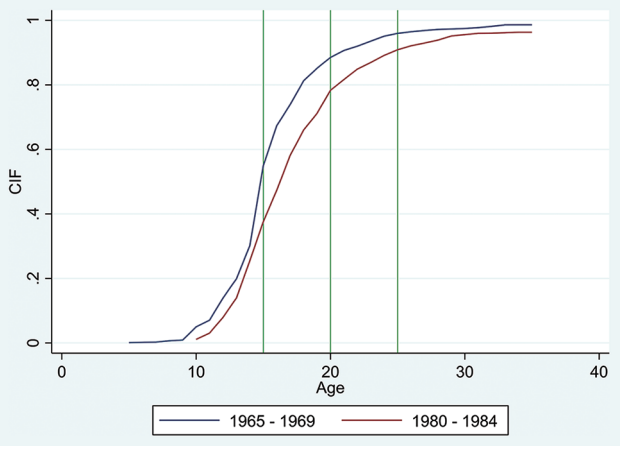

Figure 1. Cumulative incidence of first marriage for the two birth cohorts by age
Abbreviation: CIF: Cumulative incidence function.

$$\Delta\overline{Y} = \left(\beta_o^1 - \beta_o^2\right) + \sum_{j=1}^{k}\beta_j^1\left(\overline{x}_j^1 - \overline{x}_j^2\right) + \sum_{j=1}^{k}\overline{x}_j^1\left(\beta_j^1 - \beta_j^2\right)$$

In the model specification shown above, $\Delta\overline{Y} = \overline{Y}^1 - \overline{Y}^2$ refers to the magnitude of change in the cumulative incidence of marriage at specific ages, namely, at 15, 20, and 25. The first component on the right-hand side (RHS), $\left(\beta_o^1 - \beta_o^2\right)$, represents the basic differences, which measure the effects of unobservable variables that are not included or accounted for in the model. Here, β_o^1 and β_o^2 are the constant terms for the models of the first and second cohorts, respectively. The second component of the RHS, $\sum_{j=1}^{k}\beta_j^1\left(\overline{x}_j^1 - \overline{x}_j^2\right)$, captures the change in the average predicted cumulative incidence of marriage for the first cohort when the covariates of the first cohort are set to match those of the second cohort. This represents the part of the overall difference that can be accounted for by group differences in the measured covariates, often referred to as the endowment effect. In this case, β_j^1 is the coefficient for the covariate $\overline{x}_j$ in the first cohort model, and for the present analysis, the overall effects were produced for categorical covariates. The final component of the RHS,, is referred to as the coefficient effect, which measures the part of the difference in the outcome caused by the differential effects of observable variables on the outcome across the two comparison groups. The *oaxaca_rif* command was used due to its flexibility in handling the decomposition of various distributional statistics (Rios-Avila, 2020).

2.4. Ethical considerations

This study was based on secondary data from the EDHS. The methodologies and questionnaires used in the EDHSs were reviewed and approved by the ICF/ORC Institutional Review Board. In addition, the study methodologies received ethical approval (no. 3.10/114/2016) from the Institutional Review Board offices of the Ethiopian Ministry of Science and Technology and the Ethiopian Health and Nutrition Research Institute. Verbal consent was obtained from the respondents before conducting the interviews. To ensure respondent anonymity, names, and other personal identifiers were removed from the final dataset.

3. Results

Table 2 shows the distribution of women by selected socioeconomic variables of first marriage in Ethiopia. The weighted sample comprises 3873 women, with 1804 respondents from the first birth cohort (1965 – 1969) and 2069 respondents from the second birth cohort (1980 – 1984). Across all birth cohorts, a sizable portion of the samples consisted of rural respondents. Between the two birth cohorts, the percentage of women living in rural areas decreased from 85.12% in the earlier cohort to 78.66% in the later one. A higher percentage of women in metropolitan areas were from the late birth cohort. The more recent cohort of women also had higher levels of education, greater media exposure, and lived in wealthier households compared to the earlier cohort (Table 2).

In terms of education level, there was a slight increase in literacy. The proportion of women with no education decreased from 79.93% in the earlier cohort to 71.79% in the later cohort. The proportion of women with primary education increased significantly from 13.68% to 19.57%, and the proportion of women with secondary and higher education increased slightly from 6.39% to 8.64%. The results also indicate that the proportion of women not working increased by 8.94%, from 34.67% to 43.61%. Similarly, the proportion of women employed in industry increased by 7.32%, from 25.17% to 32.49%. Amhara, Oromiya, and the Southern Nations, Nationalities, and Peoples' Region (SNNPR), accounted for more than four-fifths of the samples in both cohorts. Distribution by religion showed a similar pattern in both cohorts, with two-thirds of the sample being affiliates of Christianity (Table 2).

In terms of community affluence, the percentage of women in the low and medium categories decreased slightly, whereas the percentage in the highest category increased significantly. Between the two birth cohorts, community literacy increased in both the medium and high

categories. For the first and second birth cohorts, medium literacy rates were 31.83% and 46.39%, respectively, and high-level community literacy rates were 14.97% and 31.45%, respectively (Table 2).

Table 2. Percentages of women by selected socioeconomic characteristics

Variables and categories	Birth cohort	
	1965 – 1969 (*n*=1804)	1980 – 1984 (*n*=2069)
Educational level		
No education	79.93	71.79
Primary	13.68	19.57
Secondary+	6.39	8.64
Place of residence		
Urban	14.88	21.34
Rural	85.12	78.66
Region		
Tigray	6.48	6.85
Affar	1.35	0.69
Amhara	24.51	23.16
Oromiya	38.49	38.33
Somali	1.51	2.36
Benishangul	1.10	1.10
SNNPR	21.98	20.47
Gambela	0.31	0.25
Harari	0.22	0.24
Addis Ababa	3.50	5.98
Dire Dawa	0.54	0.57
Occupation		
Not working	34.67	43.61
Agricultural employee	40.17	23.89
Industry employee	25.17	32.49
Religious affiliation		
Christians	66.68	68.09
Muslim	30.49	30.89
Others	2.83	1.02
Community affluence		
Low	28.41	26.78
Medium	50.92	47.85
High	20.67	25.36
Community education		
Low	53.20	22.16
Medium	31.83	46.39
High	14.97	31.45

Abbreviation: SNNPR: Southern nations, nationalities, and peoples' region.

The overall estimates of CIF showed that the hazard of getting married for both birth cohorts is almost similar before age 15. The results indicated that the incidence of first marriage is highly concentrated at early ages. The incidence of entering marital unions was comparable across the two cohorts before age 15. However, the cumulative incidence showed a difference after the age of 15 for the two birth cohorts. The cumulative incidence of first marriage for both birth cohorts showed a progressively widening inter-cohort gap starting at age 15. For nearly four in five girls in the second birth cohort (78%) and nine in 10 girls in the first birth cohort (88%), the cumulative incidence of first marriage occurred by age 20. The gap in cumulative incidence of first marriage narrows after age 30, but there remains a small difference between the two birth cohorts (Figure 1).

Regarding marital instability, Figure 2 shows a significant decrease in the number of women who have been married more than once between the two birth cohorts. About 61.28% of women in the former cohort were married once, compared to 78.96% in the latter cohort. The likelihood of remarriage was much lower for women in later birth cohorts compared to those in earlier cohorts. In the former birth cohort, 38.72% of women remarried, whereas in the latter birth cohort, the proportion decreased to 21.04%. That means that the remarriage rate was approximately two in five women in the earlier cohort and one in five women in the latest cohort (Figure 2).

For both cohorts, the distribution of first marriage entry at ages 15, 20, and 25 was compared and divided into its component parts. The overall cumulative incidence of first marriage was 55%, 88.5%, and 96% at ages 15, 20, and 25, respectively, for the first birth cohorts. The corresponding figures for the second birth cohort were 37.6%, 78.3%, and 90.9% at ages 15, 20, and 25, respectively (Tables 3-5). The decomposition analysis of the incidence of first marriage revealed a 17.4% reduction in the cumulative incidence of marriage at age 15. Nearly one-third of this reduction (−0.054/−0.174=31.0%) was attributed to differences in characteristics between the two birth cohorts of women.

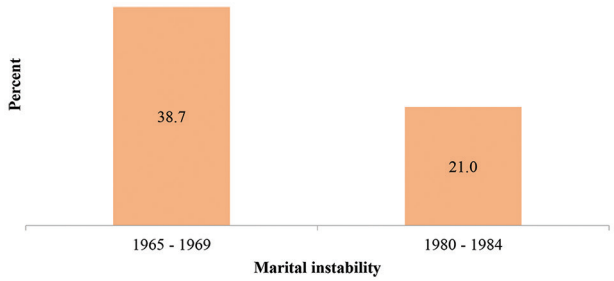

Figure 2. Marital instability rate by birth cohort

Table 3. Decomposition analyses of cumulative incidence of first marriage at age 15

Components of Decomposition	Coefficient	*p*-value	95% CI
Overall			
1980 – 1984	0.376	0.000	(0.355, 0.397)
1965 – 1969	0.550	0.000	(0.527, 0.573)
Difference	−0.174	0.000	(−0.205, −0.143)
Explained	−0.054	0.000	(−0.077, −0.032)
Unexplained	−0.120	0.000	(−0.157, −0.083)

Characteristics	Endowment effect			Coefficient effect		
	Coefficient	*p*-value	95% CI	Coefficient	*p*-value	95% CI
Rural	0.003	0.497	(−0.007, 0.013)	0.034	0.650	(−0.112, 0.190)
Education	−0.010	0.006	(−0.017, 0.003)	0.005	0.819	(−0.036, 0.180)
Regions	−0.005	0.021	(−0.010, −0.001)	0.009	0.771	(−0.054, 0.045)
Occupation	−0.022	0.000	(−0.031, −0.012)	0.008	0.042	(0.000, 0.073)
Religion	−0.001	0.377	(−0.003, 0.001)	0.012	0.065	(−0.001, 0.016)
Wealth	−0.002	0.520	(−0.008, 0.004)	0.015	0.002	(0.006, 0.025)
Community Education	−0.020	0.145	(−0.048, 0.007)	0.017	0.001	(0.008, 0.027)
Community Affluence	0.002	0.383	(−0.003, 0.008)	0.000	0.964	(−0.014, 0.014)
Constant				−0.221	0.004	(−0.370, −0.07)

Abbreviation: CI: Confidence interval.

Table 4. Decomposition analyses of cumulative incidence of marriage at age 20

Components of Decomposition	Coefficient	*p*-value	95% CI
Overall			
1980 – 1984	0.783	0.000	(0.766, 0.801)
1965 – 1969	0.885	0.000	(0.870, 0.900)
Difference	−0.102	0.000	(−0.12, −0.079)
Explained	−0.027	0.001	(−0.042, −0.011)
Unexplained	−0.075	0.000	(−0.100, −0.050)

Characteristics	Endowment effect			Coefficient effect		
	Coefficient	*p*-value	95% CI	Coefficient	*p*-value	95% CI
Rural	0.008	0.020	(0.001, 0.015)	0.091	0.075	(−0.009, 0.190)
Education	−0.013	0.000	(−0.021, −0.006)	−0.002	0.897	(−0.030, 0.027)
Regions	−0.004	0.007	(−0.008, 0.001)	0.030	0.187	(−0.015, 0.075)
Occupation	−0.011	0.000	(−0.016, 0.006)	0.004	0.202	(−0.002, 0.009)
Religion	−0.001	0.362	(−0.003, 0.001)	0.017	0.000	(0.008, 0.026)
Wealth	0.002	0.304	(−0.002, 0.006)	0.004	0.222	(−0.002, 0.010)
Community Education	−0.003	0.750	(−0.019, 0.014)	0.004	0.233	(−0.003, 0.011)
Community affluence	−0.004	0.031	(−0.008, 0.000)	−0.016	0.001	(−0.025, 0.007)
Constant				−0.207	0.000	(−0.310, 0.104)

Abbreviation: CI: Confidence interval.

However, the remainder of the reduction resulted from differences in the effects of variables or coefficients effects. The detailed decomposition of the reduction in the cumulative incidence of first marriage at age 15 showed that educational achievement, occupation, and region significantly contributed to the reduction. Differences in women's educational achievement contributed to a 6% reduction in the overall gap. Differences in women's

Table 5. Decomposition analyses of cumulative incidence of first marriage at age 25

Components of Decomposition	Coefficient	*p*-value	95% CI
Overall			
1980 – 1984	0.909	0.000	(0.896, 0.921)
1965 – 1969	0.960	0.000	(0.951, 0.969)
Difference	−0.051	0.000	(−0.066, −0.035)
Explained	−0.014	0.004	(−0.024, −0.005)
Unexplained	−0.037	0.000	(−0.053, −0.020

Characteristics	Endowment effect			Coefficient effect		
	Coefficient	*p*-value	95% CI	Coefficient	*p*-value	95% CI
Rural	−0.002	0.296	(−0.006, 0.002)	−0.088	0.008	(−0.152, −0.023)
Education	−0.007	0.003	(−0.012, −0.002)	0.007	0.485	(−0.012, 0.025)
Regions	−0.004	0.003	(−0.006, −0.001)	0.035	0.018	(0.006, 0.065)
Occupation	−0.004	0.011	(−0.007, −0.001)	0.001	0.438	(−0.002, 0.005)
Religion	0.000	0.382	(−0.001, 0.000)	0.006	0.053	(0.000, 0.012)
Wealth	0.002	0.083	(0.000, 0.005)	−0.002	0.349	(−0.006, 0.002)
Community Education	0.001	0.776	(−0.009, 0.012)	0.006	0.021	(0.001, 0.011)
Community Affluence	−0.001	0.514	(−0.003, 0.001)	−0.005	0.101	(−0.011, 0.001)
Constant				0.003	0.937	(−0.064, 0.069)

Abbreviation: CI: Confidence interval.

occupations between the two cohorts resulted in a far greater decrease in early marriage (12.6%) than in education. The increase in the relative share of urban regions also contributed to the reduction in early marriage to a smaller extent (2.9%) (Table 3).

Regarding the contributions of the coefficient effects, occupation, wealth, and community education played significant roles in the marriage dynamics in Ethiopia. These factors contributed to the widening gap in the incidence of marriage between the two birth cohorts rather than reducing it. The positive coefficient value of community education in the detailed decomposition analysis (0.017) reflects its significant role in reducing the incidence of marriage in the former cohort but a loss of significance in the latter cohort. Similarly, the positive coefficient for women's occupations (0.008) indicates a decline in the significance of women's employment, particularly in the agricultural sector, in promoting early marriage. Contrarily, for household wealth, the positive contribution (0.015) reflects an increase in its influence on the incidence of early marriage. This suggests that wealthier households in the recent cohort tend to marry off their daughters earlier than those in earlier cohorts. The higher significant coefficient value of the constant suggests that certain factors that could reduce the gap were not included in the model at age 15 (Table 3).

The decomposition analysis of the cumulative incidence of first marriage at age 20 revealed a 10.2% reduction. Nearly one-fourth of this reduction (−0.027/−0.102 = 26.0%) was attributed to differences in characteristics between the two birth cohorts of women. The remainder of the reduction (74%) resulted from the effects of variables or coefficient effects. A detailed decomposition of the reduction in the cumulative incidence of first marriage at age 20 showed that women's education, community affluence, and occupation significantly contributed to the reduction. The positive coefficient for residence indicates that the disparity in cumulative incidence of marriage between urban and rural areas was significantly higher in the former birth cohort than in the more recent cohort when other factors were controlled.

The inter-cohort gap in women's educational achievement contributed to a 12.7% reduction in the overall gap. Differences in women's occupations between the two cohorts resulted in a greater reduction in the incidence of first marriage (10.7%) than differences in community affluence (3.9%). In addition, the increase in the relative share of urban regions (urbanization) contributed significantly to the reduction in cumulative incidence of first marriage, although the magnitude of this contribution was small (3.9%) (Table 4).

The differential effects of variables were also evaluated, and the results indicate that religion and community affluence played significant roles. Regarding the contributions of the coefficient effect, religion significantly

influenced marriage dynamics at age 20 in Ethiopia. These factors contributed to the widening gap in the incidence of marriage between the two birth cohorts rather than reducing it. In the comprehensive decomposition analysis, women's religious affiliation had a positive coefficient value of 0.017, due to its considerable contribution to the higher incidence of marriage in the earlier cohort and its decline in significance in the later cohort. The difference effects of community affluence (0.016) significantly contributed to the reduction in cumulative incidence of first marriage between the two cohorts. Wealthier communities in the more recent cohort tend to delay the marrying of their daughters compared to wealthier communities in the earlier cohort.

The higher significant coefficient value of the constant suggests that certain factors, which could further reduce the gap, were not included in the model at age 20. The overall impact of unidentified variables contributing to the reduction in cumulative incidence of marriage at age 20 was higher than that at age 15 (Table 4).

The decomposition analysis of the cumulative incidence of first marriage revealed a 5.1% reduction between the two cohorts. Nearly one-fourth of this reduction (−0.014/−0.051 = 27.5%) was attributed to differences in characteristics between the two cohorts. The remainder of the reduction (72.5%) resulted from the effects of variables or coefficients effects. A detailed breakdown of the reduction in the aggregate incidence of first marriage at age 25 indicated that women's education level, region, and occupation significantly contributed to the reduction.

The inter-cohort gap in women's education level contributed approximately 13.7% to the reduction in the cumulative incidence of first marriage. In addition, shifts in women's occupations and regional differences between the two cohorts contributed equally (13.7%) to the reduction. The number and concentration of first marriages across the two birth cohorts also varied by regional state, as demonstrated by the differences in cumulative incidence at the regional level (Table 5).

Regarding the differential effects of variables, region, community education, and rural residence were significant contributors. This suggests that the urban-rural gap in the incidence of marriage was greater in the recent cohort compared to the earlier cohort. The differential effects of rural women (−0.088) played a significant role in reducing the cumulative incidence of marriage between the two cohorts. For regional states, the positive coefficient effect indicates that regional variability in the incidence of marriage was higher in the recent cohort than in the former cohort. In contrast, community education played a more substantial role in limiting the incidence of marriage in the former cohort compared to the more recent one (Table 5).

4. Discussion

This study aimed to compare the nuptiality patterns of selected cohorts of Ethiopian women. Further, components and sources of changes in nuptiality patterns among Ethiopian women were identified using the 2000 and 2016 EDHSs. A decomposition analysis framework was employed to evaluate the cumulative incidence of transition to first marriage and its components. The results of the study generally revealed that marriage is nearly universal in both cohorts of women. However, the age of entry into the first marriage was slightly delayed (beyond 20 years), and a 46% reduction in the degree of marital dissolution was noted. A large proportion of the difference in cumulative incidence of first marriage between the cohorts was observed at age 15 and below, and this difference declined after age 35. Overall, this study identified the factors contributing to changes in the nuptiality patterns of Ethiopian women between the two cohorts.

From a life-course perspective, researchers delve into the intricate dynamics of how demographic events evolve over time, seeking to unravel the underlying factors driving these changes. They explore how historical events, socioeconomic transformations, and individual agency intertwine to shape the trajectory of individuals' lives (Roy, 2014). The findings provide empirical evidence supporting the life-course perspective. Specifically, they demonstrate how ever-evolving social and economic landscapes profoundly influence individuals' choices regarding marriage patterns across different birth cohorts. This study also highlights the complex interplay between broader societal changes and individual decision-making, shedding light on how individuals navigate their lives in response to the opportunities and constraints presented by their historical and socioeconomic contexts.

4.1. Socioeconomic factors

Despite the slight difference in percentages, it is crucial to note that both cohorts exhibit a high prevalence of marriage. The fact that over 90% of individuals in both groups married before the age of 25 suggests that marriage remains a prevalent and customary practice among these cohorts. In sub-Saharan Africa, marriage has traditionally occurred early and been commonplace, with the expectation that every adult female will marry at least once during her reproductive career (Ayiga & Rampagane, 2013). Marriage has been an early and nearly universal social institution in Ethiopia. By age 30, over 95% of

women are most likely to be married (Central Statistical Agency (CSA) [Ethiopia] & ICF, 2016).

The incidence of first marriage before age 15 decreased by about 17%, and the reduction in first marriage before age 20 amounted to 10%. These shifts across different decomposition sections were the results of several socioeconomic factors, including the rise in women's education level and changes in occupations across the birth cohorts. The distribution of occupations, directly linked to higher education levels, significantly contributed to lowering the risk of early marriage (Amoo, 2017). In agreement with our findings, studies have shown that modernization, characterized by mass education and shifts in means of livelihood, has contributed to the reduction in early marriage (Paul, 2019). Education empowers girls to make informed decisions about their lives, including when and whom to marry. It also equips them with the skills necessary to participate in economic activities and become financially independent, which further reduces their reliance on early marriage as a means of economic security.

Moreover, studies have indicated that modernization causes a shift in values and marriage expectations among younger individuals, leading to the postponement of marriage or the decision to remain unmarried (Himawan *et al*., 2019). Conversely, our findings show that girls who do not attend school or fail to complete primary education are more likely to marry young (Paul, 2019). In the earlier cohort, communities characterized by higher levels of wealth and social status experienced a notable decline in the incidence of marriages. This trend continued in more recent cohorts, where communities with medium levels of affluence similarly experienced a decrease in the number of marriages.

Approximately 55% of the earlier cohort's married women, or 17.4% of the total, postponed their first marriage to a later age in the recent cohort. In addition, for every five women, one delayed her first marriage from the earliest possible age to a slightly later age. The 1991 National Population Policy and the 2000 Revised Family Code of Ethiopia established the minimum age of marriage as 18 years (TGE, 1993; The Revised Family Code of FDRE, 2000). By age 15, a significant number of women were influenced by these policies and chose to delay their first marriage from a very young age. The occurrence of the earliest marriages was significantly delayed due to these policies and programs.

The shift can be attributed to improvements in girl's education at all levels. In primary school, the percentage of girls enrolled rose from 20% in 1993 to 90.5% in 2007/2008; in secondary school, the percentage rose from 7.1% in 1993 to 22% in 2007/2008 (TGE, 1993). However, the policy primarily aimed to reduce the incidence of marriage before age 18 but has not yet fully achieved this goal. This study revealed that the cumulative incidence of first marriage was reduced by 10% at age 20, meaning that among 10 women, one delayed her marriage to a later age. Policies and programs have been ineffective in delaying the incidence of first marriage beyond the age of 20.

The experience of women entering into first marriages before and after these policy interventions has shifted due to changes in socioeconomic factors. According to LCT, changes in demographic events are shaped by individuals' socioeconomic status and other contextual factors. The timing and occurrence of important life events are greatly influenced by socioeconomic background. Therefore, the socioeconomic differences between the birth cohorts before and after the policy intervention can be understood within the framework of LCT.

4.2. Spatial drivers

The largest proportion of marriage prevalence was contributed by Oromia, Amhara, and SNNPR in both cohorts. The regional administrations have significantly influenced the reduction or shift in characteristics of cumulative marriage incidence across all decomposition points. According to Islam *et al*. (2016), significant geographical differences in child marriage were found in Bangladesh. Another study revealed that regional differences were a community-level factor associated with child marriage (Zegeye *et al*., 2021). By ages 15, 20, and 25, the differences in characteristics were primarily attributed to urban areas (Harari, Addis Ababa, and Dire Dawa), which contributed to the reduction in cumulative incidence between the two cohorts. In addition, urban areas showed discriminatory effects, leading to marriages at age 25. The structural effects of place of residence and regional variation contributed minimally to the reduction in marriage occurrences at all levels of decomposition, except at age 25. After controlling for other factors, each regional state responded separately to the encouragement of marriage between the two cohorts. The coefficient effects observed at age 25 were a response from women residing in rural areas within the recent cohort, with no coefficient effects noted in the earlier cohorts. According to Erulkar (2022), Addis Ababa, Amhara, and Tigray experienced the most significant declines in child marriage, whereas estimates for Somali and Oromia during the same period indicate a rise in child marriage. In Afar, Beneshangul-Gumuz, Somalia, and Oromia, the majority of girls get married before turning 18.

4.3. Coefficient effects

The results confirm the hypothesis that the cumulative incidence of entry into marriage is influenced by the discriminatory effects of socioeconomic determinants in

addition to socioeconomic inequalities. A similar finding has been reported in a study conducted in Ethiopia, which showed that the potency of socioeconomic factors largely determines the reproductive transition of youths (Dejene & Gurmu, 2023). The discriminatory effects of community education, household wealth, and occupation significantly contributed to the reduction in cumulative marriage incidence at age 15 across birth cohorts. These factors had greater impacts on the recent cohort compared to the earlier cohort in determining the rate of entry to first marriage, in the absence of socioeconomic inequality across cohorts. This means that the gap in the rate of first marriage at age 15 would have widened due to differences in the potency of these factors.

Christian believers were more likely to postpone marriage until after age 20, whereas other religious groups actively encouraged earlier marriage. Muslim women are significantly more likely to marry at a younger age compared to women from other religious groups (Islam *et al.*, 2016). Similarly, in Bangladesh, religion has a significant impact on early marriage, with Muslims more likely to marry early compared to individuals from other religious groups (Sarkar, 2009). The influence of wealthy households contributes to a decrease in early marriages in the earlier cohort compared to the later cohort.

The impact of community education on marriage rates becomes evident when examining the discriminatory effects at the ages of 15 and 25, alongside other predictor variables. This finding emphasizes the significant role that community literacy plays in shaping and reducing the incidence of marriages, surpassing the impact of other factors. In contrast, communities with lower levels of education may experience higher rates of early marriages. Limited access to education can result in fewer opportunities for personal and professional development, leading individuals to prioritize marriage at a younger age due to cultural, economic, or social pressures.

The results suggest that communities with higher education level display a lower incidence of early marriages. This may be due to better educational opportunities within these communities, which promote personal growth, career development, and the pursuit of individual aspirations before marriage. The significant role of community literacy in influencing marriage patterns emphasizes the importance of promoting accessible and quality education for all. By investing in education, communities can empower individuals to make informed decisions about their lives, including marriage, and alleviate societal pressures that perpetuate early marriage practices.

These findings highlight the need for targeted interventions, such as educational initiatives, awareness campaigns, and policy reforms, to address disparities in community education and promote opportunities that enable individuals to make autonomous decisions about their marital futures. The general effect of unidentified factors contributing to a reduction in marriage incidence was notably significant at both ages 15 and 20. Therefore, although the specific unknown factors responsible for the gap in cumulative marriage incidence at these ages between the cohorts remain unclear, their impact cannot be ignored.

4.4. Marital stability

Early marriage has a significant impact on divorce and remarriage rates. A survey conducted in Thailand showed an increase in the number of divorced and widowed women who have remarried, rising from 60.5% in 2001 to 71.3% in 2016. Concurrently, married women who had never married increased dramatically from 8.8% in 2001 to 21.6% in 2016 (Pothisiri *et al.*, 2023). In Nigeria, the crude rate of marital breakup was 11/1000 people, with a marriage dissolution rate of 29.5/1000 among those who had been married. The south-eastern region had the lowest rate of marital divorce, whereas the north-eastern and southern regions had the highest rates (Ntoimo & Akokuwebe, 2014).

Ethiopia also exhibits a high rate of marital breakdown, with 45% of first marriages resulting in divorce. It was estimated that 25% of married women had divorced during their first marriage. This figure is higher than the 2019 EDHS mini-report, which indicated that 6% of Ethiopian women aged 15 – 49 were divorced or separated (Asfaw & Alene, 2023). The rate of divorce in Ethiopia decreased from 8.7% to 6.3% between the 2000 and 2016 EDHSs.

4.5. Strengths and limitations

This study compared changes in nuptiality patterns between birth cohorts within the context of socioeconomic shifts and policy changes. Unlike previous studies that simply examined the average age at first marriage at a given point in time, this study provided a more comprehensive comparison between the two cohorts. In addition, the use of large, cross-sectional nationally representative datasets enhances the applicability of the findings to similar populations.

However, this study's cross-sectional design has limitations, including the exclusion of experiences from deceased and migrant women. Furthermore, the analysis focused solely on socioeconomic and demographic characteristics as explanatory variables. In particular, among older and less educated respondents, retrospective reporting of age at first marriage may introduce a recall to potential misreporting and digit preference issues.

4.6. Implications for research and policy

The study's findings indicate geographic variability in nuptiality patterns. Future research should focus on elucidating the regional variability and investigating the fundamental causes of spatial differences in nuptiality patterns within a similar national policy context. This study provides evidence that socioeconomic shifts significantly influence changes in nuptiality patterns in Ethiopia. These changes directly impact fertility transitions, especially in sub-Saharan countries.

The findings highlight the potential for designing effective socioeconomic policies that drive demographic transformation and result in a demographic dividend. By understanding the interplay between socioeconomic factors, nuptiality patterns, and fertility transitions, policymakers can develop targeted strategies to leverage demographic dividends and promote sustainable development in the region.

5. Conclusions

The results in this study demonstrated that changes in nuptiality patterns were explained by a reduction in cumulative incidence of marriage (magnitude), a shift in the timing of entry into the first marriage, and a 46% reduction in marital dissolution across the two birth cohorts. This study identified three key sources of changes in nuptiality patterns: socioeconomic factors, spatial drivers, and coefficient effects.

Marriage has traditionally been an early and nearly universal social institution in Ethiopia. However, this study found a shift from extremely early marriage to early but nearly universal marriage, indicating that women are delaying getting married. In addition, the findings revealed that socioeconomic factors such as occupation and education level, alongside spatial drivers such as region, significantly accounted for the reduction in the cumulative incidence of marriage. Further research is needed to reveal unknown factors that may contribute to the decline in marriage rates.

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Conflict of interest

The authors declare that they have no competing interests.

Author contributions

Conceptualization: All authors
Formal analysis: Dame Kedir, Tariku Dejene
Investigation: All authors
Methodology: All authors
Writing–original draft: Dame Kedir
Writing–review & editing: All authors

Ethics approval and consent to participate

This study used secondary data from the 2011 to 2016 Ethiopia Demographic and Health Surveys. The methodologies and questionnaires for these surveys were reviewed and approved by the ICF/ORC Institutional Review Board. In addition, the study protocols received ethical approval from the Institutional Review Boards of the Ethiopian Ministry of Science and Technology and the Ethiopian Health and Nutrition Research Institute. All interviews were conducted after obtaining verbal consent from the respondents.

Consent for publication

Not applicable.

Availability of data

The Demographic and Health Survey data used in this study are publicly available for use free of charge. The data can be obtained upon request through the following website: https://dhsprogram.com/data/available-datasets.cfm.

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ACCSCIENCE PUBLISHING

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RESEARCH ARTICLE

Marital dissolution in India: Patterns and correlates

Harihar Sahoo[1]*, Manas Ranjan Pradhan[2], Manoj Alagarajan[2], Madhurima Sharma[3], and Sunandita Das[1]

[1]Department of Family and Generations, International Institute for Population Sciences, Mumbai, Maharashtra, India

[2]Department of Fertility and Social Demography, International Institute for Population Sciences, Mumbai, Maharashtra, India

[3]Department of Population and Development, International Institute for Population Sciences, Mumbai, Maharashtra, India

Abstract

The rate of marital dissolution in India is relatively low from a global perspective; however, the rate of separation exceeds that of divorce. This study aims to estimate the prevalence, trends, variations, and determinants of marital dissolution in India. We employed the approaches of descriptive statistics and multivariate logistic regression to examine the relationship between marital dissolution and its correlates among ever-married women in India. The findings revealed that urban women are more prone to marital dissolution, with higher rates observed among the impoverished and childless compared to their counterparts. Risk factors such as infertility, poverty, child marriage, the educational gap between spouses, urbanization, and spousal violence contribute significantly to marital disintegration. Special attention should be directed towards these segments of the population to promote marital stability.

Keywords: Marital dissolution; Divorce; Separate; India; Region

***Corresponding author:**
Harihar Sahoo
(harihar@iipsindia.ac.in)

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1. Introduction

Marriage in India reflects a lot of the ambiguity and inconsistencies that define a traditional society transitioning into a modern one (Sonpar, 2005). The previous decades have observed a steady increase in the age of marriage for women worldwide, accompanied by a rise in delayed marriage and singlehood in both developed and developing countries. In spite of the universality of marriage, its types and customs differ across communities due to diverse religious and cultural practices (Kaur & Singh, 2013). Marriages may terminate either through divorce or separation. Divorce typically refers to the legal dissolution of a formally contracted marriage, while separation refers to the informal dissolution of either a formal or informal marriage.

Separation and divorce are becoming increasingly common in many parts of Asia. In East Asia, except for China, marriage rates have decreased, with divorce rates briefly surpassing those observed in OECD nations (Dommaraju & Jones, 2011). During the Vedic period in India, marriage was viewed as an institution that could not be dissolved, with this sentiment persisting through the Buddhist era. However, during the middle

ages, the gradual loss of egalitarian and progressive values in Indian society led to the denial of leverage to women. The British Indian Government, in collaboration with progressive Indians, implemented various social reforms in the form of legislation in the latter centuries, which accelerated the process of social change (Rangarao & Sekhar, 2002). The Hindu Marriage Act of 1956 was amended to facilitate mutual consent divorce, often known as "no-fault divorce." Divorce rates in India have increased since the amendment (Amato, 1994). While India still maintains lower marriage breakup rates compared to western countries, recent estimates indicate an exponential growth in divorce cases (Huang, 2005; Dummett, 2011; Dutta, 2013). The Census 2011 data provide a good opportunity to understand the phenomenon as it separately enumerates individuals who were divorced from those who were separated. According to the census, 13.6 lakh people have divorced, accounting for 0.24% of Indians who have ever been married and 0.11% of the country's entire population.

As India undergoes societal transformations, traditional marriage unions are gradually being replaced by western family structures such as nucleation and cohabitation, leading to notable shifts in Indian family systems (Dommaraju, 2016). Numerous attempts have been made to formulate explanations for marital dissolution, mainly in western countries. The primary models explaining breakups in close relationships are rooted in social exchange theory. One influential social exchange theory is the interdependence theory of relationships (Thibaut & Kelley, 1959). This theory focuses on two key concepts: outcomes and evaluations of outcomes. Outcomes are based on the rewards gained and the costs incurred in a relationship, where rewards encompass positive experiences that bring pleasure, while costs encompass negative experiences such as embarrassment or anxiety. The magnitude of rewards depends on individual needs and values and how well these align with the partner's actions. Thibaut and Kelley identified two types of evaluations of outcomes: (i) the personal comparison level of outcomes and (ii) the comparison level for alternatives. The personal comparison level reflects an individual's expectations for the quality of outcomes in their relationship. If rewards surpass costs based on this standard, the relationship is deemed satisfactory; otherwise, it may be seen as unsatisfactory. On the other hand, the comparison level for alternatives is the lowest level of outcomes attainable outside the relationship. Individuals weigh the rewards and costs of other potential options. As long as the balance of outcomes favors the ongoing relationship over available alternatives, individuals are inclined to stay in that relationship. Therefore, decisions regarding whether to leave or stay in a relationship hinge on the balance of outcomes between the current relationship and alternative opportunities.

In the Indian context, social exchange theory provides valuable perspectives on factors contributing to marital dissolution. When individuals consistently encounter challenges such as financial issues, mental and sexual incompatibility, infidelity, impotency, or domestic violence in their marriage, they may explore alternative options or choose to dissolve the marriage. Several studies in Indian literature have revealed that women who were married as child brides face a significantly higher risk of experiencing marital dissolution. Moreover, a majority of urban areas in India experience marital disintegration through separation and divorce (Adedini *et al.*, 2020). Approximately 80% of Indian women who sought divorce cited "cruelty or domestic violence in their marital homes" as the reason (Singh, 2013). Additionally, according to the 2011 Census, there are roughly 3 times as many separated individuals as there are divorced individuals, whereby separated individuals constitute 0.61% of married people and 0.29% of the general population, whereas divorced individuals account for 0.24% and 0.11%, respectively. The absence of children in a marriage often exerts significant strain on marital ties because children are the primary focus of family life. Consequently, men may view a childless union as justification for seeking remarriage, whether or not they choose to divorce their first spouse. Although some childless women try to create new identities and preserve their marriages together (Riessman, 2000), for many couples, childlessness marks the end of their marriage. If marital stability were supported by factors such as marital satisfaction, a symmetrical gender power dynamic, an equitable socio-legal system, and egalitarian beliefs, the relatively low rate of divorce in India might be perceived as a desirable arrangement (Dommaraju, 2016). However, women who are divorced or separated lack legal protections and are not entitled to any of the property or assets accrued during the marriage (Agnes, 2011; Singh, 2013). In addition, literature has demonstrated an inverse association between the number of children and the risk of divorce, particularly in rural areas. Older women with only female offspring and childless couples were found to have a higher incidence of divorce (Bose & South, 2003).

Micro-level statistics on marital status are available through surveys, with numerous large-scale, nationally representative demographic, household, and health surveys having been carried out in India over the past two decades. Thus, this paper aims to utilize such survey data to estimate the prevalence, trends, variations, and determinants of marital dissolution in India. By analyzing nationally representative survey data, we seek to provide

a clearer understanding of the overview of divorce and separation in India.

2. Methods

2.1. Data

The present study utilized data from the fifth round of the National Family Health Surveys (NFHS-5), conducted from 2019 to 2021. The NFHS is a large-scale, multi-round survey conducted on a representative sample of households across India. The 2019 – 21 NFHS comprised 636,699 households, 724,115 women aged 15 – 49 years, and 101,839 men aged 15 – 54 years. The survey provides state and national information for India on fertility, infant and child mortality, family planning practices, maternal and child health, reproductive health, nutrition, anemia, and the utilization and quality of health and family planning services. The data provide information for 707 districts, 28 states, and eight union territories (UTs). Employing a stratified, two-stage sampling design and the survey encompasses 30,198 primary sampling units. In the first stage, clusters were selected using a probability proportional to cluster size. In the second stage, 22 households from each cluster were selected with an equal opportunity of systematic selection from the household listing. A detailed description of the sampling procedure and survey design can be found in the India report of NFHS-5 (International Institute for Population Sciences [IIPS] & ICF, 2021). All methods were carried out in accordance with relevant guidelines and regulations, with informed consent obtained from all subjects and/or their legal guardian(s). The analysis for this study was based on a subsample of ever-married women interviewed in NFHS-5 surveys. A total of 511,604 ever-married women were included in the analysis, after excluding women who were never married (n = 181,285), widowed (n = 21,530), and married more than once (n = 9,696). Figure 1 is calculated from Census 1981 – 2011.

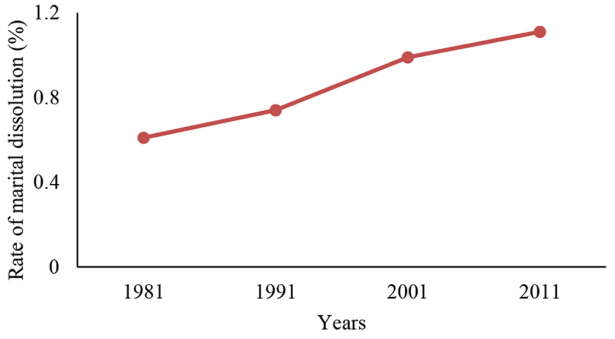

Figure 1. The trend of marital dissolution among women aged 15 – 49 years in India (1981 – 2011). Source: Computed from the data of the Census of India.

2.2. Analysis

Utilizing the NFHS-5 dataset, this paper employed descriptive statistics and the multivariate logistic regression approach to examine the relationship between marital dissolution and its correlates among ever-married women in India.

2.2.1. Outcome variable

The main outcome variable for this study is "marital dissolution." Considering the lack of direct questions in the NFHS to measure marital dissolution, we have utilized the information on current marital status, which was actually categorized as never-married, currently married/living with a partner, widowed, divorced, and separated. We excluded women who have never been married or in a union, as our focus was on patterns of union status among ever-married women. In addition, we filtered out our sample by excluding women who married once and whose marital status is widowed among the ever-married women. For the analysis, we classified women who were married and living together with a partner as "0," while those who were divorced and separated were collectively designated as "1."

2.2.2. Explanatory variables

With guidance from existing literature, this study identified several explanatory variables encompassing demographic, socio-economic, and fertility-related factors. These variables include birth cohort, current age of women, age at first cohabitation, social groups, religion, and place of residence. In addition, household wealth status, educational attainment, and exposure to mass media were considered. Selected fertility characteristics, such as declared infecundity and the number of living sons, were also controlled for in the analysis.

2.3. Statistical analysis

The data analysis was conducted using Stata 16.1 software and Microsoft Excel. Descriptive and inferential statistics were employed to analyze the data. Initially, percentage distributions of respondent profiles were presented to provide a clear understanding of the results obtained from inferential statistics. Given that the dependent variable is dichotomous, indicating whether a woman has experienced marital dissolution or not, binary logistic regression was employed to estimate the effects of identified demographic, socio-economic correlates, and fertility characteristics on marital dissolution among ever-married women in India. The complex design of the health and demographic survey was taken into account by applying sampling weights.

3. Results

The study began by providing a socioeconomic overview of the study population. It then proceeded to analyze the

variation in marital dissolution across states and districts, examining its prevalence among ever-married women aged 15 – 49 based on their background characteristics. The research further delved into region-specific analysis by considering socio-economic and demographic parameters.

3.1. Profile of women considered in the study

Table 1 illustrates the demographic and socioeconomic characteristics of the ever-married women of the reproductive age group (15 – 49 years) in India. A total of 511,604 ever-married women aged 15 – 49 years were included in the study, of which 50,3947 (98.5%) were currently married or within a union, 2,332 (0.5%) were divorced, and 5,324 (1.0%) were separated as per their marital status. To present a long-term trend, we further analyzed the data by comparing birth cohorts. Among the respondents, about 27% were born during the 1969 – 1979 cohort, while about 35%, 34%, and 3% of respondents

Table 1. Demographic and socioeconomic profile of the sampled women and profile of divorced/separated women in India (NFHS 2019 – 2021)

Characteristics	Sampled women distribution (%)	Divorced/ separated women distribution (%)
Marital status		
Currently married	98.5	
Divorced	0.46	30.46
Separated	1.04	69.54
Birth cohort		
1969 – 1979	26.91	31.63
1980 – 1989	35.2	37.87
1990 – 1999	34.42	28.25
2000 – 2006	3.48	2.25
Current age		
15 – 24	16.7	11.62
25 – 34	37.62	35.75
35+	45.69	52.62
Age at first cohabitation (years)		
<18	41.15	40.01
18 – 21	38.64	33.04
22 – 29	19.06	23.37
>30	1.15	3.58
Number of sons		
None	26.21	52.22
1	43.02	34.25
2	24.6	11.3
3 or more	6.17	2.23
Consanguineous marriage		
No	87.09	87.82
Yes	12.91	12.18
Declared infecundity		
No	97.81	91.97
Yes	2.19	8.03
Social groups		
SC	22.74	26.5
ST	9.61	11.61
OBC	45.35	42.6
None of them	22.3	19.29
Religion		
Hindu	81.89	76.63
Muslim	13.18	15.45
Christian	2.2	4.28
Others	2.73	3.64
Educational attainment		
No education	27.22	29.28
Primary	58.34	58.45
Secondary	1.52	1.42
Higher	12.92	10.85
Exposure to mass media		
Not at all	24.23	23.47
Partially exposed	74.12	74.66
Fully exposed	1.65	1.87
Wealth status		
Poorest	18.65	20.93
Poorer	19.98	21.9
Middle	20.48	22.56
Richer	20.83	20.19
Richest	20.06	14.42
Residence		
Urban	31.55	39.07
Rural	68.45	60.93
Region		
North	13.65	8.71
Central	23.47	16.01
East	23.73	19.08
Northeast	3.69	4.93
West	14.40	18.84
South	21.06	32.43
Total	100	100
Total sample size	511,604	7900

Source: Computed from data of NFHS-5.
Abbreviation: NFHS-5: National Family Health Surveys.

belonged to the 1980 – 1989, 1990 – 1999, and 2000 – 2006 birth cohorts, respectively. The majority of the respondents resided in rural areas (68%). About 22% and 9% belonged to the scheduled caste and scheduled tribe social groups, respectively. Nearly 82% of the respondents belonged to the Hindu religion. The respondents with primary education (58%) nearly accounted for four times more than those who pursued higher education (13%). About 27% of the respondents had no education in their lifetime. Approximately 19% belonged to the poorest wealth index, whereas 20% belonged to the richest wealth index, and 20% and 21% of respondents belonged to the poorer and richer wealth index, respectively. Nearly 24% of women were not exposed to mass media at all, while 74% were partially exposed and 1.65% were fully exposed, including all types of mediums such as television, magazine/newspaper, radio (once a week), and cinema (once a month). Nearly 16% were between the ages of 15 and 24, and about 46% belonged to the age group of 35 years and above. Nearly 39% of the respondents started to cohabit with a partner in the 18 – 21 year age group, and about 41% of women started cohabiting before reaching the age of 18 years. Most of the women had only one son (43%), and around 26% of women reported that they did not have any sons. About 2% of ever-married women declared that they were infecund. Approximately 12.91% of women were related to their first husband before marriage. Most of the respondents belonged to the eastern region (24%). Only 3.69% of the women belonged to the northeastern region. About 21% of the respondents resided in the southern part of India.

3.2. Variation of marital dissolution by states and districts

Figure 1 illustrates the trend of marital dissolution among women aged 15 – 49 years from 1981 to 2011. In 2011, the rate increased to 1.11% from 0.61% in 1981. Table 2 presents the patterns and variations of marital dissolution across the states and UTs of India. It is noted that separation rates are higher than divorce rates due to stigma related to reporting divorce across all states and UTs. Meghalaya has the highest reported separation rate at 5.8%, while Ladakh has the lowest at 0.15%. The dissolution rate is notably higher in the southern region of the country, encompassing states such as Andhra Pradesh (2.4%), Karnataka (2.1%), Kerala (2.1%), Tamil Nadu (2.5%), Puducherry (3.3%), Telangana (2.5%), Lakshadweep (1.3%), and Andaman and Nicobar Islands (2.2%). In contrast, northern states exhibit lower rates of marital dissolution compared to other regions. Jammu and Kashmir (0.3%), Himachal Pradesh (0.2%), Uttarakhand (0.25%), and Haryana (0.2%) are among the states with lower divorce rates. In the northeastern region, Mizoram (9.3%) and Meghalaya (6.7%) reported

Table 2. Prevalence of marital dissolution among ever-married women of reproductive age group (15 – 49 years) by state in India (NFHS 2019 – 2021)

State	Divorced	Separated	Dissolved marriage	*n*
North	0.37	0.59	0.96	69,858
Jammu and Kashmir	0.31	0.16	0.47	3,938
Himachal Pradesh	0.28	0.38	0.66	2,764
Punjab	0.59	0.85	1.44	10,797
Chandigarh	0.88	0.91	1.79	391
Uttarakhand	0.25	0.49	0.74	4,067
Haryana	0.22	0.55	0.77	9,889
NCT of Delhi	0.38	0.75	1.13	7,159
Ladakh	0.48	0.15	0.63	(69)
Rajasthan	0.36	0.55	0.91	30,784
Central	0.35	0.67	1.02	1,20,058
Chhattisgarh	0.62	1.5	2.12	11,326
Madhya Pradesh	0.38	0.78	1.16	29,825
Uttar Pradesh	0.31	0.5	0.81	78,907
East	0.3	0.91	1.21	1,21,381
West Bengal	0.4	1.27	1.67	46,244
Jharkhand	0.3	0.44	0.74	13,246
Odisha	0.44	1.39	1.83	17,221
Bihar	0.14	0.49	0.63	44,670
North-East	0.71	1.29	2.00	18,898
Sikkim	0.8	1.41	2.21	213
Arunachal Pradesh	0.6	0.84	1.44	403
Nagaland	1.86	0.6	2.46	433
Manipur	1.56	1.35	2.91	818
Mizoram	7.94	1.31	9.25	329
Tripura	0.39	1.8	2.19	1,760
Meghalaya	0.98	5.76	6.74	1,074
Assam	0.47	0.91	1.38	13,867
West	0.77	1.18	1.95	73,686
Gujarat	1.06	0.57	1.63	23,724
Dadra and Nagar Haveli	0.53	1.82	2.35	191
Maharashtra	0.65	1.48	2.13	49,102
Goa	0.24	0.57	0.81	669
South	0.54	1.76	2.3	1,07,724
Andhra Pradesh	0.54	1.82	2.36	21,585
Karnataka	0.35	1.7	2.05	27,127
Lakshadweep	1.03	0.31	1.34	(29)
Kerala	0.99	1.15	2.14	13,211
Tamil Nadu	0.44	2.02	2.46	31,168
Puducherry	0.46	2.79	3.25	463
Andaman and Nicobar Island	0.47	1.77	2.24	140
Telangana	0.73	1.76	2.49	14,001
India	0.46	1.04	1.5	511,604

Note: Figure presented within parentheses/() represents a sample size <70.
Source: Computed from data of NFHS-5.
Abbreviations: NCT: National capital territory, NFHS-5: National Family Health Surveys.

higher rates of marital dissolution, with separation being more prevalent than divorce cases. In the western parts, Maharashtra (0.65%) and Dadar and Nagar Haveli have recorded higher divorce rates compared to other states and UTs.

District-level mapping reveals significant inter- and intra-state heterogeneity in levels of marital dissolution (Figure 2). The map highlights that the southern regions of the country are where marital dissolution is most common. We also discovered that the pace of dissolution is higher in the north-eastern states compared to the northern and western parts of the nation. The rate of marital dissolution, which includes divorce and separation cases, spans from the West Jaintia Hills district of Meghalaya (16.3%) to the Jalaun district of Uttar Pradesh (0.06%). When compared to other southern states, Tamil Nadu (2.46%), Kerala (2.14%), Andhra Pradesh (2.36%), and Karnataka (2.05%) have a disproportionately high number of divorce cases. Mizoram (9.25%) and Meghalaya (6.74%), in contrast to other north-east states, have witnessed a considerable increase in divorce and separation cases. The districts of Aizawl (10.01%), Serchhip (11.58%), and Lunglei (11.36%) in Mizoram state have reported a higher prevalence of marital dissolution among ever-married women aged 15 – 49 years. Conversely, Jammu and Kashmir (0.47%) is the state with the lowest cases of marital dissolution, with some districts like Shupiyan and Badgam recording no marital dissolution cases at all in the survey. In the northern regions, states like Rajasthan (0.91%), Uttarakhand (0.74%), Jammu and Kashmir (0.47%), Ladakh (0.63%), and Haryana (0.77%) have recorded comparatively lower rates of marital dissolution than other states.

3.3. Differentials of marital dissolution by background characteristics

Table 3 presents the prevalence of marital dissolution among ever-married women of reproductive age (15 – 49 years) categorized by demographic and socio-economic characteristics. The prevalence was relatively higher among women born during the 1969 – 1979 birth cohort

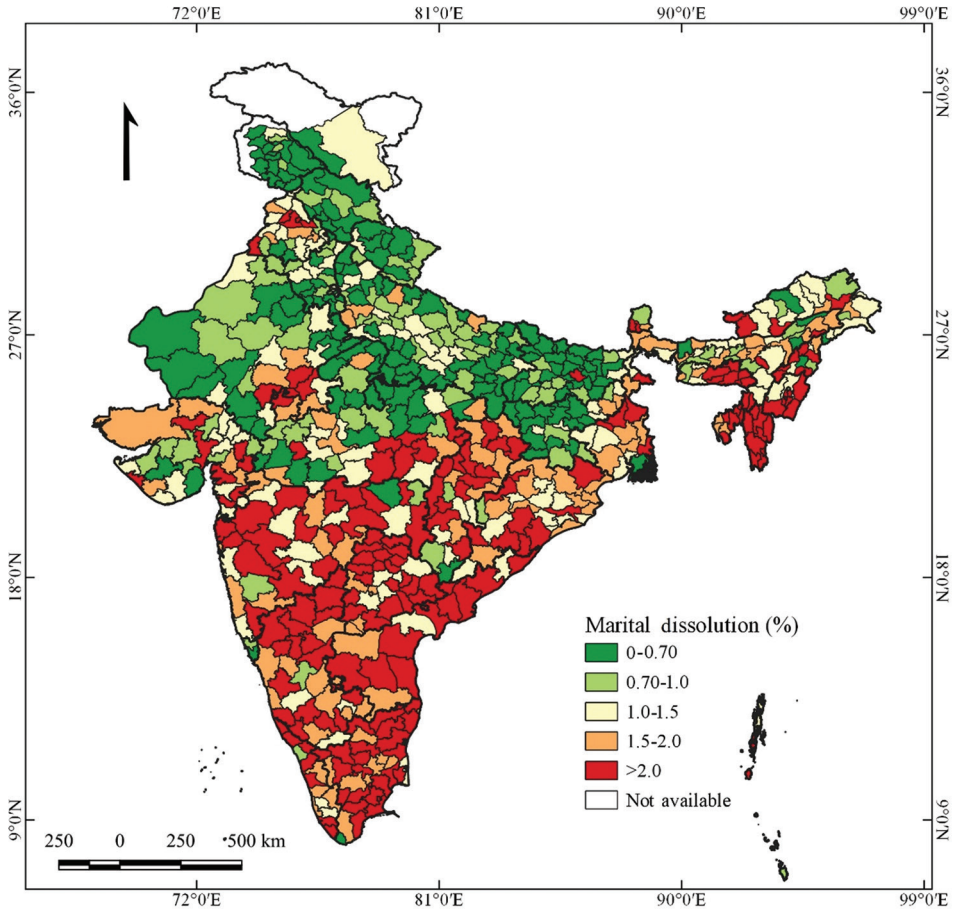

Figure 2. District-wise variation of marital dissolution in India, 2019 – 2021. Source: Computed from data of National Family Health Surveys-5.

Table 3. Prevalence of martial dissolution among ever-married women of reproductive age group (15 – 49 years) by background characteristics in India (NFHS 2019 – 2021)

Background characteristics	Divorced	Separated	Dissolved marriage
Birth cohort			
1969 – 1979	0.48	1.28	1.76
1980 – 1989	0.47	1.14	1.61
1990 – 1999	0.43	0.8	1.23
2000 – 2006	0.32	0.64	0.96
Current age			
15 – 24	0.36	0.68	1.04
25 – 34	0.47	0.95	1.42
35+	0.48	1.24	1.72
Age at first cohabitation (years)			
<18	0.39	1.06	1.45
18 – 21	0.37	0.91	1.28
22 – 29	0.7	1.13	1.83
>30	1.47	3.19	4.66
Number of sons			
None	1.17	1.81	2.98
One	0.27	0.92	1.19
Two	0.1	0.58	0.68
3 or more	0.1	0.44	0.54
Consanguineous marriage			
No	0.47	1.04	1.51
Yes	0.36	1.05	1.41
Declared infecundity			
No	0.42	0.98	1.4
Yes	1.87	3.63	5.5
Social groups			
SC	0.46	1.28	1.74
ST	0.55	1.25	1.8
OBC	0.44	0.96	1.4
None of them	0.41	0.88	1.29
Religion			
Hindu	0.38	1.02	1.4
Muslim	0.73	1.02	1.75
Christian	1.01	1.91	2.92
Others	0.82	1.18	2
Educational attainment			
No education	0.45	1.16	1.61
Primary	0.44	1.06	1.5
Secondary	0.49	0.91	1.4
Higher	0.55	0.71	1.26
Exposure to mass media			
Not at all	0.39	1.06	1.45
Partially exposed	0.47	1.04	1.51
Fully exposed	0.73	0.97	1.7
Wealth status			
Poorest	0.39	1.29	1.68
Poor	0.41	1.23	1.64
Middle	0.46	1.19	1.65
Richer	0.53	0.92	1.45
Richest	0.47	0.6	1.07
Residence			
Urban	0.6	1.25	1.85
Rural	0.39	0.94	1.33
Region			
North	0.37	0.59	0.96
Central	0.35	0.67	1.02
East	0.3	0.91	1.21
Northeast	0.71	1.29	2
West	0.77	1.18	1.95
South	0.54	1.76	2.3
Total	0.46	1.04	1.5

Note: The sample size is 511,604.
Source: Computed from data of NFHS-5.
Abbreviation: NFHS-5: National Family Health Surveys.

compared to those born in later birth cohorts (Figure 3). Additionally, the prevalence of marital dissolution was comparatively higher in the southern region (2.3%) and the north-east region (2%). Furthermore, the prevalence of separation and divorce increased with the age of women; with those aged 35 years (1.7%) exhibiting a higher prevalence compared to those aged 15 – 24 years. The prevalence of marital dissolution was higher among ever-married women who resided in urban areas (1.9%) than people who lived in rural areas. The prevalence of marital dissolution was higher among Christian women (2.9%) compared to Hindus and Muslims. Women who reported having no sons were more susceptible to marital dissolution (2.9%), particularly separation (1.8%). Education also played a major role in character development and stable marital status, with women lacking any level of education presenting a comparatively higher prevalence of marital dissolution (1.61%). However, the prevalence rate decreased with increasing levels of education, with those with higher education displaying a low prevalence (1.2%). Fecundity status also plays a major role in the overall stability of

marital relations in the Indian context. Those who have declared themselves as infecund had a higher prevalence of marital dissolution (5.5%). Additionally, the prevalence rate was 1.7% among those belonging to the poorest wealth index, while it was lowest for the richest wealth index (1.0%), although the range is minimal. Moreover, women related to their first husband before marriage (1.41%) were comparatively less likely to experience marital dissolution than those who were not related. Lastly, the respondents who were fully exposed to mass media (1.7%) exhibited a higher prevalence of marital dissolution compared to those not exposed to mass media at all.

According to the state module of NFHS-5, we have considered three key factors: the educational gap between spouses, the occupation of respondents (women), and instances of spousal violence to portray the coverage of marital dissolution among ever-married women in India (Table 4). The results revealed a significantly higher prevalence among women who are more educated than their husbands or partners (2.7%) than those with lower levels of education relative to their husbands (1.3%). In addition, employed women are notably more likely to experience divorce than those who are not. Interestingly, agricultural workers (2.2% of respondents) appear to face a lower risk compared to women (3.9% of respondents) employed in other service and industrial sectors. Regarding the incidence of violence, women (0.7%) who have never experienced any form of spousal violence, including physical, sexual, and emotional abuse, have reported much fewer incidents of marital dissolution than those who have (4%), representing a four-fold increase.

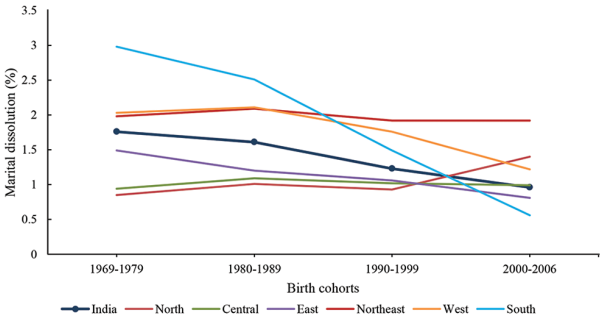

Figure 3. Pattern of marital dissolution across birth cohorts of women National Family Health Surveys (NFHS 2019 – 2021). Source: Computed from data of NFHS-5.

The estimated prevalence of marital divorce in India and its regional disparities are presented in Table 5. This table demonstrates that, in comparison to other regions, both the southern and northeastern regions exhibit higher rates of divorce and separation. Notably, women over the age of 35 are more common in the central region than in the northern states (0.96%) when it comes to the prevalence of marital separation, with a substantially higher frequency observed among this age group in the northeastern regions (2.01%). Across nearly every region, with the exception of the central area, there is a trend of increased prevalence of marriage dissolution as women age. Furthermore, women who entered their first cohabitation before the age of 18 are substantially more likely to experience divorce in the southern (2.54%) and northeastern (2.23%) regions. In contrast to those who had at least one or more boys, those who had never had a son were more prone to marital dissolution, with this frequency being particularly higher across western sections (3.65%) compared to other regions. Regarding infertility,

Table 4. Prevalence of martial dissolution among ever-married women of reproductive age group (15 – 49 years) by background characteristics in India (NFHS 2019 – 2021)

Variables	Divorced	Separated	Dissolved marriage	*n*
Educational gap of spouses (*n*=76,878)				
Husband higher than wife	0.35	0.98	1.33	23,303
Both at same level	0.46	1.15	1.61	41,985
Husband lower than wife	0.83	1.91	2.74	11,589
Women's occupation (*n*=76,878)				
Non-working	0.32	0.72	1.04	51,992
Agricultural	0.44	1.74	2.18	12,099
Non-agricultural	1.19	2.71	3.90	12,786
Ever experienced spousal violence (*n*=60,333)				
No	0.27	0.47	0.74	41,299
Yes	1.08	2.93	4.01	19,033

Source: Computed from individual data of NFHS-5.
Abbreviation: NFHS-5: National Family Health Surveys.

Table 5. Region-wise prevalence of martial dissolution among ever-married women of reproductive age group (15 – 49 years) by background characteristics in India (NFHS 2019 – 2021)

Background characteristics	North	Central	East	Northeast	West	South
Total sample size	69,858	120,058	121,381	18,898	73,686	107,724
Birth cohort						
1969 – 1979	0.86	0.94	1.49	1.98	2.03	2.98
1980 – 1989	1.02	1.09	1.2	2.09	2.11	2.51
1990 – 1999	0.93	1.02	1.06	1.92	1.76	1.49
2000 – 2006	1.4	0.99	0.81	1.92	1.22	0.56
Current age						
15 – 24	0.98	1.01	0.8	1.84	1.47	1.08
25 – 34	0.94	1.06	1.26	2.06	1.91	1.91
35+	0.96	0.99	1.37	2.01	2.15	2.9
Age at first cohabitation (years)						
<18	0.95	0.94	1.01	1.85	2.23	2.54
18 – 21	0.79	0.95	1.11	1.85	1.47	1.96
22 – 29	1.12	1.3	1.93	2.39	2.29	2.26
>30	3.25	3.95	6.61	2.32	3.94	5.85
Number of sons						
None	2.38	2.58	2.44	3.00	3.71	3.74
One	0.65	0.72	0.93	1.8	1.58	1.89
Two	0.4	0.4	0.54	1.15	0.92	1.29
Three or more	0.41	0.3	0.39	1.15	1.42	1.02
Consanguineous marriage						
No	0.96	1.04	1.19	2.00	2.02	2.50
Yes	0.92	0.83	1.32	1.91	1.55	1.72
Declared infecundity						
No	0.91	0.97	1.15	1.87	1.87	2.11
Yes	3.06	3.59	4.33	6.25	5.42	9.11
Social groups						
SC	1.2	1.15	1.13	1.73	3.65	2.65
ST	0.68	1.48	1.44	3.25	2.13	2.32
OBC	0.91	0.93	0.9	1.42	1.49	2.32
None of them	0.87	0.86	1.45	1.43	1.7	1.67
Religion						
Hindu	0.88	0.96	1.11	1.31	1.79	2.29
Muslim	1.02	1.4	1.61	1.9	2.43	2.36
Christian	4.65	2.75	1.45	5.02	1.79	2.45
Others	1.27	1.41	1.73	3.15	3.65	0.6
Educational attainment						
No education	0.87	1.02	1.33	2.17	2.47	3.4
Primary	0.93	1.02	1.13	1.93	1.99	2.24
Secondary	1.69	1.27	0.7	2.56	1.39	1.71
Higher	1.15	1.02	1.37	2.01	1.35	1.34

(Cont'd...)

Table 5. ***(Continued)***

Background characteristics	North	Central	East	Northeast	West	South
Exposure to mass media						
Not at all	0.95	1.05	1.11	2.22	2.45	4.27
Partially exposed	0.95	1.01	1.24	1.89	1.84	2.18
Fully exposed	1.06	0.81	3.3	2.38	2.32	1.53
Wealth status						
Poorest	0.97	1.25	1.41	2.37	3.4	4.66
Poorer	0.99	0.98	1.01	1.77	2.1	4.1
Middle	0.94	0.9	0.98	1.64	2.43	2.58
Richer	0.95	0.99	1.35	1.89	1.87	1.74
Richest	0.96	0.91	1.08	2.63	1.18	1.2
Residence						
Urban	1.29	1.43	1.88	2.62	2.05	2.23
Rural	0.78	0.88	1.01	1.86	1.89	2.35
Total	0.96	1.02	1.21	2.00	1.95	2.30

Source: Computed from individual data of NFHS-5.
Abbreviations: OBC: Other backward class; SC: Scheduled caste; ST: Scheduled tribe; NFHS-5: National Family Health Surveys.

women who reported being infertile had a substantially higher divorce rate, especially concentrated in the south (9.11%) compared to the north (3.06%), central (3.59%), east (4.33%), and west (5.42%) regions. In southern states, women with no exposure to mass media (4.27%) are more susceptible to marital breakdowns in terms of separation or divorce compared to other regions. In addition, there is a higher prevalence of marital dissolution among women who were not related to their first husband before marriage than those who were related, the rate being particularly evident in the southern (2.50%) and western (2.02%) regions. In all regions, women who live in urban areas exhibit higher rates of marital dissolution (south: 2.23%; west: 2.05%; north-east: 2.26%; east: 1.88%; central: 1.43%; and north: 1.29%) compared to women who live in rural areas.

3.4. Factors associated with marital dissolution

The region-wise binary regression results for marital dissolution and its determinants are presented in Table 6. Except for exposure to mass media ($p > 0.05$), all other factors were predicted to significantly influence marital dissolution ($p < 0.05$). Among demographic factors, women born between 1969 and 1979 (odds ratio [OR] = 3.40; 95% confidence interval [CI] = 2.911 – 3.980) were significantly associated with higher odds of marital dissolution, indicating that ever-married women from earlier birth cohorts experienced greater odds of marital dissolution compared to younger women. Across India, women who began their first cohabitation between ages 22 and 29 (OR = 0.867; 95% CI = 0.804 – 0.918) had lower odds of marital dissolution compared to those who started cohabiting before turning 18. However, in the southern region, women who started cohabitation at age 30 or above (OR = 1.51; 95% CI = 1.170 – 1.960) faced notably higher risks of marital dissolution compared to those below 18 years of age. Ever-married women without sons (OR = 7.457; 95% CI = 6.472 – 8.602) were more likely to experience marital dissolution than the women who have. In all regions of the nation, the scenario is indifferent. Those women who declared themselves infecund (OR = 2.043; 95% CI = 1.870 – 2.233) have significantly higher odds of marital dissolution. As for the education level, compared to the respondents who have attended higher education, the respondents who have not attended school ever (OR = 1.140; 95% CI = 1.029 – 1.266) have significantly higher odds of marital dissolution. The women who attended primary education (OR = 1.095; 95% CI = 1.004 – 1.194) and those who attended secondary education (OR = 1.052, 95% CI = 0.860 – 1.283) were more prone to marital dissolution compared to highly educated women. Furthermore, lack of exposure to mass media (OR = 1.052; 95% CI = 0.847 – 1.294) and partial exposure (OR = 1.124; 95% CI = 0.913 – 1.370) were correlated with higher risks of marital dissolution compared to full exposure to mass media and communication facilities. Women related to their first husband before marriage (OR = 0.774, 95% CI = 0.717 – 0.836) had lower odds of marital dissolution, particularly prominent in southern states (OR = 0.68; 95% CI = 0.608 – 1.702) compared to other regions. We discovered from this regression model that higher income was linked to a lower likelihood of marital dissolution. For example, the

Table 6. Odds ratios from multivariable logistic regressions showing the relationship between selected characteristics and marital dissolution in India (NFHS 2019 – 2021)

Background characteristics	North	Central	East	Northeast	West	South	India
Birth cohort							
1969 – 1979 (2000 – 2006)	2.64***	5.06***	4.39***	1.33	5.20***	11.01***	3.40***
1980 – 1989 (2000 – 2006)	2.24***	4.23***	3.30***	1.16	4.72***	9.07***	2.87***
1990 – 1999 (2000 – 2006)	1.35	2.23***	1.96***	1.04	2.58***	4.47***	1.79***
Age at first cohabitation (years)							
18 – 21 (<18)	0.69***	0.76***	0.92	0.84*	0.86	0.82**	0.81***
22 – 29 (<18)	0.74*	0.88	1.23*	0.75***	0.98	0.94	0.86***
30+ (<18)	1.15	1.17	2.07**	0.65*	1.08	1.51*	0.94
Number of sons							
0 (3+)	11.02***	18.14***	14.55***	3.35***	7.38***	6.46***	7.46***
1 (3+)	2.36**	3.75***	4.07***	1.94***	1.95*	2.69***	2.50***
2 (3+)	1.27	1.68*	1.56	1.06	1.04	1.61*	1.27**
Consanguineous marriage							
Yes (no)	0.82	0.65***	1.08	0.86	0.73*	0.68***	0.774***
Declared infecundity							
Yes (no)	2.02***	1.972***	2.02***	1.55***	1.72***	2.84***	2.04***
Social groups							
SC (others)	1.48***	1.43**	0.89	1.28	1.59***	1.37*	1.30***
ST (others)	0.85	1.41*	1.04	1.29*	1.07	1.07	1.26***
OBC (others)	1.29*	1.16	0.84	1.30*	1.02	1.35*	1.13**
Religion							
Muslim (Hindu)	0.88	1.61***	1.43**	2.64***	1.50*	1.34***	1.32***
Christian (Hindu)	3.64***	2.34*	0.69	3.38***	0.62	0.89	2.11***
Others (Hindu)	1.54***	1.3	0.99	1.75***	1.13	0.89	1.41***
Educational attainment							
No education (high school or above)	0.99	1.044	1.49*	0.96	1.01	1.24*	1.14*
Primary school (high school or above)	0.93	1.08	1.27	0.97	1.12	1.19*	1.10*
Secondary school (high school or above)	1.04	1.74	0.65	1.05***	1.09	1.02	1.05
Exposure to mass media							
Not at all (fully exposed)	1.56	1.03	0.68	1.1	0.64	1.56*	1.05
Partially exposed (fully exposed)	1.42	1.09	0.93	1.17	0.65	1.27	1.12
Wealth status							
Poorest (richest)	1.82***	2.61***	4.17***	1.01	4.03***	5.28***	2.63***
Poorer (richest)	1.74***	2.02***	2.90***	0.79	2.68***	4.361***	2.17***
Middle (richest)	1.45***	1.56**	2.27***	0.84	2.55***	2.56***	1.772***
Richer (richest)	1.2	1.33*	1.96**	0.81	1.53***	1.62***	1.312***
Residence							
Rural (urban)	0.53***	0.56***	0.49***	0.75***	0.6***	0.66***	0.61***
N	69858	120058	121381	18898	73686	107724	511604
Lr Chi-square	734.86	1175.60	826.39	757.10	647.61	1479.64	5963.09
Log likelihood	−4509.05	−5897.86	−4461.48	−7309.17	−4201.48	−8188.12	−35147.13

Notes: The category of a given variable in the parentheses is the reference group. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.
Source: Computed from data of NFHS-5.
Abbreviations: OBC: Other backward class; SC: Scheduled caste; ST: Scheduled tribe; NFHS-5: National Family Health Surveys.

poorest individuals (OR = 2.625; 95% CI = 2.358 – 2.939) faced the highest odds of marital dissolution, while richer individuals (OR = 1.312; 95% CI = 1.198 – 1.436) and those belonging to middle wealth status (OR = 1.772; 95% CI = 1.614 – 1.945) exhibited lower risks compared to the poorest. This analysis indicates that women who live in rural areas (OR = 0.611, 95% CI = 0.577 – 0.650) have significantly lower odds of experiencing marital dissolution compared to those who live in urban areas. In terms of spatial perspective, southern states (OR = 1.992, 95% CI = 1.824 – 2.177) and north-eastern states (OR = 1.811, 95% CI = 1.640 – 1.991) carry a higher risk of marital dissolution compared to other states.

Table 7 displays the findings of a region-based logistic regression on marital dissolution and its contributing factors. Women who possessed higher education than their spouses (OR = 2.239; 95% CI = 1.829 – 2.741) were significantly associated with higher odds of marital dissolution than women who were at the same level of education as their husbands (OR = 1.45; 95% CI = 0.964 – 1.363). The education gap between spouses has a significant impact on dissolution and is much more visible in the western and northern regions of India. Compared to women who work in non-agricultural sectors (OR = 3.099; 95% CI = 2.632 – 3.657), agricultural employees (OR = 1.851; 95% CI = 0.431 – 0.607) are less at risk. Since women do not work, their risk is lower. Among the respondents' women (OR = 3.969; 95% CI = 3.429 – 4.597) who have experienced any type of violence by their spouses, they are very likely to experience marital dissolution. Violence-driven divorce is more common in the northern (OR = 8.421; 95% CI = 5.294 – 13.397) and western (OR = 8.191; 95% CI = 4.996 – 13.414) regions of India.

4. Discussion

As per our knowledge, very few studies have been conducted on the prevalence and risk factors of marital dissolution in the Indian context, creating a knowledge gap. This study aims to fill this gap by presenting estimates of trends, prevalence, variability, and factors related to marital dissolution in India. Indian family systems have been changing as the country's conventional marriage unions slowly fade away, making room for western family structures, including nucleation and cohabitation (Dommaraju, 2016). The estimates show a fluctuating trend of divorce and separation starting from the base. The widely acclaimed interdependence theory of relationships (Thibaut & Kelley, 1959) provides a robust framework for comprehending the dynamics of marital dissolution. This theory centers on the major balance of rewards and costs within relationships, where rewards indicate pleasure while costs encompass adverse experiences. At the core of this theory lies the personal comparison level, a critical factor that shapes expectations regarding relationship quality. The couple's equilibrium can be destroyed for so many reasons, including compatibility issues due to an educational or age gap, financial problems, role conflicts, childlessness, and domestic violence (Jimenez Cabello *et al.*, 2023). Our study's findings illuminate the theory's principles with real-world examples. Notably, we discovered that women with higher levels of education tend to enjoy more stable

Table 7. Odds ratios from multivariate logistic regressions showing the relationship between selected variables and marital dissolution in India (NFHS 2019 – 2021)

Background characteristics	North	Central	East	Northeast	West	South	India
Educational gap between spouses							
Both at same level (husband higher than wife)	2.04*	1.36	1.02	0.92	0.85	0.93	1.15
Husband lower than wife (husband higher than wife)	3.53***	2.22**	1.29	2.45***	2.72**	1.53*	2.24***
Women's occupation							
Agricultural (Non-working)	2.02	2.08**	2.73**	1.48*	1.02	1.43	1.85***
Non-agricultural (Non-working)	3.09***	2.10**	4.97***	2.47***	3.48***	3.07***	3.10***
Ever experienced spousal violence							
Yes (No)	8.42***	5.65***	6.10***	2.77***	8.19***	2.30***	3.97***
N	11652	12978	10413	9038	6199	10053	60333
Likelihood ratio Chi-square	219.62	228.93	250.59	208.07	237.31	302.46	1279.64
Log likelihood	-402.32	-534.46	-454.41	-843.73	-355.66	-993.01	-3782.71

Notes: The category of a given variable in the parentheses is the reference group. All variables considered in Table 6, except the educational attainment of women, have been controlled while tabulating the adjusted odds ratio for the table above. *p<0.05, **p<0.01, ***p<0.001.
Source: Computed from data of NFHS-5.
Abbreviation: NFHS-5: National Family Health Surveys.

marriages compared to their less-educated counterparts. Significantly, the instability in marriages among women with limited or no education has shown a worrisome upward trajectory over the past two decades (1987 – 2008), contributing to a widening educational gap in marital stability. Individuals with higher levels of education are far more likely to have marriages, whereas women tend to have more of a voice (Andrist *et al.*, 2013). This empirical evidence suggests that the choice of a marital partner significantly influences marital stability, echoing the principles of interdependence theory. The resilience of marriages among highly educated women underscores the potential benefits of more balanced gender dynamics, increased autonomy in mate selection, and enhanced negotiating power in forging stronger and more enduring marital bonds. The findings revealed that education has a significant impact on marital dissolution, which is more prominent in the northern and western parts of the country. Women with a higher education level than their spouses have a higher risk of marital dissolution. Ego is one of the major causes of marital misunderstandings and breakups due to the educational gap among spouses, specifically when women possess higher education qualifications. There is some evidence in support of the argument that couples marrying at young ages tend to have poor marital role performance (Booth & Edwards, 1985).

The findings of this study also revealed that women who started cohabitation below 18 years of age are more likely to have marital dissolution than those who married at ages 22 – 29 and 30 – 34. The Hindu Marriage Act, in Section 13 – 2, allows for divorce in cases where the marriage occurred before the age of 15, permitting individuals to file for divorce before reaching the age of 18. According to Booth & Edwards (1985), young people may not fully understand the implications of getting married. Furthermore, those who marry young often do so without the support or approval of their families, making it more likely for the marriage to face challenges and be less stable. Consistent with our study findings, some research has also identified a higher likelihood of divorce among Christian women, followed by Muslim women, compared to Hindu women (Dommaraju, 2016). A possible explanation for this result could be the considerable authority granted to men under Muslim personal laws, notably through the practice of "Triple Talaq," coupled with limited political will to address the specific needs of this community. Consequently, there may be distinct factors contributing to the elevated divorce rates among Christian women in India, warranting further in-depth investigation. Our analysis further established that women in rich households in all the regions are likely to have more stable marriages than those in poor households. This finding implies that meeting households' financial requirements prevents marital breakdowns. Findings from the analysis established an interesting pattern of marital dissolution across different regions of India. For instance, the proportion of married women who separated from their partners was highest in Southern and North-east India and lowest in the northern region. This is similar to previous North-South distinctions made in the demography literature, most notably those of Dyson & Moore (1983), who claimed that female autonomy is generally higher in the southern region. Among the northern states with a relatively low level of marital dissolution are Jammu and Kashmir, Himachal Pradesh, and Rajasthan. Among the southern states and UTs with relatively higher rates of dissolution are Kerala, Karnataka, Tamil Nadu, and Puducherry. In north-east states, tribal customary laws allow for informal unions where cohabiting couples are deemed married (Xaxa, 2004). The findings revealed that marriage dissolution rates in the north-east region were relatively higher than elsewhere in India, among which Mizoram and Meghalaya stood out. Women who leave their relationships may experience stigmatization and social exclusion and are referred to by a variety of derogatory labels (Belliappa, 2013), given how long matters typically take to be heard and resolved in Indian courts (Kumar, 2012), which is considered a possible reason behind the lower divorce rate among northern states.

Economic independence empowers women by enabling them to bear their own expenses and participate more actively in decision-making and other aspects as well, which tends to increase the risk of separation and divorce. According to a study, childlessness is seen as deviating from normative expectations and might sever the relationship between spouses in an arranged marriage in which the couple does not have strong bonds at the time of marriage (Riessman, 2000). The results highlighted the value of having children, particularly sons, for maintaining a stable marriage. As per this study, women without any sons and those who declare themselves infecund are much more likely to experience marital breakdown than others. In particular, women with three or more surviving sons tend to have stable unions. According to Singh (2013), about 80% of Indian women who sought divorce did so because of "cruelty or domestic violence in their marital homes." Based on these results, women who have experienced spousal abuse of any form, including physical, emotional, and sexual abuse, are considerably more likely to file for divorce.

This study underscores the significance of addressing the specific needs of women who are pre-disposed to marital instability in light of the detrimental socioeconomic, psychological, and health effects of marital dissolution.

4.1. Strength and limitation

In general, data on divorce and separation in the Indian context are scarce. However, our study stands out for several strengths, notably a large sample size and comprehensive data on women's marital status, age at marriage, women's education, and first pregnancy. Nevertheless, there are some limitations to this study. As the age at which marriage dissolution occurs is unavailable in the NFHS data, more advanced techniques, such as event history analysis, could not be used. Small sample sizes in certain UTs (i.e., Ladakh and Lakshadweep) require cautious interpretation of findings. Furthermore, some variables were only available in the state module; we could not include them in the all-over analysis, which may differ from the results and may affect the accuracy of the findings of the study. As a result, it is essential to approach the interpretation of our research outcomes with caution.

5. Conclusion

In this study, we quantified the prevalence and variability of divorce and separation in India. Research indicates a rising trend in divorce- and separation-related marital disintegration. While the overall divorce rate among ever-married women of reproductive age remains low, significant disparities by area and religion were observed. In India, education emerges as a factor promoting marital tenacity. Our study contributes empirical data on the shifts in family structure in the Indian subcontinent. Risk factors such as infertility, poverty, child marriage, the educational gap among spouses, urbanization, and spousal violence are associated with marital disintegration, especially through divorce and separation, which is a rising phenomenon across India. Marital dissolution can have profound financial, psychological, and health effects. Therefore, this paper aims to raise awareness about the factors contributing to marital dissolution, empowering individuals to address them proactively in the early stages of their marital life.

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Conflict of interest

The authors declare that they have no competing interests.

Author contributions

Conceptualization: Harihar Sahoo, Manas Ranjan Pradhan, Manoj Alagarajan

Formal analysis: Harihar Sahoo, Madhurima Sharma, Sunandita Das

Investigation: Harihar Sahoo

Methodology: Harihar Sahoo

Writing – original draft: Harihar Sahoo, Madhurima Sharma

Writing – review & editing: all authors

Ethics approval and consent to participate

This study is based on secondary data available in the public domain. The survey report states that the necessary ethical procedure was followed for the survey, and only those respondents who gave oral or written consent were interviewed.

Consent for publication

Not applicable.

Availability of data

The utilized data are secondary and freely available to everyone on request at the DHS website (https://dhsprogram.com/Countries/Country-Main.cfm?ctry_id=57&c=India).

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RESEARCH ARTICLE

Early marriage and childbearing among Bengali women in India: Exploring the role of culture

Manas Ranjan Pradhan*, Sourav Mondal, and Prasanna Kumar Mudi

Department of Fertility and Social Demography, International Institute for Population Sciences (IIPS), Mumbai, Maharashtra, India

Abstract

One's culture influences age at marriage, rules of mate selection, and fertility preferences. Language, as a component of culture, also influences culture itself. Therefore, language, as an indicator of cultural identity, is a significant, yet understudied social determinant of health in health-care settings. This study analyzes the role of cultural norms, measured through language, in early marriage and childbearing among Bengali speakers in India. Descriptive, bivariate, and multivariate analyses were conducted for 51,069 women aged 15 – 49 years from three Indian states (Assam, Tripura, and West Bengal) using data from the fifth round of the National Family Health Survey (2019 – 2021). Stata was used for the analyses, with $p < 5\%$ considered significant. Among these women, 46% were married before the age of 18, 34% were married before 18 and began childbearing before 19, and 55% were native Bengali speakers. After controlling for predictors, Bengali-speaking women were significantly more likely to marry before the age of 18 (odds ratio [OR]: 1.72, 95% confidence interval [CI]: 1.66 – 1.79) and marrying and having their first child before the age of 19 (OR: 1.55, CI: 1.49 – 1.62) compared with their non-Bengali-speaking counterparts. Thus, Bengali culture appears to be associated with early marriage and motherhood. To address this, a multi-pronged strategy involving social and behavioral change communication, targeted programs delivered by grassroots health workers, and school-based campaigns that emphasize the adverse effects of early marriage and childbearing may help reduce these practices in states with significant Bengali-speaking populations.

Keywords: Culture; Language; Early marriage; Adolescent childbearing; Bengali; India

***Corresponding author:**
Manas Ranjan Pradhan
(manas.pradhan@iipsindia.ac.in)

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1. Introduction

Culture comprises the attitudes, beliefs, behavioral conventions, and values shared by a group and influences each member's behavior. Language, a system of communication, is viewed by linguists as a representation of the culture of a particular social group. Culture and language are intertwined (Rabiah, 2018) and inseparable due to this relationship (Chaer, 2003). Individuals use language to communicate their shared values, ideas, and meanings. Language reflects the history of culture and helps explain why certain ideas and beliefs hold prominence (Alwi, 2004). There is an adage that language influences culture and the way their speakers think (Rabiah, 2018). Therefore, as a vehicle of culture, language is closely linked to social institutions such as marriage and family. Moreover,

culture influences social systems, gender norms, and economic conditions, which affect norms and practices related to marriage age (Desai & Andrist, 2010) and fertility preferences (Chakravarty *et al*., 2022; Krishnan, 2001; Sheoran & Sarin, 2015). Therefore, language, which is a reflection of cultural traits, should be viewed not only as a demographic marker but also as a significant, though understudied, social determinant of health.

Most studies that examine the relationship between language and health have focused on inequities in the quality of health-care delivery when language barriers exist between providers and patients. Language barriers negatively affect the quality of health-care services and patient satisfaction (Pandey *et al*., 2021; Al Shamsi *et al*., 2020). Language-concordant care has been demonstrated to improve health-care outcomes by reducing medical errors, enhancing understanding of illness and treatment plans, increasing adherence to these plans, and improving satisfaction with care (Green & Nze, 2017). One study even advocates for the professionalization of language competency in medical schools (Molina & Kasper, 2019). Likewise, studies based on applied linguists highlight the relationship between language and health from the perspective of linguistic marginalization, which creates barriers to accessing health services and information (Kindig *et al*., 2004). However, the contribution of language barriers to health disparities remains largely under-theorized and under-researched (Showstack *et al*., 2019). In particular, the role of the interview language in large-scale demographic and health surveys has attracted the attention of demographers, who have used language concordance/discordance between interviewer and interviewee to assess data quality (Ram *et al*., 2022).

Early marriage has often been explained through various theoretical perspectives, including patriarchy, social norms, division of labor, and economics (Jejeebhoy, 2019; Roest, 2016). Patriarchy reinforces male dominance within the family and society. To prevent the transfer of powers to females, it advocates for the early marriage of girls (Facio, 2013; Ortner, 2022; Sultana, 2012). A lack of agency in negotiating marriage decisions forces many girls into early marriages (Psaki *et al*., 2021). Moreover, in societies where girls' virginity is highly valued and patriarchal gender norms prevail, child marriage is supported because it provides a socially and legally sanctioned space for sexual activity, shielding families from potential dishonor should a girl deviate from sexual norms (CEFM & Sexuality Programs Working Group, 2019). The effects of social norms, especially gender norms, as drivers of child marriage are well-established (Psaki *et al*., 2021). Studies have demonstrated that community norms supporting child marriage often reflect parents' normative, internalized beliefs rather than social pressure (Azeez Abdul & Poonia, 2015; Rajwani & Pachani, 2016). Kinship theory promotes the traditional gendered division of labor, with males serving as breadwinners and females as caretakers, and reproduction is seen as the sole purpose of marriage. This practice promotes the early marriage of girls to maintain their traditional roles (Wimalasena, 2016). Meanwhile, economic theory explains early marriage through the financial costs and benefits involved. In the marriage market, a girl's perceived "quality" decreases as she ages after puberty, resulting in higher dowry payments for older girls to compensate for the perceived lower quality (Wahhaj, 2014). In addition, child marriages can be a financial strategy to alleviate the burden of raising or educating daughters, particularly in areas with limited opportunities for women to enter the workforce (Bajracharya & Amin, 2012). Poverty and social disadvantage reduce girls' opportunities, increasing their vulnerability and pressuring families to adhere to socially desirable practices, thus reinforcing norms on early marriage and childbearing (Roest, 2016). Figure 1 illustrates the pathway through which culture and language influence early marriage and childbearing.

In India, the early marriage of daughters receives excessive sociocultural importance, with such practices often symbolizing pride and prestige in society. This is one of the major reasons for the high prevalence of early marriage (Kapadia, 1966). Despite significant improvements in education, urbanization, and modernization, the pressure to marry early persists in Indian society (Bhagat, 2016). The National Family Health Survey (NFHS)-5 reveals that 23% of women aged 20 – 24 were married before the legal minimum age of 18, compared with 47% for women aged 45 – 49 (IIPS & ICF, 2022). Among the states, nearly two-fifths of women in West Bengal (42%) and Tripura (39%), along with one-third of women in Assam (32%), married before reaching the age of 18 (IIPS & ICF, 2022).

Early marriages usually lead to early childbearing, primarily due to pressure from mothers-in-law through their sons (Barua & Kurz, 2001). Across the country, the

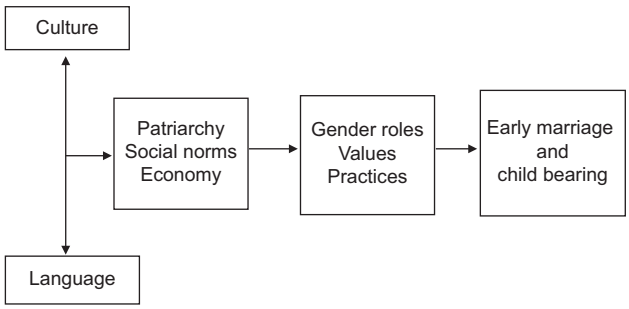

Figure 1. Theoretical framework

proportion of women giving birth before the age of 18 declined from 28% to 22% between 1993 and 2006 (Moore *et al*., 2009). Nevertheless, in 2019 – 2021, 7% of women aged 15 – 19 had already begun childbearing, marking only a 1% decline compared with 2015 – 2016 (IIPS & ICF, 2022). Among the states, higher levels of teenage pregnancy were observed in Tripura (22%), West Bengal (16%), and Assam (12%). West Bengal has the country's highest incidence of child marriage and teenage pregnancy, with Tripura ranking second. Meanwhile, Assam ranks fourth in teenage pregnancy (IIPS & ICF, 2022).

The states of Assam, Tripura, and West Bengal share a commonality: A significant portion of their population speaks Bengali. With 272.2 million native speakers, Bengali is the seventh most spoken language in the world (STATISTA, 2022), and it is primarily spoken in Bangladesh and the aforementioned Indian states. According to the 2011 Indian Census, 87% of West Bengal's population speaks Bengali, and the figures are 67% in Tripura and 28% in Assam (ORGI & MHA, 2011).

This raises a pertinent question: Does language, which conveys cultural norms and values, influence early marriage and childbearing? To the best of our knowledge, no study has explored the potential role of language, as a representation of a community's cultural norms, as a determinant of early marriage and pregnancy in the Indian context. Thus, this study assesses the role of culture, as measured through language, in early marriage and childbearing among Bengali speakers in India.

2. Data and methods

2.1. Data sources

This study used data from the fifth round of the NFHS, conducted between 2019 and 2021. The NFHS-5 is a nationally representative survey that covers 636,699 households and provides data on various health, nutrition, and women empowerment indicators, including marriage and fertility. The survey followed a two-stage stratified sampling method, achieving a 98% response rate. Primary sample units – survey villages in rural areas and census enumeration blocks in urban areas – were selected using probability proportion to size sampling. Trained research investigators collected data through computer-assisted personal interviews, and participants provided either verbal or written informed consent. Only respondents who voluntarily consented to participate were interviewed. The published report offers more details regarding the survey design, questionnaire, quality control procedures, and management information (IIPS & ICF, 2022).

The study sample included 51,069 married women aged 15 – 49 from Assam, Tripura, and West Bengal. These states share similar socioeconomic characteristics, with a large proportion of their population comprising native Bengali speakers.

2.2. Outcome variables

The outcome variables were (1) early marriage, defined as the percentage of women married before the age of 18, and (2) early marriage and childbearing, defined as the percentage of women married before the age of 18 who had begun childbearing (they had either given birth or were pregnant at the time of the survey) before the age of 19.

2.3. Predicting variables

The main predictor variable was women's culture, which was measured using their native language (Bengali or non-Bengali). The native language was considered a proxy for broader social and cultural norms. Studies from India, Pakistan, and Bangladesh have similarly used language as an indicator of cultural identity and practices (Basu & Amin, 2000; Muhammad, 1996; Routh & Maji, 2021).

Several socioeconomic and demographic factors were also included to analyze the adjusted effect of culture on early marriage and childbearing. These included the following: Women's education level (no schooling, up to 9 years, 10, or more), mass media exposure (no or yes), sex of the household head (male or female), social group (scheduled caste [SC], scheduled tribe [ST], other backward classes [OBC], non-SC/ST/OBC, and who did not know their social classification), religion (Hindu, Muslim, or others), household economic status (poorest, poorer, middle, richer, or richest), and place of residence (urban or rural).

2.4. Statistical analysis

The study used bivariate analysis to examine socioeconomic and demographic differences in early marriage and childbearing. To assess the adjusted association between culture and early marriage and childbearing, the study employed binary logistic regression. Multicollinearity was verified using the variance inflation factor; only predictor variables with acceptable multicollinearity levels were included in the final regression. Sample weights were applied to adjust for non-response. The analyses were conducted using Stata (Version 15), and the results were reported at a significance level of 5%.

3. Results

3.1. Sample characteristics

Table 1 presents the socioeconomic, demographic, and health profiles of the women aged 15 – 49 years included in the analysis. Among the sample, 46% were married before

Table 1. Socioeconomic and demographic profiles of married women aged 15 – 49, 2019 – 2021

Background characteristics	Percentage	Total women (N)
Age at marriage		
<18 years	46.2	23,604
18 years and above	53.8	27,465
Married before 18 & childbearing before 19 years		
No	66.3	33,850
Yes	33.7	17,219
Native language		
Non-Bengali	45.4	23,185
Bengali	54.6	27,883
Years of schooling		
No education	21.1	10,794
<10 years	53.8	27,498
10 or more years	25.0	12,777
Sex of the household head		
Male	86.1	43,957
Female	13.9	7,111
Mass media exposure		
No	32.8	16,735
Yes	67.2	34,334
Social group		
Non-SC/ST/OBC	47.3	24,135
SC	19.6	10,031
ST	11.9	6,058
OBC	20.2	10,318
Don't know	1.0	527
Religion		
Hindu	67.3	34,356
Muslim	29.9	15,281
Others	2.8	1,432
Economic status of the household		
Poorest	34.58	17,611
Poorer	31.1	15,864
Middle	18.5	9,473
Richer	11.2	5,741
Richest	4.7	2,380
Type of place of residence		
Urban	21.6	11,049
Rural	78.4	40,020
Total	100.00	51,069

Abbreviations: SC: Scheduled caste; ST: Scheduled tribe; OBC: Other backward classes.

the age of 18. Nearly one-third had experienced both early marriage and childbearing. Among the sample, 55% were native Bengali speakers whereas the remaining spoke other languages. Over one-fifth (21%) of the women were illiterate, and a quarter had completed 10 or more years of schooling. Approximately one-third of the women had no exposure to mass media. Most women (86%) lived in male-headed households. Of the sample, 67% identified as Hindu, with the remainder identifying as non-Hindus. In terms of social group, 47% of the women were non-SC/ST/OBC, 20% were SC, 12% were ST, and 20% were OBC. Regarding economic status, 34% of the women belonged to the poorest category, 31% were poorer, 19% were in the middle category, 11% were richer, and 5% belonged to the richest category. A majority (78%) of the women resided in rural areas. With respect to the states, a substantial percentage of women in West Bengal (96%), Tripura (78%), and Assam (22%) were native Bengali speakers (Figure 2).

3.2. Socioeconomic differentials in early marriage and adolescent childbearing

Over half (53%) of the Bengali-speaking women were married before the age of 18, and nearly two-fifths (39%) had begun childbearing by 19 years. In comparison, 39% of non-Bengali-speaking women were married before the age of 18, and 28% had begun childbearing before 19 (Table 2). The prevalence of early marriage and childbearing decreased as women's education level increased. Among illiterate women, 56% were married before the age of 18, compared with 22% for those with 10 or more years of schooling. Similarly, 42% of illiterate women were married before the age of 18 and began childbearing by 19, compared with 13% for those who had 10 or more years of schooling.

Women who were exposed to mass media were less likely to marry early (43%) compared with those who were

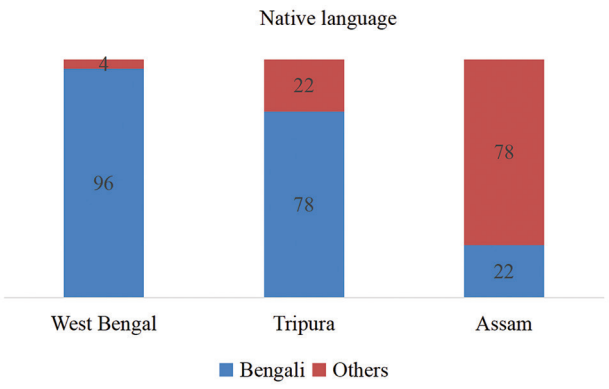

Figure 2. Percentage of native Bengali-speaking women in the three Indian states, 2019 – 2021

Table 2. Early marriage and childbearing by background characteristics of married women aged 15 – 49 (2019 – 2021)

Background characteristics	% married before 18 years	% Married before 18 years and childbearing before 19 years	N
Native language			
Non-Bengali	38.6	28.0	23,186
Bengali	52.6	38.5	27,884
Years of schooling			
No education	56.2	41.7	10,794
<10 years	53.7	40.1	27,498
10 or more years	21.8	13.1	12,777
Sex of the household head			
Male	46.4	33.9	43,958
Female	45.1	32.4	7,111
Mass media exposure			
No	52.6	38.2	16,735
Yes	43.1	31.5	34,334
Social group			
Non-SC/ST/OBC	48.6	35.4	24,135
SC	51.2	37.3	10,031
ST	40	29.3	6,058
OBC	38.6	27.9	10,318
Do not know	63.9	50.0	527
Religion			
Hindu	42.7	30.8	34,356
Muslim	55.1	40.7	15,281
Others	35.9	28.1	1,432
Economic status of the household			
Poorest	53.2	38.6	17,611
Poorer	49.8	36.7	15,864
Middle	43.3	31.7	9,473
Richer	31.4	22.6	5,742
Richest	18.4	12.3	2,380
Type of place of residence			
Urban	38.4	28.3	11,049
Rural	48.4	35.2	40,020
Total	46.2	33.7	51,069

Abbreviations: SC: Scheduled caste; ST: Scheduled tribe; OBC: Other backward classes.

not exposed (53%). Likewise, 32% of women with mass media exposure had begun childbearing by 19, compared with 38% for those who were not exposed. Regarding social groups, women from SC communities (51%) had the highest percentage of early marriage, followed by those from the non-SC/ST/OBC (49%), ST (40%), and OBC (39%) categories. A similar trend was observed for early marriage and childbearing. In addition, 55% of Muslim women married before 18, compared with 43% of Hindu women. Furthermore, 41% of Muslim women were married before 18 and began childbearing by 19, compared with 31% of Hindu women.

Early marriage and early childbearing declined with rising economic status. Among the poorest women, 53% married before 18, and 39% had started childbearing by 19. These figures dropped to 18% and 12%, respectively, for women from the richest households. Finally, rural

women had higher rates of early marriage (35%) and early childbearing compared with their urban counterparts (28%).

3.3. Determinants of early marriage and early childbearing

After adjusting for sociodemographic factors, Bengali-speaking women were more likely to marry before the age of 18 (OR: 1.72, CI: 1.66 – 1.79) than non-Bengali-speaking women (Table 3). Similarly, they were more likely to marry before the age of 18 and start childbearing by 19 (OR: 1.55, CI: 1.49 – 1.62) than non-Bengali-speakers.

Women with 10 or more years of schooling were 75% less likely to marry before the age of 18 (OR = 0.25, CI = 0.24 – 0.27) and 77% less likely to marry before the age of 18 and start childbearing by 19 (OR = 0.23, CI = 0.22 – 0.25) than women without schooling. Women exposed to mass media had slightly higher chances of early marriage (OR: 1.08, CI: 1.04 – 1.13) and early childbearing (OR: 1.11, CI: 1.06 – 1.16) compared with those without exposure.

Women from female-headed households were less likely to marry and start childbearing early (OR = 0.94, CI = 0.89 – 1.00) compared with those from male-headed households. Women in SC categories were more likely to marry early (OR: 1.15, CI: 1.09 – 1.22) as well as marry early and start childbearing (OR: 1.14, CI: 1.07 – 1.21) than women from non-SC/ST/OBC categories. However, OBC women were less likely to marry early (OR: 0.87, CI: 0.82 – 0.92) and marry early and start childbearing (OR: 0.91, CI: 0.85 – 0.96).

Muslim women were more likely to marry before the age of 18 (OR: 1.40, CI: 1.33 – 1.48) and begin childbearing early (OR: 1.37, CI: 1.30 – 1.45) compared with Hindu women. Women from the richest households were 46% less likely to marry before the age of 18 than those from the poorest households. Similarly, these women had a 39% lower chance of marrying before 18 and starting childbearing by 19. Rural women had higher chances of early marriage (OR: 1.16, CI: 1.10 – 1.23) and early marriage plus childbearing (OR: 1.10, CI: 1.04 – 1.16) than their urban counterparts.

4. Discussion

The study discovered that a substantial number of women in India marry before the age of 18 and begin childbearing before 19. Moreover, early marriage and childbearing are significantly correlated with cultural practices among Bengali-speaking women. Previous studies have identified poverty, patriarchy, and social norms (Jejeebhoy, 2019; Roest, 2016), as well as cultural traditions, customs, and community pressure (NITI Aayog, 2015; Dixit *et al.*, 2021), as key factors driving the persistence of child marriage and early childbearing in India. According to previous small-scale studies conducted in West Bengal (Ghosh, 2011; Roy & Chouhan, 2022) and Assam (Khanam & Laskar, 2015; Mudoi, 2020), societal norms accelerate early marriage among girls.

An earlier study highlights that patriarchy, poverty, illiteracy, lack of social security for girls, and dowry are predominant factors resulting in child marriage in West Bengal (Ghosh & Guven, 2007). Patriarchal values and institutions significantly influence marriage patterns, although poverty is also frequently cited as a key factor (Ghosh, 2011). A girl's virginity and chastity are strongly linked to the honor and status of her family or clan (Ghosh, 2011; Human Rights Law Network, 2015; Mudoi, 2020). Hence, there is tremendous pressure to minimize the risk of untoward incidents or improper sexual activity through early marriage. One study found that early marriage of daughters is a societal practice in West Bengal where parents prefer to fulfill sociocultural expectations (Ghosh, 2011). A recent study among urban middle-class Bengali families further highlights ongoing social pressure on parents regarding the marriageable age of their daughters (Chatterjee, 2022).

Our findings align with the well-established theoretical perspective that patriarchy and social norms drive the child marriage of girls (Psaki *et al.*, 2021; E.P & Poonia, 2015; Rajwani & Pachani, 2016). The intergenerational transmission of norms, values, traditions, and customs related to marriage and childbearing occurs through language. Thus, the findings validate the contribution of language as an indicator of cultural identity in early marriage and childbearing among Bengali speakers.

The economic theory posits that the financial cost and benefits of early marriage, as well as poverty, are key determinants (Jejeebhoy, 2019; Bajracharya & Amin, 2012). Our study also found that women from economically disadvantaged households are more vulnerable to early marriage. Notably, a prior study in West Bengal indicates that early marriage and childbearing also occur in wealthier families, although poor socioeconomic condition often aggravates the situation (Ghosh, 2011).

In addition, the study found that women without schooling, those from male-headed households, those who belong to SC categories, those who practice Islam, and those who reside in rural areas are at a higher risk of early marriage and childbearing. This result is consistent with previous studies on the determinants of early marriage and pregnancy in India (Ghosh, 2011; Roy & Chouhan, 2022; Seth *et al.*, 2018). A previous study reveals that poor economic conditions and social disadvantage reduce

Table 3. AORs of early marriage and early childbearing, 2019 – 2021

Background characteristics	Married before 18 years		Married before 18 years and childbearing before 19 years	
	OR	AOR	OR	AOR
Native language				
Non-Bengali®	1 (1.00 – 1.00)	1 (1.00 – 1.00)	1 (1.00 – 1.00)	1 (1.00 – 1.00)
Bengali	1.76*** (1.70 – 1.83)	1.72*** (1.66 – 1.79)	1.60*** (1.55 – 1.67)	1.55*** (1.49 – 1.62)
Years of schooling				
No education®		1 (1.00 – 1.00)		1 (1.00 – 1.00)
<10 years		0.90*** (0.86 – 0.94)		0.92*** (0.88 – 0.96)
10 or more years		0.25*** (0.24 – 0.27)		0.23*** (0.22 – 0.25)
Sex of the household head				
Male®		1 (1.00 – 1.00)		1 (1.00 – 1.00)
Female		0.96 (0.91 – 1.01)		0.94* (0.89 – 1.00)
Mass media exposure				
No®		1 (1.00 – 1.00)		1 (1.00 – 1.00)
Yes		1.08*** (1.04 – 1.13)		1.11*** (1.06 – 1.16)
Social group				
Non-SC/ST/OBC®		1 (1.00 – 1.00)		1 (1.00 – 1.00)
Scheduled caste (SC)		1.15*** (1.09 – 1.22)		1.14*** (1.07 – 1.21)
Scheduled tribe (ST)		0.90** (0.84 – 0.97)		0.94 (0.88 – 1.02)
Other backward classes (OBC)		0.87*** (0.82 – 0.92)		0.91** (0.85 – 0.96)
Don't know		1.35** (1.12 – 1.63)		1.40*** (1.18 – 1.68)
Religion				
Hindu®		1 (1.00 – 1.00)		1 (1.00 – 1.00)
Muslim		1.40*** (1.33 – 1.48)		1.37*** (1.30 – 1.45)
Others		0.80*** (0.71 – 0.90)		0.93 (0.82 – 1.05)
Economic status of the household				
Poorest®		1 (1.00 – 1.00)		1 (1.00 – 1.00)
Poorer		1.03 (0.98 – 1.08)		1.06* (1.01 – 1.11)
Middle		0.97 (0.92 – 1.03)		1.03 (0.97 – 1.10)
Richer		0.79*** (0.73 – 0.85)		0.88** (0.81 – 0.96)
Richest		0.54*** (0.48 – 0.62)		0.61*** (0.53 – 0.71)
Type of place of residence				
Urban®		1 (1.00 – 1.00)		1 (1.00 – 1.00)
Rural		1.16*** (1.10 – 1.23)		1.10** (1.04 – 1.16)

Notes: ®: Reference category; *p<0.05; **p<0.01; ***p<0.001.
Abbreviations: AORs: Adjusted odds ratios; OR: Odds ratio; CI: Confidence interval.

opportunities and increase girls' vulnerability, compelling them and their families to adhere to social norms based on early marriage and childbearing (Roest, 2016).

Marriage before the age of 18 violates adolescents' legal rights (Jain & Kurz, 2007) and increases their risk of unwanted pregnancies and sexually transmitted infections (Clark *et al.*, 2006; Santhya *et al.*, 2008). In addition, women who marry early are more vulnerable to intimate partner violence (Singh *et al.*, 2018; Yount *et al.*, 2016). Adolescent childbearing is further a human rights violation due to its adverse implications for the health and welfare of girls, including increased risks of pregnancy complications (de la Calle *et al.*, 2021), sexually transmitted infections (Cortés Alfaro, 2019), miscarriage and stillbirth (Kamal & Hassan, 2015; Paul, 2018), and restricted fetal growth and low birth weight (Oyeyemi *et al.*, 2019; Raj *et al.*, 2014), all

of which can lead to maternal mortality (Neal *et al*., 2012) and infant death (Noori *et al*., 2022). A previous study reported a higher likelihood of miscarriage or stillbirth and complications during pregnancy and delivery among women married before the age of 18 in West Bengal (Roy & Chouhan, 2022). Therefore, greater efforts are required from law-enforcement authorities and civil society to prevent marriage before the legal age of 18.

This study has several strengths. To our knowledge, this study is the first to analyze the role of culture, as measured through native language, in early marriage and childbearing among women. As a result, it contributes to the scarcity of evidence on the role of culture on women's health and welfare. Furthermore, the study uses large-scale, nationally representative NFHS-5 data with a robust sampling design, ensuring that the findings are contemporary and relevant. However, the study also has limitations. The results are based on cross-sectional data, which limits the ability to draw causal inferences between the predictor and outcome variables. In addition, while language is used as a proxy for culture, it may only partially capture broader social and cultural norms and expectations.

5. Conclusion

Culture plays a significant role in early marriage and childbearing among Bengali women in India. A substantial percentage of Bengali girls are married before the age of 18 and begin childbearing before age 19, indicating the need for preventive measures. Cultural attitudes and behaviors toward early marriage and childbearing are complex, and influenced by individual and societal factors. Therefore, the government should prioritize social and behavior change communication strategies that emphasize the adverse effects of early marriage and childbearing. In addition to mainstream media, grassroots-level health workers, such as accredited social health activists and "anganwadi workers" could contribute to dedicated programs aimed at reducing early marriage and childbearing. Moreover, in-school campaigns focusing on the harmful effects of early marriage and childbearing may foster positive social change regarding marriage and childbearing age. These efforts would uphold women's reproductive rights and contribute to achieving Sustainable Development Goal 3: "Good Health and Well-being."

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Conflict of interest

The authors declare they have no competing interests.

Author contributions

Conceptualization: Manas Ranjan Pradhan
Formal analysis: Sourav Mondal, Prasanna Kumar Mudi
Methodology: Manas Ranjan Pradhan
Writing – original draft: Manas Ranjan Pradhan
Writing – review & editing: All authors

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Availability of data

The datasets generated and/or analyzed during the current study are available in the [Demographic and Health Surveys Repository] repository, [https://dhsprogram.com].

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ACCSCIENCE PUBLISHING

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RESEARCH ARTICLE

Age patterns of fertility and the fertility transition in Ethiopia and its regions: An attempt using regression models to predict age-specific fertility rates

Mezgebo Gebregeorgis[1]*, Kinfe Abraha[1], Mache Tsadik[2], and Krishna Murthy Ponnapalli[1]

[1]Center for Population and Development, Institute of Population Studies, Mekelle University, Mekelle, Tigray, Ethiopia

[2]Department of Public Health, College of Health Sciences, Mekelle University, Mekelle, Tigray, Ethiopia

Abstract

Ethiopia has experienced a considerable decline in fertility rates in urban and rural areas across various regions over the past few decades, largely due to government initiatives. Ethiopian Demographic and Health Surveys (EDHS) from 2000, 2005, 2011, and 2016 provide substantial evidence of this trend in terms of total fertility rates (TFRs). Due to the lack of reliable vital registration systems and recent census data, research heavily relies on these EDHS surveys. A review of the literature reveals a gap in understanding the age patterns of fertility and the fertility transition in Ethiopia and its regions. To address this, this study proposes a "model fertility table" for Ethiopia, providing reliable estimates of age-specific fertility rates (ASFRs) based on TFR data. Using TFRs from multiple EDHS surveys, ASFRs are derived for the years 2000, 2005, 2011, and 2016 to study regional fertility transition in Ethiopia. The results show a typical uni-modal distribution of ASFRs, with a broad peak in fertility rates among women aged 20 – 24, 25 – 29, and 30 – 34 during the early stages of the transition. As TFRs decline, the peak shifts toward older age groups. In addition, the fertility pattern becomes more concentrated in older age groups. Significant fertility differences were observed between regional and rural-urban areas. This study has both theoretical and practical implications. It introduces a new methodology for population studies and offers detailed ASFR data, aiding policymakers in designing targeted fertility and health policies and addressing regional fertility differences for more effective interventions.

Keywords: Ethiopia fertility transition; Model fertility table; Ethiopian demographic and health surveys; Age-specific fertility rate; Total fertility rate

***Corresponding author:**
Mezgebo Gebregeorgis
(mezgebug@gmail.com)

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1. Introduction

1.1. Background

Ethiopia, the second most populous country in Africa, like any other country in Africa, has undergone a fertility transition over the past few decades. This is evidenced by national and regional total fertility rate (TFR) data from various censuses and the Ethiopian

Demographic and Health Surveys (EDHS) conducted in 2000, 2005, 2011, and 2016. Due to the absence of a reliable vital statistics system and recent census data in Ethiopia, many researchers rely heavily on EDHS data. However, as EDHS surveys depend on various sampling procedures, their fertility and mortality indicators are subjected to sampling errors and other statistical biases (Central Statistical Agency [Ethiopia] & ICF, 2012, 2016; Central Statistical Authority [Ethiopia] & ORC Macro, 2001, 2006).

TFR, a widely used summary measure of fertility, represents the average number of children per woman and is calculated by simply summing the age-specific fertility rates (ASFRs) of various age groups. ASFRs are generally reported for seven successive age groups: 15 – 19, 20 – 24, 25 – 9, 30 – 34, 35 – 39, 40 – 44, …, and 45 – 49. In some African countries, ASFRs may include younger (10 – 14) or older (50 – 54) age groups due to the observed births in these ranges. Births below age 15 or above age 50 are often added to adjacent groups for the calculation of ASFRs. For example, births taking place in women above age 50 are added to the 45 – 49 age group for ASFRs calculation. While ASFRs provide a detailed fertility profile, TFR offers a concise summary. Whenever feasible, it is preferable to analyze ASFRs instead of TFR or any other indicator. The calculation of the Net Reproduction Rate further requires information on survivors from the relevant life tables. In addition, ASFRs can be reported for individuals ages 15, 16, 17, …, and 54, although this is a rare practice nowadays (Siegel & Swanson, 2004).

Ethiopia has shown a decline in TFR from 6.4 in 1990 to 4.6 in 2016 (Central Statistical Agency [Ethiopia] & ICF, 2016; Central Statistical Authority [Ethiopia] & ORC Macro, 2001). Despite this declining trend, fertility remains high and exhibits significant regional variation. According to the 2016 EDHS, for instance, the TFR varies from 1.8 in Addis Ababa to 7.2 in the Somali region (Central Statistical Agency [Ethiopia] & ICF, 2016). The same report also indicate that the Afar and Somali regions experienced an increase in TFR during the period from 2000 to 2016.

The TFR derived from EDHS is susceptible to both sampling and non-sampling errors, a common issue in many developing countries. The TFR sampling errors for Ethiopia and its regions are detailed in the "estimates of sampling errors" part in Appendix B of the EDHS reports, highlighting precision issues in TFR estimates. Notably, the standard errors at the regional level are generally higher than at the national level, primarily due to smaller sample sizes. The quality of fertility data related to age preference and birth date reporting (affected by non-sampling errors) is provided in the "data quality tables" in Appendix C of the EDHS reports. Simple line graphs (not reported here) for single-year ages of women aged 15 – 49 across all four EDHS surveys reveal considerable age preference in the terminal digits 0 and 5.

Among the indicators provided by the EDHS surveys at the regional level, TFRs are observed as plausible estimates by many researchers. However, ASFRs obtained from the EDHS are sometimes under-estimated or over-estimated. In addition, ASFRs for the extreme age groups of 15 – 19 or 45 – 49 are occasionally reported as zero due to the small sample size of live birth data. This limitation leads many researchers to restrict their studies to the extent possible. Observing these drawbacks, this study employs an innovative approach to derive ASFRs from a model fertility table (MFT) developed following the study of Mitra (1965).

MFTs by Mitra provide ASFRs corresponding to general fertility rate (GFRs), which were developed using a set of simple linear regressions between ASFRs and GFRs. These tables are observed to be similar to the model mortality tables. Given the GFR, one can determine the ASFRs for different age groups. Thus, seven ASFRs can be obtained from a given GFR for a specific population at a particular time (Mitra, 1965).

Over the years, researchers have made numerous attempts to indirectly estimate various fertility and mortality indicators at both national and regional levels to understand the levels, trends, variations, and determinants of fertility in Ethiopia and its regions. Censuses and survey data from the past few years served as the main data sources in all these attempts. However, their use and policy implications are observed to be limited nowadays (See: Teklu *et al*., 2013).

1.2. Modeling ASFRs

Historical evidence shows that ASFRs are observed to be low in the 15 – 19 and 20 – 24 age groups, comparatively high in the 25 – 29, 30 – 34, and 35 – 39 age groups, and then decrease in the 40 – 44 and 45 – 49 age groups. This pattern is observed universally across populations due to the influence of biological, socio-economic, environmental, and other background factors on women's fertility. Theories such as Davis-Blake's theory of fertility and Bongaarts' proximate determinants theory provide substantial evidence supporting this trend (Bongaarts, 1978, 1982, 2015; Bongaarts & Potter, 1983; Davis & Blake, 1956; Mitra, 1967; United Nations, 1963).

ASFRs exhibit a particular shape and pattern, similar to age-specific death rates, and are often modeled by researchers using various mathematical curves (Gaire *et al*., 2022; Gogoi & Deka, 2023; Islam & Ali, 2004; Islam, 2009; Jena *et al*., 2023; Mishra *et al*., 2017; Wani *et al*.,

2020). Mathematical models help smooth reported ASFRs, project them, and estimate them. The literature includes several parametric and non-parametric mathematical models that attempt to describe the ASFRs. It is observed that as modernization increases, ASFRs vary across populations based on their stage of demographic transition, leading to the development of new mathematical models (Brijesh *et al*., 2015; Coale & Trussell, 1974; Gayawan *et al*., 2010). Over the past few decades, fertility patterns in developed countries have deviated from the classical uni-modal distribution, with a notable bulge in early-age fertility observed in ASFR curves. To accommodate this bulge, different models have been developed, assuming that the distorted fertility distributions may represent not a homogeneous population but multiple sub-populations (Chandola *et al*., 1999; Peristera & Kostaki, 2007). Recently, researchers like Chao *et al*. (2023) have used the Bayesian hierarchical model (BHM) developed by the United Nations Population Division to estimate ASFR trends. The BHM is gaining popularity due to its ability to incorporate uncertainty and prior knowledge. The Kumaraswamy-log-logistic distribution, commonly used in survival analysis, is also being used to model ASFRs (Gaire *et al*., 2024). Mishra *et al*. (2017) used the skew-logistic distribution to model India's ASFR pattern, which effectively captures the skewed nature of the ASFR curve. Polynomial models are also used in modeling ASFRs (Gaire *et al*., 2022; Singh *et al*., 2015). Vanella & Hassenstein (2024) proposed a stochastic forecast model for regional ASFRs, which can account for demographic fluctuations and is particularly valuable during times of economic or political instability when fertility rates experience high variability or uncertainty. The integration of big data from online sources with machine learning is becoming increasingly important in fertility modeling (Islam *et al*., 2022; Tzitiridou-Chatzopoulou *et al*., 2024), enabling machine learning algorithms to uncover hidden patterns, thus improving the decision-making process.

At the onset of fertility transition, where development is very low, fertility is typically very high and distributed across various age groups. As development progresses and fertility declines, the shape of the fertility curve changes, with fertility becoming more concentrated in the 20 – 24 or 25 – 29 age groups. Thus, observing age-specific fertility curves over time provides a comprehensive view of the fertility transition in any nation or population. Factors such as increased age of marriage, higher use of modern contraceptives, childlessness, and other behavioral changes contribute to shifts in fertility and the transition process (Mitra, 1967; United Nations, 1963). Therefore, examining the ASFR curves of a nation or any region over the transition period facilitates a thorough study of fertility transitions. One of the primary objectives of this study is to analyze the fertility transition in Ethiopia by observing changes over time in ASFRs across various regions.

Understanding the existing interrelationships and high correlations between fertility and mortality measures, socio-economic indicators, and other measures, researchers have attempted to derive summary indicators such as TFR and gross reproduction rate (GRR) using simple regression models from relevant highly interrelated development and demographic indicators (Bogue & Palmore, 1964; Hauer *et al*., 2013; Jagadeesh Kumar, 1977; Mitra, 1965; Palmore, 1978; Premi, 1974; Rele, 1967).

Rele (1967) developed a method to estimate GRR and TFR from the Child–Woman Ratio (CWR) corresponding to a given level of life expectancy at birth, based on stable population theory principles (Rele, 1967). Bogue & Palmore (1964) estimated various fertility indicators such as crude birth rate, GFR, ASFRs, and TFR from a set of fertility, mortality, and development indicators. Mitra (1965) attempted to provide a set of regression models and a correspondence table to derive ASFRs from GFR information. These researchers generally preferred to use simple regression models to achieve their goal.

However, regression models typically provide reliable estimates only for periods under consideration and have limited applicability. Interestingly, Rele's (1967) methodology, which uses stable population theory to estimate GRR/TFR from CWR, still yields plausible results in populations currently considered non-stable.

Observations from the EDHS survey estimates of TFRs across various regions in Ethiopia (Figure 1) reveal a significant decline in fertility from 2000 to 2016. However, this decline varies substantially between regions and over time within the same region. Despite this, to the knowledge of the present researchers, no comprehensive study has been conducted to study the fertility transition in Ethiopia using ASFRs or other acceptable detailed indicators, primarily due to the lack of reliable ASFR estimates.

To address this research gap, this paper proposes two main objectives. First, it aims to develop a suitable methodology for creating an MFT for Ethiopia, which can provide plausible estimates of ASFRs for different regions/provinces of Ethiopia over time from the given TFR. Second, it seeks to understand the fertility transition in regions in Ethiopia from 2000 to 2016 using ASFR estimates obtained from the MFT.

The primary goal is to construct an MFT for Ethiopia that takes TFR as input and outputs plausible ASFR estimates and to study the fertility transition in Ethiopia and its regions over the past two decades using these ASFRs.

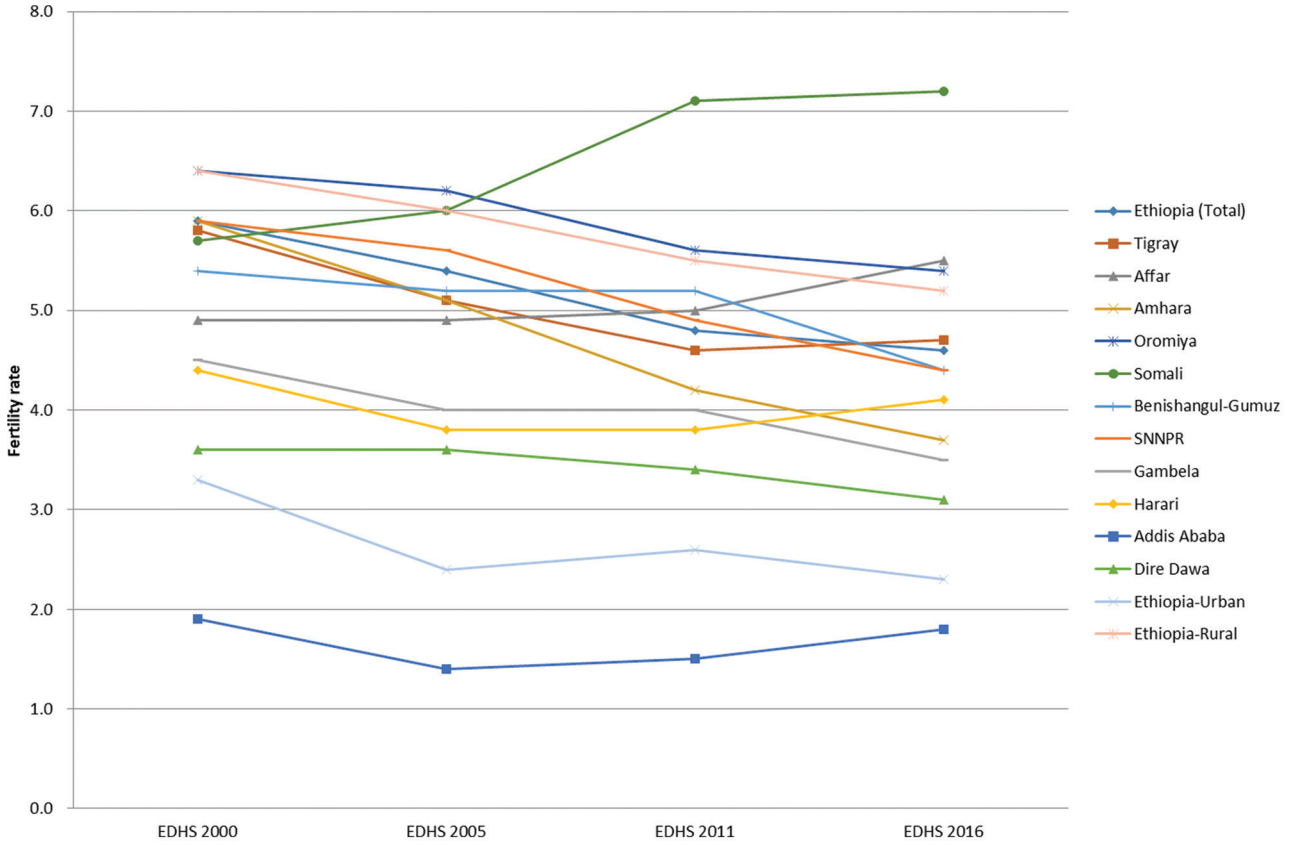

Figure 1. EDHS estimates of total fertility rates in Ethiopia and its regions for 2000, 2005, 2011, and 2016. Data were sourced from various EDHS reports. Note: SNNPR has recently dissolved to Sidama Region, Southwest Ethiopia Region, South Ethiopia Regional State and Central Ethiopia Regional State and results for SNNPR refer to the four regional states as unity.
Abbreviations: EDHS: Ethiopian Demographic and Health Survey; SNNPR: Southern Nations, Nationalities and Peoples' Region.

2. Data and methods

The data requirement and methodological details are provided as follows.

2.1. Data sources

2.1.1. TFRs from the EDHS

In the absence of any other reliable data, the present researchers observe that the TFRs reported by EDHS surveys are the most readily available and plausible estimates that can be used as input in obtaining the ASFRs of various regions and Ethiopia over time from the MFT. It is assumed that regions in Ethiopia reflect the changes occurring at the national level.

Figure 1 illustrates the time trends in the reported EDHS TFRs of the regions and Ethiopia, compiled from various published EDHS reports. A close observation of these trends reveals that Afar and Somali are the only regions where TFR continuously increased from 2000 to 2016. Conversely, a consistent decline in TFR is observed in Ethiopia (Total and Rural), Amhara, Oromiya, Benshangul-Gumuz, Southern Nations, Nationalities and Peoples' Region (SNNPR), Gambela, and Dire Dawa over the same period. In regions such as Tigray, Harari, Addis Ababa, and Ethiopia (Urban), TFR declined from 2000 to 2016 but showed a slight increase in 2011 and/or 2016. These regions are noted for urbanization levels, especially Harari and Addis Ababa.

This analysis of EDHS TFRs for Ethiopia and its regions above clearly indicates that fertility transition is progressing in all the regions in Ethiopia except for Afar and Somali. This exception is attributed to strong prevailing cultural factors and slower socioeconomic development compared to others.

The EDHS has been conducted at regular intervals since 2000 with the full support of international organizations like the United States Agency for International Development. The main objective of the EDHS surveys is to provide policymakers, planners, researchers, and

program managers with up-to-date information to guide the planning, implementation, monitoring, and evaluation of population and health programs in the country (Central Statistical Agency [Ethiopia] & ICF International, 2012). During the EDHS 2016, it stated that detailed information was collected on "background characteristics of the respondents, fertility, marriage, fertility preferences, awareness and the use of family planning methods, child feeding practices, nutritional status of women and children, adult and childhood mortality, awareness and attitudes regarding HIV/AIDS, female genital mutilation, domestic violence, and height and weight of women" (Central Statistical Agency [Ethiopia] & ICF, 2016, pxix). Further details on fertility information from the EDHS reports can be obtained from the EDHS reports of Ethiopia (Central Statistical Agency [Ethiopia] & ICF. 2012, 2016; Central Statistical Authority [Ethiopia] & ORC Macro. 2001, 2006; Ethiopian Public Health Institute [Ethiopia] & ICF 2021).

The EDHS includes a series of questions designed to calculate fertility rates. These questions typically inquire about the number of children a woman has ever had, the dates of their births, the survival status of each child, and the age at which a woman gave birth to each child. While these questions provide valuable data on fertility rates, there are limitations regarding the quality of information. As indicated in the introduction, there are issues related to birth history data, like recall bias, where respondents may inaccurately remember birth dates or underreport sensitive topics like child mortality or fertility intentions. In addition, age preferences when reporting the mother's age pose another challenge. Moreover, the DHS data include potential sampling errors.

2.1.2. TFRs and ASFRs from the United Nation's World Population Prospects (WPP) 2022

The ASFRs and relevant TFRs for Ethiopia from 1950 to 2100 were obtained from the WPP 2022 (United Nations, 2022a). In the WPP 2022: summary of Results, it is stated that "WPP 2022 is the twenty-seventh edition of the official estimates and projections of the global population that have been published by the United Nations since 1951. They form a comprehensive set of demographic data to assess population trends at the global, regional, and national levels." (United Nations, 2022b, p.1). Furthermore, it states that "For the first time, the 2022 revision presents all demographic indicators and population estimates from 1950 and projections to 2100 by single age and sex for one-year intervals." (United Nations, 2022b, p.1).

The WPP 2022 is widely used by demographers and researchers worldwide. It provides the required plausible estimates and projected ASFRs for Ethiopia for every single year starting from 1950 to 2100. In this study, the data from the WPP 2022 was used to develop the MFT for Ethiopia, adopting Mitra's 1965 methodology (Mitra, 1965). Unlike Mitra's use of the GFR as the basic input indicator, this study employed TFR as the basic input. Additionally, instead of simple linear regression, this present study included estimated and projected ASFRs and TFRs as basic inputs in developing various age-specific fertility models using cubic regression techniques. The inclusion of projected estimates allowed the researchers to cover the entire fertility transition period of Ethiopia and derive plausible estimates for regions like Addis Ababa, which has already reached below-replacement fertility level of TFR of 2.1 per woman.

Despite its uses, the fertility data from the WPP have several limitations. Inconsistencies in data quality may arise due to differences in data collection methods across countries and underreporting in regions with poor statistical infrastructures. The WPP uses models to estimate fertility when data are unavailable or unreliable, which leads to uncertainty. Future fertility projections are made based on assumptions of future trends in fertility, which may not capture the socio-economic changes that could occur in the future. Therefore, it is important to consider these factors when using WPP data for research or policy formulation. In the present paper, we compared the WPP ASFRs with regression model-based ASFRs to assess the suitability of WPP fertility data for constructing an MFT.

2.2. Methods

2.2.1. Cubic polynomials to construct the MFT for Ethiopia

In brief, the MFT for Ethiopia provided here consists of a set of nine regression models, each corresponding to consecutive age groups: 10 – 14, 15 – 19, 20 – 24, 25 – 29, 30 – 34, 35 – 39, 40 – 44, 45 – 49, and 50 – 54. These models are collectively referred to as the "MFT for Ethiopia."

The regression model used is expressed as:

$$ASFR = a + b \times TFR + c \times TFR^2 + d \times TFR^3 \quad (I)$$

which provides estimated values of ASFRs for Ethiopia that are very close to the observed values of ASFRs reported by the United Nations WPP 2022 report. Initially, ASFRs and TFRs of all available single years from 1950 to 2100, which amounted to about 151 individual observations, were considered in the above models to develop the MFT. However, the developed fertility model failed to provide acceptable estimates for 1950 to 1983. Moreover, no reliable survey or census existed from 1950 to 1983 that provided reliable fertility estimates. Therefore, the model

was revised using the TFR and ASFR data from 1984 to 2100, totaling 117 observations.

A cubic polynomial regression was employed, assuming a smooth, continuous relationship between the dependent and independent variables. The approach provides the necessary flexibility to model the data accurately and captures key data features without overfitting. However, limitations include complexity, interpretability issues, sensitivity to outliers, and potential correlation between polynomial terms.

2.2.2. Methods for model validation

To assess the stability of the cubic models developed in this study, the cross-validity prediction power, ρ^2_{cvpp}, is applied (Gogoi & Deka, 2023). The formula is given in Equation II, where k is the number of cases, is the number of variables in the model ($k \leq n$-2).

$$\rho^2_{cvpp} = 1 - \frac{(n-2)(n^2-1)}{n(n-k-1)(n-k-2)}(1-R^2) \quad \text{(II)}$$

The cross-validated R is the correlation between observed ASFRs and expected ASFRs obtained from the fitting polynomial model. The higher the value of R, the better the model fits the data. For assessing the stability of the coefficient of determination of the model, the relationship (1- shrinkage) was used, where the expression $\left|\rho^2_{cvpp} - R^2\right|$ represents the shrinkage of the model. Furthermore, to verify the overall measure of the significance of the model and the significance of R, we chose the formula of F-test statistics as given below in Equation III.

$$F = \frac{ESS/k}{RSS/(n-k-1)} = \frac{R^2/k}{(1-R^2)/(n-k-1)} \sim F_{k,n-k-1} \quad \text{(III)}$$

In addition, to check the validity of the cubic models, a comparison of ASFRs from the fitted models and observed ASFRs from WPP was carried out. Furthermore, ASFRs for Ethiopia reported from EDHS were compared against the model-based ASFRs.

2.3. Statistical analysis

In this study, curve fitting and diagrammatic display of data were used for data analysis. The diagrammatic display was mainly employed to visualize the shapes of fertility patterns and their changes over time. IBM Statistical Package for the Social Sciences Statistics version 20 and Microsoft Excel version 2016 were used in the analysis.

3. Results

3.1. Results from the fitted regressions

The final set of regression models used in the present study to obtain the ASFRs from the TFR information was developed using the TFR and ASFR data of Ethiopia from 1984 to 2100, as provided by WPP 2022. The regression models are as follows:

(i) ASFR (10 – 14) = (2.009598) + (-1.806028) × TFR + (0.402741) × TFR^2 + (0.013968) × TFR^3, R^2 = 0.985

(ii) ASFR (15 – 19) = (−10.432059) + (4.713365) × TFR + (4.49149) × TFR^2 + (−0.243894) × TFR^3, R^2 = 0.998

(iii) ASFR (20 – 24) = (−86.171273) + (109.777812) × TFR + (−14.118317) × TFR^2 + (0.825919) × TFR^3, R^2 = 0.998

(iv) ASFR (25 – 29) = (33.959525) + (48.239717) × TFR + (−1.639273) × TFR^2 + (−0.017611) × TFR^3, R^2 = 0.999

(v) ASFR (30 – 34) = (98.229064) + (−20.783838) × TFR + (13.459766) × TFR^2 + (−1.001477) × TFR^3, R^2 = 0.998

(vi) ASFR (35 – 39) = (8.83864) + (20.504395) × TFR + (1.282253) × TFR^2 + (0.005215) × TFR^3, R^2 = 0.999

(vii) ASFR (40 – 44) = (−22.228452) + (21.81263) × TFR + (−1.660136) × TFR^2 + (0.240218) × TFR^3, R^2 = 0.999

(viii) ASFR (45 – 49) = (−27.628117) + (20.694123) × TFR + (−3.059896) × TFR^2 + (0.234623) × TFR^3, R^2 = 0.985

(ix) ASFR (50 – 54) = (−3.104749) + (2.328573) × TFR + (−0.396156) × TFR^2 + (0.027416) × TFR^3, R^2 = 0.968

In all nine regression models, the total number of observations is always 117, and the R^2 values, which indicate the goodness of fit of the regression model, are very high across all models. This suggests that the proposed models are effective for estimating the ASFR based on the given TFR.

3.2. Validity of the fitted models

Table 1 summarizes the values of the coefficient of determination, cross-validated prediction power, shrinkage, F-calculated, and P-values for each model. Notably, most of the fitted models exhibit strong statistical significance and account for more than 99% of the variance.

Table 1. Estimated cross-validation prediction power and shrinkage of the proposed polynomial models

Models	n	k	R^2	ρ^2_{cvpp}	Shrinkage	Calculated F	P-value
Model 1	117	3	0.985	0.984	0.0009	2,453.66	0.000
Model 2	117	3	0.998	0.998	0.0001	16,501.65	0.000
Model 3	117	3	0.998	0.998	0.0001	22,299.49	0.000
Model 4	117	3	0.999	0.999	0.0001	35,665.07	0.000
Model 5	117	3	0.998	0.998	0.0001	24,405.23	0.000
Model 6	117	3	0.999	0.999	0.0001	30,111.71	0.000
Model 7	117	3	0.999	0.999	0.0001	34,821.58	0.000
Model 8	117	3	0.985	0.984	0.0009	2,402.69	0.000
Model 9	117	3	0.968	0.966	0.0020	1,144.95	0.000

Abbreviations: cvpp: Cross-validation prediction power.

The shrinkage values of all the models are small, indicating that the estimated and observed values of ASFRs are closely aligned. The cross-validation findings further demonstrate the high performance of the fitted polynomial models for ASFRs. Most of the ASFRs polynomial models that were fitted have stability rates higher than 99%. The coefficient of determination *R*, for these models exceeds 98% in terms of stability except for Model 9.

Moreover, all 117 observations revealed that the fitted values of ASFRs obtained from the regression models closely align with the WPP ASFR values. This comparison was made possible by visually comparing the regression model-based ASFRs with the WPP ASFR values (results not reported in this paper).

To further validate the regression models, a set of model-based ASFRs is presented alongside the observed ASFRs for Ethiopia during the periods of 2000, 2005, 2011, and 2016 (Figure 2). These observed ASFRs for these periods are based on the EDHS surveys for the corresponding years. These results suggest that the regression models developed using the United Nation's estimates of ASFRs and TFRs for Ethiopia provide plausible model fertility values, which can be used to estimate the ASFRs over time for various regions of Ethiopia, based on the TFRs of the EDHS surveys spanning 2000 to 2016. This period covers about 15 years, during which fertility transition in Ethiopia and its regions is clearly in progress. It is important to note that the EDHS ASFRs for regions, especially at extreme ages, may not accurately represent fertility data due to smaller sample sizes. This limitation prompted the development of the "MFT for Ethiopia," which assumes that regions in Ethiopia closely mirror the national trends in overall fertility behavior and patterns over time.

To the best of our knowledge, no attempt has been made to develop an MFT for Ethiopia or any other country in Africa. Thus, the present methodology sets a precedent for future studies, underscoring the uniqueness of the present study. The present regression models do not require any further modifications as the input covers the entire fertility transition period of Ethiopia. The medium-term estimated future ASFRs and TFRs for 2022 to 2100 are considered stable and do not require further reconsideration.

3.3. MFT for Ethiopia and its regions

Table 2 presents the model-based ASFRs for Ethiopia developed using the regression models and TFR ranging from 7.4 to 1.2. These estimates illustrate how the ASFRs vary over the fertility transition period, reflecting the expected changes in TFR from 7.4 to 1.2 per woman. The researchers recommend using Table 2 for practical purposes. From Table 2, it can be interpreted that, over

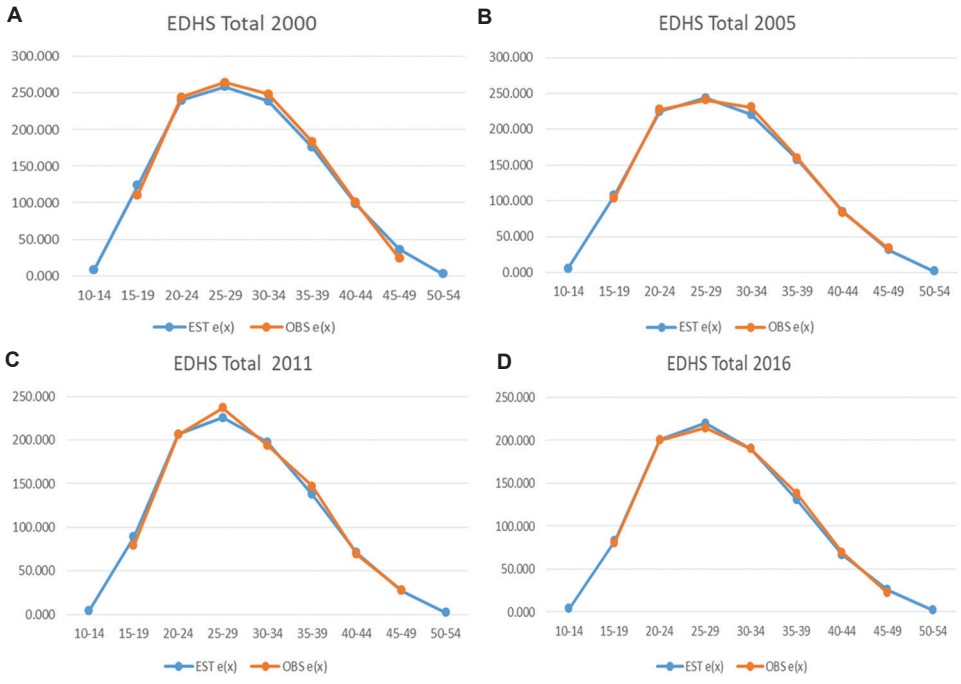

Figure 2. Observed and estimated age-specific fertility rates for Ethiopia based on the Ethiopian Demographic and Health Surveys periods of (A) 2000, (B) 2005, (C) 2011, and (D) 2016.

Table 2. The patterns of age-specific fertility rates developed for Ethiopia using the regression models

TFR	ASFR 10 – 14	ASFR 15 – 19	ASFR 20 – 24	ASFR 25 – 29	ASFR 30 – 34	ASFR 35 – 39	ASFR 40 – 44	ASFR 45 – 49	ASFR 50 – 54
7.4	16.36	171.57	287.75	294.03	275.66	232.90	145.62	53.02	3.54
7.3	15.72	168.45	284.14	291.90	274.19	228.88	141.98	51.65	3.45
7.2	15.10	165.31	280.61	289.73	272.54	224.89	138.42	50.32	3.36
7.1	14.49	162.16	277.15	287.52	270.73	220.93	134.93	49.03	3.27
7.0	13.89	158.99	273.77	285.27	268.76	216.99	131.51	47.77	3.19
6.9	13.31	155.81	270.44	282.98	266.65	213.08	128.15	46.56	3.11
6.8	12.74	152.62	267.18	280.65	264.38	209.20	124.87	45.38	3.03
6.7	12.19	149.42	263.98	278.28	261.98	205.35	121.64	44.23	2.96
6.6	11.65	146.21	260.82	275.87	259.44	201.52	118.48	43.12	2.89
6.5	11.12	142.99	257.70	273.42	256.78	197.73	115.38	42.04	2.82
6.4	10.61	139.77	254.63	270.93	253.99	193.96	112.35	40.99	2.76
6.3	10.11	136.54	251.59	268.40	251.09	190.21	109.37	39.96	2.70
6.2	9.62	133.32	248.58	265.84	248.08	186.50	106.45	38.97	2.64
6.1	9.15	130.09	245.60	263.23	244.97	182.81	103.58	38.00	2.58
6.0	8.69	126.86	242.64	260.58	241.76	179.15	100.77	37.06	2.53
5.9	8.24	123.64	239.69	257.89	238.46	175.52	98.01	36.14	2.47
5.8	7.81	120.41	236.75	255.17	235.07	171.92	95.31	35.24	2.42
5.7	7.39	117.20	233.81	252.40	231.60	168.34	92.65	34.36	2.37
5.6	6.98	113.98	230.88	249.60	228.06	164.79	90.05	33.50	2.33
5.5	6.58	110.78	227.94	246.76	224.46	161.27	87.49	32.66	2.28
5.4	6.20	107.59	224.99	243.88	220.79	157.77	84.98	31.84	2.24
5.3	5.83	104.41	222.03	240.96	217.06	154.31	82.51	31.03	2.19
5.2	5.47	101.23	219.05	238.00	213.29	150.87	80.08	30.23	2.15
5.1	5.13	98.08	216.04	235.01	209.47	147.45	77.70	29.45	2.10
5.0	4.79	94.94	213.00	231.98	205.62	144.07	75.36	28.67	2.06
4.9	4.47	91.81	209.93	228.90	201.73	140.71	73.06	27.91	2.02
4.8	4.17	88.70	206.82	225.79	197.82	137.38	70.79	27.15	1.98
4.7	3.87	85.62	203.66	222.65	193.90	134.08	68.56	26.40	1.94
4.6	3.58	82.55	200.46	219.46	189.95	130.80	66.36	25.66	1.89
4.5	3.31	79.51	197.20	216.24	186.00	127.55	64.20	24.91	1.85
4.4	3.05	76.49	193.88	212.98	182.05	124.33	62.07	24.17	1.81
4.3	2.80	73.49	190.49	209.68	178.11	121.13	59.97	23.43	1.76
4.2	2.56	70.52	187.04	206.35	174.17	117.96	57.90	22.69	1.72
4.1	2.34	67.59	183.51	202.97	170.25	114.82	55.85	21.95	1.67
4.0	2.12	64.68	179.91	199.56	166.36	111.71	53.83	21.21	1.63
3.9	1.92	61.80	176.22	196.12	162.49	108.62	51.84	20.46	1.58
3.8	1.73	58.95	172.44	192.63	158.66	105.56	49.87	19.70	1.53
3.7	1.55	56.14	168.56	189.11	154.87	102.52	47.92	18.94	1.48
3.6	1.38	53.37	164.59	185.56	151.12	99.52	45.99	18.16	1.42
3.5	1.22	50.63	160.51	181.96	147.43	96.54	44.08	17.38	1.37
3.4	1.07	47.93	156.33	178.33	143.80	93.58	42.19	16.58	1.31
3.3	0.94	45.27	152.03	174.67	140.23	90.65	40.31	15.77	1.25

(Cont'd...)

Table 2. *(Continued)*

TFR	ASFR 10 – 14	ASFR 15 – 19	ASFR 20 – 24	ASFR 25 – 29	ASFR 30 – 34	ASFR 35 – 39	ASFR 40 – 44	ASFR 45 – 49	ASFR 50 – 54
3.2	0.81	42.65	147.61	170.96	136.73	87.75	38.44	14.95	1.19
3.1	0.70	40.08	143.07	167.23	133.31	84.88	36.59	14.11	1.12
3.0	0.59	37.55	138.40	163.45	129.98	82.03	34.75	13.25	1.06
2.9	0.50	35.06	133.59	159.64	126.73	79.21	32.93	12.37	0.99
2.8	0.42	32.63	128.65	155.79	123.57	76.42	31.11	11.48	0.91
2.7	0.34	30.24	123.56	151.91	120.52	73.65	29.29	10.56	0.83
2.6	0.28	27.90	118.33	147.99	117.58	70.91	27.48	9.62	0.75
2.5	0.23	25.61	112.94	144.04	114.75	68.20	25.68	8.65	0.67
2.4	0.19	23.38	107.39	140.05	112.03	65.51	23.88	7.66	0.58
2.3	0.16	21.20	101.68	136.03	109.44	62.85	22.08	6.64	0.49
2.2	0.13	19.08	95.80	131.97	106.99	60.21	20.28	5.59	0.39
2.1	0.12	17.02	89.75	127.87	104.67	57.60	18.48	4.51	0.29
2.0	0.12	15.01	83.52	123.74	102.49	55.02	16.68	3.40	0.19
1.9	0.13	13.07	77.10	119.58	100.46	52.46	14.87	2.25	0.08
1.8	0.15	11.18	70.50	115.38	98.59	49.93	13.06	1.08	0.00
1.7	0.17	9.36	63.71	111.14	96.88	47.43	11.24	0.00	0.00
1.6	0.21	7.61	56.71	106.87	95.33	44.95	9.41	0.00	0.00
1.5	0.25	5.92	49.52	102.57	93.96	42.50	7.57	0.00	0.00
1.4	0.31	4.30	42.11	98.23	92.77	40.07	5.72	0.00	0.00
1.3	0.37	2.75	34.49	93.86	91.76	37.67	3.85	0.00	0.00
1.2	0.45	1.27	26.66	89.46	90.94	35.30	1.97	0.00	0.00

Abbreviations: ASFR: Age-specific fertility rate; TFR: Total fertility rate.

time, as TFR changes, there is an expected change in the ASFRs of various age groups. ASFRs are observed to be very high in each of the age groups in the early stages of the fertility transition period when the TFR is around seven per woman. When the TFR approaches or falls below 2.1, fertility becomes more concentrated in specific age groups, particularly 25 – 29 and 30 – 34, reflecting the impacts of modernization, the use of modern contraceptives, and other factors. We assume that the present model-based ASFRs provide plausible estimates of ASFRs from the given TFR for various sub-regions in Ethiopia over time. As such, the estimated ASFRs of various regions/provinces and periods, presented in Figure 3, are derived from Table 2 using the TFRs of various regions of various periods outlined in Figure 1.

3.4. Fertility patterns and transition in Ethiopia and its regions

In the present section, the estimated ASFRs for regions in Ethiopia over time are presented and analyzed to study the fertility transition in Ethiopia from a comparative perspective. Figure 3 depicts the ASFRs for various regions obtained using the TFRs of the EDHS reports for the years 2000, 2005, 2011, and 2016, also detailed in Table 2.

It is reasonable to assume that Ethiopia's ASFRs and its patterns during the transition period reflect those of its regions, as population, socio-economic, and other development policies have been uniformly applied across the country. Furthermore, to the best of the knowledge of the present authors, no other reliable estimates of ASFRs from any other study are readily available for comparative purposes during these study periods.

However, it is possible, in a few cases, that the patterns of ASFRs for Ethiopia may not be applicable at the regional level for certain years. This is due to the potential inaccuracy of regional TFRs reported in the EDHS, which are used as input to reflect fertility patterns specific to its region. If the regional TFRs from the EDHS are accurate, the ASFRs predicted by the aggregate model based on national data are likely to be reliable. However, if regional-level ASFRs and TFRs were available for the entire transition period, we would have developed specific region-based regression models to estimate ASFRs for smaller sub-regions. These

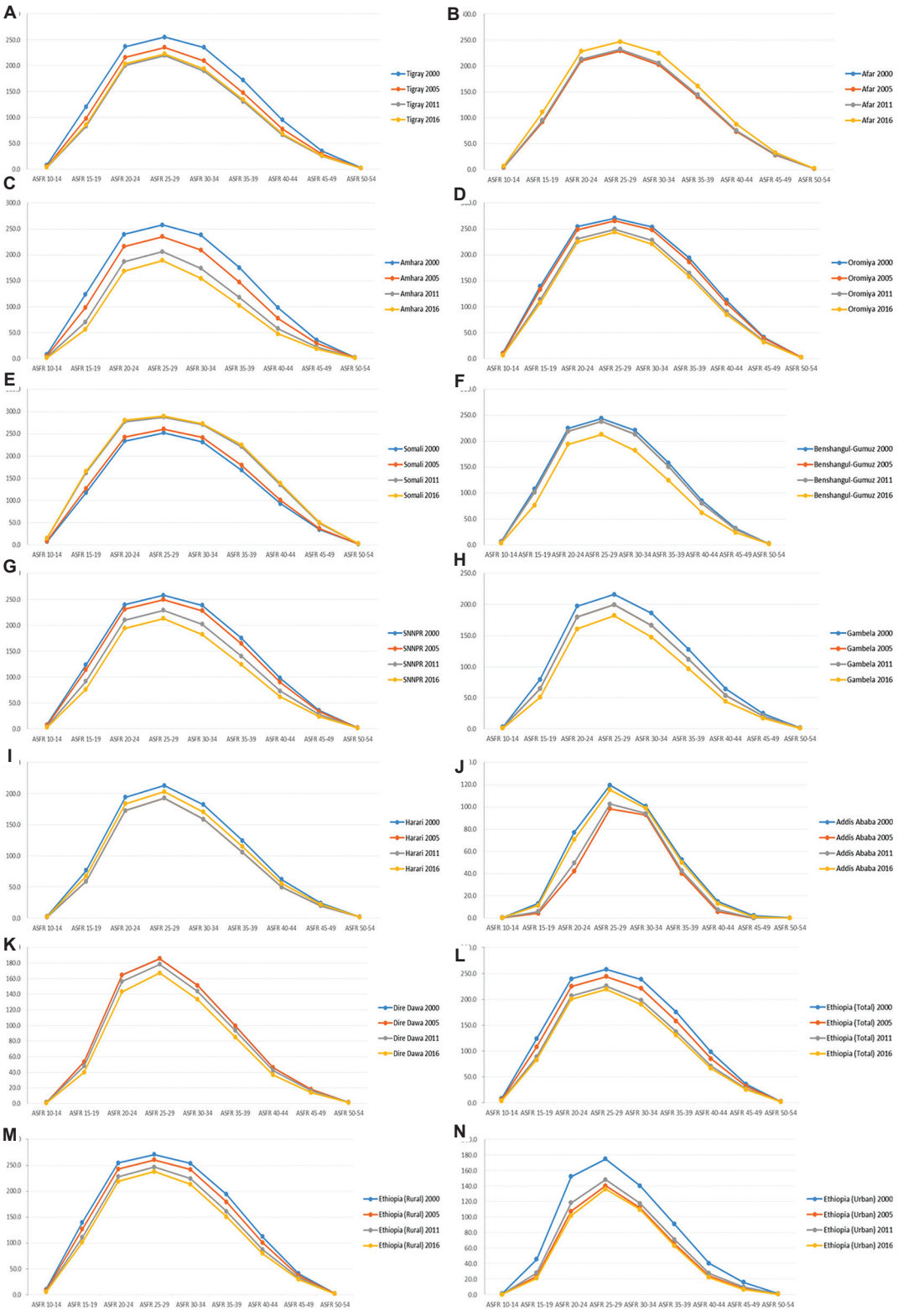

Figure 3. Model-based age-specific fertility rates for Ethiopia and its various regions for the years 2000, 2005, 2011, and 2016. (A) Tigray, (B) Afar, (C) Amhara, (D) Oromia, (E) Somali, (F) Benshangul-Gumuz, (G) SNNPR, (H) Gambela, (I) Harari, (J) Addis Ababa, (K) Dire Dawa, (L) Ethiopia (Total), (M) Ethiopia (Rural), (N) Ethiopia (Urban).
Abbreviations: ASFR: Age-specific fertility rate; SNNPR: Southern Nations, Nationalities and Peoples' Region.

regression models could have helped validate the region-specific ASFRs reported by surveys like the EDHS or various censuses.

The model-based patterns of fertility for Ethiopia and its regions generally exhibit a uni-modal distribution, with maximum fertility among women aged 25 – 29, followed by a steady decline. This indicates that the fertility patterns in Ethiopia have a right-skewed distribution where most births occur within younger age groups and few in older age groups (Figure 3).

The fertility patterns are broad due to high fertility among women aged 20 – 34, except in urban areas. The fertility patterns for Ethiopia (urban) and cities such as Addis Ababa, Dire Dawa, and Harari had relatively sharp peaks, indicating low fertility rates. In particular, Addis Ababa and Ethiopia (urban) showed very sharp peaks attributable to smaller fertilities.

During the study period, fertility declines were observed in most regions, indicating ongoing fertility transition. Tigray, Amhara, Oromiya, Benshangul Gumuz, SNNP, Gambela, Dire Dawa, Ethiopia (total), Ethiopia (rural), and Ethiopia (urban) showed fertility declines during the study period. However, fertility transition setbacks were observed in urban places such as Addis Ababa and Harari.

Notably, the Afar and Somali regions showed an increment in ASFRs during the study period, with the Somali region displaying a broader peak than others due to high fertility among women aged 20 – 39.

4. Discussion

In countries like Ethiopia, producing fertility indicators is crucial for effective interventions to ensure fertility transition. However, fertility indicators can be biased due to issues related to fertility data, such as birth omissions, age misreporting, and small sample sizes. This study aimed to overcome these challenges by developing plausible ASFR estimates using a model-based approach. Model-based ASFRs can serve multiple purposes. They can be used to evaluate the quality of empirical data, correct irregularities in data, and make predictions (Sloggett, 2015). Understanding the pattern of fertility and its stable features is essential for producing acceptable indicators.

Previous studies by major researchers such as Hadwiger (1940), Hoem *et al.* (1981), Gompertz (1825), Brass (1975, 1978), Pasupuleti and Pathak (2010), Chandola *et al.* (1999), Schmertmann (2003), Peristera & Kostaki (2007), and Gayawan *et al.* (2010) focused on modeling ASFR as a function of maternal age during birth. Each study built upon previous work by proposing new models that better fit the available fertility data. This study differs in its approach using TFRs as input to obtain plausible ASFRs. The use of a long series of ASFRs and corresponding TFRs is an advantage.

The cubic polynomials developed in this study are well-suited for modeling fertility over time due to their flexibility in capturing the typical fertility transition pattern, which includes periods of high fertility, potential stalling, and subsequent decline. This makes the cubic polynomial a useful tool for modeling the non-linear nature of fertility transitions over time.

The fertility schedules estimated for various regions and periods using the MFT of Ethiopia were consistent with expectations, reflecting the rise in modernization and the ongoing fertility transition of the various provinces in Ethiopia. At the early stages of fertility transition (with a TFR of about seven), the majority of births occur at ages 20 – 24 and 25 – 29. In addition, births are also significant at ages 15 – 19, 30 – 34, 35 – 39, and 40 – 44, indicating early entry to childbearing and late exit. In this stage, births are predominantly concentrated in the 20s. However, as TFR decreases, the majority of births shift to ages 30 – 34 and 25 – 29, while the values of other age groups decline. At the later stage of the fertility transition, the majority of births are concentrated in the late twenties and early thirties, indicating late entry to childbearing and early exit. This phenomenon is expected and is known as childbearing transition characterization (El-Khorazaty & Horne, 1992).

The model-based ASFRs for Ethiopia and its regions exhibited a uni-modal distribution similar to those depicted in the EDHS results (Central Statistical Agency [Ethiopia] & ICF, 2016, p. 78). In addition, the ASFR curves are broad peaked with high values during the study period, except for urban Ethiopia, due to the high fertility of women aged 20 – 34. This finding aligns with EDHS reports, which consistently show higher fertility for this age group across all survey periods. The broad peaks associated with high ASFR values imply that fertility remains high in most parts of the country. In contrast, urban areas show sharp peaks and lower ASFRs, indicating declining fertility in urbanized areas.

The difference in fertility in urban Ethiopia and other regions of the country may be attributable to differences in family planning utilization. Urban Ethiopia has higher family planning use compared to rural areas, contributing to lower fertility rates in cities such as Addis Ababa, Dire Dawa, and Harari (Central Statistical Agency [Ethiopia] & ICF International, 2012, p. 98; Central Statistical Agency [Ethiopia] & ICF., 2016, p. 112; Central Statistical Authority [Ethiopia] & ORC Macro, 2001, p. 55; Central Statistical Authority [Ethiopia] & ORC Macro, 2006, p. 63).

As the fertility transition progresses, the ASFR shape becomes more sharply peaked, with higher fertility concentrated in specific age groups. The model-based results also show regional differences in fertility experiences. For instance, the Somali region exhibits a flatter ASFR curve than other regions due to high fertility across consecutive age groups (20 – 24, 25 – 29, 30 – 34, and 35 – 39), which is distinct from other regions. This demonstrates the flexibility of the MFT in capturing diverse fertility experiences across parts/regions with varying fertility levels.

The age-specific fertility curves, when multiplied by TFR, can be considered as density functions of age at childbearing (Brijesh *et al*., 2015). As the fertility transition progresses in Ethiopia, one can expect changes in parameters, such as location, scale, and shape. Specifically, the mean childbearing age of mothers is likely to increase, and the childbearing duration will become narrower, causing the ASFR curve to become more peaked. The transition may manifest as a shift from a broader peak to a relatively sharp peak in ASFRs, an increase in the modal age of mothers, and a decrease from a high reproductive life span to a lower one.

The study presents several strengths and limitations. One of its primary strengths is the innovative construction of an MFT, which is the first of its kind in Africa, providing plausible ASFRs derived solely from TFR data. The model-based ASFRs provide information about ASFRs at sub-national levels that enable policymakers to design and implement policies targeted at fertility-related programs. It also facilitates understanding regional differences in fertility rates that can help tailor specific interventions. In addition, the generalizability of the methodology allows for its application in other African countries or regions with similar demographic and socioeconomic contexts. It is also possible to construct MFTs for other countries, given that similar input data is available. The information on ASFRs would also help in informing fertility transition policies by identifying age groups with high fertilities, facilitating appropriate policies like community-based programs, changes in laws regarding marriage age, or campaigns promoting gender equity. Moreover, the knowledge of ASFRs would enable improved health policy and family planning programs, allowing health policymakers to tailor family planning and reproductive health services to specific age groups, regions, or communities.

However, the study also has limitations. The MFT was constructed by applying regressions based on actual and projected data that are subject to change over time. As a result, the MFT may require revisions periodically when remarkably new data emerges. In addition, the model assumes that regional fertility patterns align with national trends. If these assumptions do not hold true in some regions, the estimates may not accurately reflect local realities.

By addressing these limitations, future research can build upon the current study to provide more robust and comprehensive insights into fertility trends and transitions.

5. Conclusions

This study aimed to develop an MFT for Ethiopia to estimate ASFRs from TFR and to analyze changes in the age patterns of fertility across provinces from 2000 to 2016. The models, developed using UN WPP 2022 ASFR and TFR data of Ethiopia, were found suitable for estimating ASFRs from the TFR of the regions of Ethiopia.

During the fertility transition, Ethiopia and its regions displayed broad peak age-specific fertility patterns, with fertility concentrated heavily among the 20 – 24, 25 – 29, and 30 – 34 age groups. Exceptions included Addis Ababa, Dire Dawa, and Ethiopia (Urban) during the latest period of 2016. On the other hand, Afar and Somali are seen to have entirely different age-specific fertility patterns during the entire fertility transition period from 2000 to 2016.

From the policy perspective, based on the findings of the present study, there is a pressing need for the government of Ethiopia to make sufficient efforts to reduce fertility, particularly in Afar and Somali. Generally, policy makers should give much focus to age groups 20-24, 25-29, and 30-34. In addition, focusing on decreasing fertility among younger age groups (15 to 25) accelerates the fertility transition.

During the fertility transition period from 2000 to 2016, in regions with high urbanization, such as Ethiopia (urban), Addis Ababa, and Dire Diwa, a significant concentration of fertility was observed in the age group of 25 – 29 compared to other groups. This pattern may be attributed to factors such as increased contraceptive use, more job opportunities, higher educational levels, and overall urbanization and modernization of the provinces. These findings highlight the considerable impact of urbanization on fertility patterns in these areas. It suggests the need for tailored policies to address the low fertility levels observed in Addis Ababa and other future urban areas in the country.

Finally, caution should be exercised when using the MFT. As with every modeling approach, the model-based ASFRs may differ from actual ASFRs. The application of the model fertility rates derived from a given TFR is recommended when data are either unavailable or unreliable. This study can serve as an inspiration for developing similar models or refining the current ones.

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Conflict of interest

The authors declare that they have no competing interests.

Author contributions

Conceptualization: Mezgebo Gebregeorgis, Kinfe Abraha
Formal analysis: Mezgebo Gebregeorgis
Investigation: Mezgebo Gebregeorgis
Methodology: Mezgebo Gebregeorgis, Krishna Murthy Ponnapalli, Kinfe Abraha
Writing – original draft: All authors
Writing – review & editing: Mezgebo Gebregeorgis, Kinfe Abraha, Mache Tsadik

Ethics approval and consent to participate

In our study, we obtained permission to use the data from the United Nations Department of Economic and Social Affairs and the Demographic and Health Surveys program. However, obtaining ethical approval is not applicable.

Consent for publication

Not applicable.

Availability of data

The dataset can be accessed at https://population.un.org/wpp/DataSources/231 and Ethiopia the Demographic and Health Surveys reports.

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RESEARCH ARTICLE

Unmet preconditions and individualism: Factors contributing to low fertility intentions and population decline in China

Haoran Chen[1], Harn Shian Boo[1]*, and Kuang Yee Teng[2]

[1]Anthropology and Sociology Section, School of Social Sciences, Universiti Sains Malaysia, Minden, Penang, Malaysia

[2]School of Educational Studies, Universiti Sains Malaysia, Minden, Penang, Malaysia

Abstract

To mitigate the plummeting birth rate, the Chinese government has shifted its birth control and population policy from a one-child policy to a two- and three-child policy in 2016 and 2021, respectively. Despite the policy being buttressed with tax cuts, subsidies, cash reward, and laced with public education about the virtue and duty of having more children, the results have been unsatisfactory. While the total fertility rate experienced a positive announcement effect (*i.e.*, an increase from 2016's 1.77 to 2017's 1.81), it declined significantly and continues to drop to 1.09 in 2022. Considering this worrying trend, this study investigates the factors that contribute to Chinese netizens' low fertility intentions for having a second child. This study performed a reflexive thematic analysis using data from 881 social media threads on Weibo. The analysis reveals five primary factors that have influenced this community's low fertility intentions. These include: (i) the unfulfillment of a range of common preconditions; (ii) the rise of individualism and desire for personal freedom; (iii) "one-and-done" parenting by choice; (iv) conscious childlessness; and (v) childcare burden. The findings indicate that the perceived unfulfilled precondition for childbearing is the strongest contributor to this community's lack of intent to have a second child. These findings emphasize the need for family planning policies that not only address financial and social-psychological barriers to childbearing but also align family growth with personal aspirations, promoting long-term demographic sustainability.

Keywords: Fertility intention; Birth rate; Population; Second child; Individualism; China

***Corresponding author:**
Harn Shian Boo
(booharnshian@usm.my)

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1. Introduction

In 1979, China implemented what is now known as a 35-year one-child policy, shaped by the nation's fears of overpopulation that could endanger the country's economic growth and its people's quality of life. While the impetus to curb the country's population growth through this policy might not be solely compelled by the noble principles of sustainable development (as enacted in the United Nations' Rio Declaration and the ICPD Programme of Action), its effects on the global population dynamics, signified by the decreasing fertility rate (The World Bank, 2023), have since played their effective part in maintaining the harmonious balance between population, resources, the environment, and development.

> *"To achieve sustainable development and a higher quality of life for all people, States should reduce and eliminate unsustainable patterns of production and consumption and promote appropriate demographic policies." Rio Declaration, Principle 8 (United Nations, 1992).*
>
> *"Sustainable development as a means to ensure human well-being, equitably shared by all people today and in the future, requires that the interrelationship between population, resources, the environment and development should be fully recognized, appropriately managed and brought into harmonious, dynamic balance." International Conference on Population and Development (ICPD) Programme of Action, Chapter II, Principle 6 (United Nations, 1994).*

Fast forward 44 years to 2023, and the nation's demographic discourse has swapped the fear of overpopulation for domestic and global fertility challenges (Dörflinger & Loichinger, 2024). The long-term implementation of the one-child policy has imbalanced the sex ratio at birth, shrank the labor resources, and aggravated population aging. Meanwhile, the principle of sustainable development, which was first institutionalized at the 1992 Earth Summit in Rio de Janeiro, has been incarnated as the Sustainable Development Goals (SDGs) and has since become an important subject in modern discourse regarding community development and individual lifestyles.

These two developments have induced two contradictory perspectives on population growth for sustainable development. On the one hand, especially from the environmentalists' perspective, a shrinking population, particularly through reproductive choices, is applauded as a means of conserving natural resources and mollifying environmental degradation (Batchelor, 2019); on the other hand, based upon the present declining fertility rates, demographic studies have shown alarming forecasts of population decline that may prove challenging to rectify (Guillemot *et al*., 2024) and inadvertently hinder broader objectives of sustainable development (Alam *et al*., 2019).

As contentious as the two narratives appear to be, we should not be surprised, given that the concept of sustainable development is a combination of two rather distinctive concepts: sustain and develop. Hickel's (2019) findings show that Goal 8 violates the sustainability objectives of the SDGs, indicating that the SDGs are not without contradictions. As much as this study would like to claim contribution to Goals 3, 8, and 10 for attending to the problem of low fertility, we are aware that, not only may it not be as convincingly compatible with goals that emphasize "harmony with nature" or to protect the planet from degradation (as laid out in Goals 6, 12, 13, 14, and 15), but it could be portrayed as violating Goals 1 and 2, which see population growth as a risk factor for poverty and food insecurity.

Given these paradoxes, we revisited the document that originally institutionalized the principles of sustainable development. We unravel this difficult conundrum from Principle 6 of Chapter II of the ICPD Programme of Action. *Dynamic balance* is an important pointer from the verse: "...requires that the interrelationship between population, resources, the environment, and development should be fully recognized, appropriately managed, and brought into harmonious, dynamic balance" (United Nations, 1994). We learned to see the two paradoxical narratives as the inevitable repercussions that follow when diverse humanity works toward a common cause, tumbling into the cumbersome task of comprehending the constant changes of ecological and human nature, as well as balancing the dynamism of the four interrelated aspects of population, resources, environment, and development. Given this understanding and the empirical evidence of dire population projections, the authors maintain that the present population dynamics support China's pressing concerns with low fertility.

The population dynamics for sustainable development are being confronted with the interconnected problems of low fertility rates and population aging. This is especially true of the challenges faced by today's China. In 2022, China's total fertility rate (TFR) fell to an estimated record low of 1.09 (National Bureau of Statistics of China, 2022), trailing both the "replacement rate" of 2.1 and the "low fertility trap rate" of 1.5 (OECD, 2022). It is a rate that predicts severe underpopulation and exacerbates the process of regaining normal levels of generational replacement. While China's fertility decline has unique drivers rooted in its historical one-child policy, the challenge of low fertility is not unique to China. Globally, countries, such as Japan (1.26), Singapore (1.05), South Korea (0.7), Italy (1.2), and Spain (1.2) are also grappling with declining fertility rates and their consequences for sustainable development (OECD, 2022)

Meanwhile, the country also grapples with a pronounced aging population, with its older population growing dramatically from approximately 130 million (or 10.2% of the total population) in 2000 to nearly 254 million (or 18.1% of the total population) in 2019 (Wang *et al*., 2022). These recent developments are leading to a decrease in its working-age population and diminishing the demographic dividend that the country has had since the 1980s (Meng, 2023), posing significant challenges to China's economic and social developments.

In response to these challenges, the Chinese government changed its family planning policy from a one-child policy

to two- (Central Committee of the Communist Party of China, 2016) and three-child (Central Committee of the Communist Party of China, 2021) policies, allowing couples to have more than one child. However, scholars hold differing views on the effectiveness of this policy. Supporters argue that it will lead to a significant increase in the TFR and slow down population aging (Zhai *et al*., 2014), while other researchers argue against it. The opponents believe that there is more to it than simply relieving the restriction on the permissible number of childbearing, citing factors such as the high cost of raising children and work stability (Yang *et al*., 2023). Indeed, despite the policy's incentives for families to have children, there is a growing social consensus in China that the two-child policy has not achieved the expected increase in TFR.

According to Shreffler *et al.* (2016), two of the several reasons for low fertility rates are medical infertility or a lack of fertility intentions. Unlike couples experiencing medical infertility, who may seek medical support, those with low fertility intentions make their behavioral choices voluntarily (Morgan & Rackin, 2010). Changing their intentions requires effective policy intervention that could address the underlying factors that impact fertility intentions. Therefore, this study recognizes the need for a deeper understanding of the factors influencing couples' intentions to have a second child or additional child, particularly among parents of one child, who are more likely to expand their families as they have not opposed parenthood from the outset. This study sought to uncover factors that may have been overlooked by past research or policymakers and are poised for exploration. It anticipates the emergence of insights into the phenomenon through themes that transcend the overt textual meaning of social media threads. Specifically, this research sought to address the question, "Why do some Chinese individuals choose not to have a second child?" by conducting a reflexive thematic analysis (RTA) of social media threads.

At the individual level, each person's decisions hold the potential to shape a sustainable future. Even seemingly minor choices, when aggregated, can exert a profound societal impact. This underscores the critical role of individual agency in driving sustainable development through personal intentions and behaviors. The insights into the factors behind low fertility intentions provide a crucial foundation for designing family planning policies that align demographic trends with long-term sustainability goals.

1.1. Definition of fertility intention

Fertility intentions – often related to fertility desire, attitude, and behavior – can be examined as quantum intention (*i.e.*, the desired number of children to have) and tempo intention (*i.e.*, when to have them) (Balbo *et al*., 2013). One's discretion in deciding whether to pursue childbirth has been afforded by the widely available, effective methods of contraception, allowing couples to decide when to have children and how many children they desire to have. In this study, fertility intention refers specifically to a person's desire to have a certain number of children, emphasizing quantum intention over tempo intention.

As a component of fertility decision-making, fertility intention is considered a predictor of childbearing behavior (Schoen *et al*., 1999). Ajzen (1991) posits that intention is an important antecedent to the subsequent behavior, thereby ascribes meaning to the intention of fertility. It means that fertility intention is a vital precursor to subsequent fertility behavior and, consequently, the fertility rate. Notwithstanding the extensive discourse challenging the predictive power of fertility intentions on actual behavior (Quesnel-Vallée & Morgan, 2003; Spéder & Kapitány, 2009), a substantial body of empirical evidence demonstrates that fertility intentions function as a reliable predictor of future fertility decisions (Balbo *et al*., 2013; Li & Xu, 2022; Morgan & Taylor, 2006; Schoen *et al*., 1999).

Furthermore, as a factor that influences fertility behavior itself, fertility intention is influenced by various underlying factors. Some of the commonly identified factors include socioeconomics (Li & Xu, 2022), demographics (Jeon *et al*., 2021), and subjective parenting (Peng *et al*., 2023).

According to Zhu *et al.* (2022), the second child's fertility intention can be gauged by the question "Do you intend to have another child?", which can be responded with either "intend," "do not intend," or "uncertain." However, as this article just offers a qualitative exploration of low fertility intentions, it primarily reflects a less definitive and non-categorical inclination of "do not intend." For this reason, we define the low side of fertility intention further. Low fertility intention reflects the lack of desire or weak inclination to have a certain number of children, as in the context of our present work in reflecting China's second child policy; the certain number of children is no more than two. To rephrase it, we define low fertility intention as the varying degrees of reluctance, including outright refusal, to have a second child.

1.2. Review of factors influencing low fertility intentions

Research on fertility intentions has consistently identified multiple factors that shape individuals' decisions regarding family expansion. These factors operate at various levels, including individual (micro), relational (meso), and

societal (macro) levels. Table 1 summarizes the factors found in the literature.

Research on fertility intentions identifies various factors that span economic, educational, psychological, and social domains. Among these, economic insecurity and employment uncertainty have consistently been shown to delay parenthood (Gatta *et al.*, 2022), especially during volatile job markets and economic downturns, as observed in Fiori *et al.* (2018). The COVID-19 pandemic exacerbated these trends, significantly reducing fertility intentions across many populations (Peng *et al.*, 2023). Vignoli and Rinesi (2014) highlight that people's narratives about their futures in uncertain socioeconomic environments lead to hesitancy in family planning.

Economic factors are not only objective but also shaped by subjective perceptions. For example, Chinese parents are concerned about their ability to provide sufficient resources for their children, given the intense social competition, which leads to lower fertility intentions (Xu & Pak, 2021). When families perceive limited resources, they often prioritize the quality of upbringing over the number of children, resulting in smaller family sizes (Becker & Lewis, 1973).

Contradictions exist regarding the relationship between income and fertility intentions. While some research indicates a positive correlation between rising income and fertility intentions (Tian *et al.*, 2017), other studies find that higher incomes are associated with lower fertility intentions as career priorities take precedence (Wang & Luo, 2021). This pattern suggests that lifestyle choices, such as personal freedom, might overshadow economic concerns as income increases.

Educational attainment also plays a significant role in delaying childbearing, as higher education is often linked to career-focused decisions (He & Lin, 2021). However, evidence varies across contexts. Testa (2018) found that in certain countries, higher education levels do not necessarily correlate with fewer children, indicating the need for further research on the educational gradient in fertility intentions.

Work-family conflict is another well-documented factor affecting fertility intentions. Jiang *et al.* (2022) found that the stress and anxiety from balancing work and family life contribute to lower fertility intentions, particularly for women in high-pressure environments. Yang *et al.* (2023) emphasized that women in China's first-tier cities experience significant work demands, reducing their likelihood of having a second child. However, other studies, such as Liu & Hynes (2012), found minimal evidence that work-family conflict directly reduces fertility intentions, suggesting resilience as a potential moderating factor.

Table 1. Factors related to fertility intentions found in literature

Level	Category	Description
Micro	Demographic factors	Reproductive age, possession of certain *hukou*, marital status, and educational attainment.
	Psychological factors	Motivational needs for procreation, life satisfaction, work pressure, envy of other people's second child.
	Interpersonal relationships factors	Marital relationships, the division of household responsibilities, partners' educational pairings, partners' family types (e.g., one-child family), work-family balance, parental support in childcare, parental financial help, and in-law relationships.
	Socioeconomic factors	Personal and household income, housing property, employment status, work stability, job title, impact of childbirth on women's careers, cost of raising children, or childcare.
	Biological and medical factors	Impact of underlying genetic predispositions, biological age factors, physical health, objective and subjective birth experiences, mode of delivery.
	Subjective parenting perceptions	Ideal number of children, sex of the first child, age of the first child, attitude of the first child and parents toward the second child, wishes to continue the family line, social competition of child-raising.
Meso	Community factors	Place-of-residence factors, place-of-occupation.
	Social capital factors	Financial support and supportive social networks.
Macro	Macro socioeconomic factors	Recession, COVID-19 pandemic, fertility costs and benefits.
	Policy factors	Family planning policies, workplace policies, public expenditure, awareness of the universal two-child policy, public medical and pension insurance, and state of supervision of childcare institutions.
	Sociological and ideological factors	Cultural and social values, gender egalitarianism, gender role attitudes, nationalism, and religious belief.
	Environmental factor	Air pollution.

Note: Hukou describes a Chinese household registration system that is passed down from one's parents and can be altered depending on a number of factors, including income, education, and property ownership, which can have an effect on a person's financial situation.

Other factors influencing fertility intentions include marital quality and birth experiences. Research shows that poor marital quality reduces the likelihood of expanding families (Gawrych *et al.*, 2021), while traumatic birth experiences deter future pregnancies

(Preis *et al.*, 2020). Biological factors, including age, miscarriages, and infertility, are also critical determinants of childlessness (Bodin *et al.*, 2021). Delaying parenthood beyond optimal reproductive age, often due to the use of contraception, can result in involuntary childlessness (Gomez *et al.*, 2014).

China's population policies, particularly the one-child policy, have left a long-lasting impact on fertility intentions. Decades of population control measures fostered a preference for smaller families, a trend that continues despite policy relaxations (Zhenzhen *et al.*, 2009). Even recent policies promoting larger families, such as the two-child and three-child policies, have struggled to overcome ingrained social norms and economic barriers (Yang *et al.*, 2023).

Despite extensive research on fertility intentions, gaps remain. Our literature review concluded that three aspects of the present research on fertility intentions in China necessitate improvement. First, contradictory findings across studies highlight the need for a clearer understanding on this subject. Second, our review of socioeconomic and educational factors discovered literature that recognizes the role of lifestyle decisions as mediators in the relationship between socioeconomic or educational factors and fertility intentions. However, there is insufficient understanding about the extent to which lifestyle decisions may be the primary sources of influence, as opposed to being an intermediary process.

Our review found two relevant articles in Riemer and Whelpton's (1955) and Campbell *et al.*'s (2013) studies. Campbell *et al.*'s (2013) suggest that freedom has a greater influence on fertility decline than improved wealth and education, which appears to support the importance of freedom in fertility discourse. However, the focus of this freedom was not on personal values on individual lifestyle decisions, such as prioritizing self-enrichment. Rather, it underscored women's liberation from unwarranted limitations on contraception and safe abortion, perceived as manifestations of patriarchal control. Riemer and Whelpton's (1955) study confirms that couples with children, experiencing a sense of personal freedom restriction or interference, seek fertility control and smaller families. Their research aligns with the theoretical framework, which suggests that individuals who place a higher value on themselves in their value hierarchies and aspire to achieve their full potential may require a degree of personal freedom beyond what childcare can offer. However, due to insufficient research, it remains uncertain to what extent an individual's personal values, such as a preference for personal freedom or a strong emphasis on personal development, may take precedence over socioeconomic or educational reasons in influencing lifestyle decisions for smaller family sizes.

Third, although researchers have employed both qualitative and quantitative research approaches to examine fertility intentions, there is a dearth of research that solely focuses on qualitative approaches to harness social media data. Prior research has primarily focused on physical-world populations, and there is a lack of studies that utilize social media data to examine fertility intentions in China. Social norms could influence research samples obtained from the physical world (Lapinski & Rimal, 2005). In contrast, according to Christopherson (2007), the relative anonymity provided by online platforms can lead to more honest and uninhibited discussions about personal intentions and decisions. Besides, expanding the range of research subjects to include online communities can greatly enhance our understanding of fertility intentions in China.

2. Data and methods

2.1. RTA

This study adopted a philosophical stance that aligned with the interpretivism paradigm, which asserts that social reality is subjective, multiple, and socially constructed (Bevir & Blakely, 2018). This belief prompted the researchers to recognize the importance of understanding social phenomena from the perspectives of the subjects. This philosophy aligns with the qualitative approach that adheres to the rigor of RTA, as outlined by Braun and Clarke (2022). For this reason, we characterize our study as RTA research.

Although this study – a "research into online communities" – could be characterized as *netnography*, we cautiously opted against this classification. Kozinets (2015), a proponent of netnography, advocates for a higher level of engagement with this method. This study acknowledges the inherent polysemic nature of this classification. The term originated from a fusion of the internet and ethnography, with an ethnography approach that relies heavily on participatory observation at its core. Since this study has less engagement than Kozinets (2015) has recommended, we prudently refrained from identifying our research method as netnography.

Furthermore, despite the rudimentary definitional differences between content analysis and thematic analysis (TA), people often understand and use the two terms interchangeably, leading to ambiguity (Humble & Mozelius, 2022). One discernible difference is the plausibility of quantifiable measures by content analysis (*i.e.*, the possibility of reaching a theme based on the frequency of its

occurrence in the text), as opposed to the sheer emphasis on understanding the meaning of the text by Braun and Clarke's TA. Given that this research was designed in such a way that the frequency of textual occurrences would not inform the generation and interpretation of a theme, the TA procedure is justified.

TA is often considered a mere data analysis technique with no analytic philosophy, lack of theoretical underpinnings, inadequately defined procedures, and poorly demarcated from other research approaches (Braun & Clarke, 2006, p. 77, 2019, p. 589). RTA is the result of the revisions to these limitations. RTA's "procedures reflect the values of the qualitative paradigm, centered researcher subjectivity, organic and recursive coding processes, and the importance of deep reflection on and engagement with the data" (Braun & Clarke, 2019, p. 593). After curbing the unduly flexibility nature of TA, RTA, as underpinned within a paradigmatic framework of interpretivism and constructivism, is still afforded some level of flexibility, constrained by four theoretical assumptions identified by Braun and Clarke (2022). These assumptions are conceptualized as a series of continua as follows: essentialist versus constructionist epistemologies; experiential versus critical orientation to data; inductive versus deductive analyses; and semantic versus latent coding of data. This article adopts Byrne's (2022) suggestion that individuals using this approach shall ascertain as to where and why their analysis is situated on each of these continua.

First, this study adopted a constructionist epistemology, with which the researchers recognize the importance of recurring perceptibly information but prioritize meaning and meaningfulness as the primary criteria in the coding process (Byrne, 2022, p. 1395). This is in line with the study's intention of emphasizing the understanding of the meaning of the text and language rather than the frequency of its occurrences. Following this stance, meanings and experiences were interpreted to be socially produced and reproduced through interplay of subjective and intersubjective constructions. This orientation is not only in alignment with the researchers' view of how the reader should interpret the findings but also particularly true in the sense that the respondents' reasons for their low fertility intentions were commented on in an open domain, where these subjective responses were susceptible to the social production and reproduction of meanings and experiences among fellow respondents.

Second, the study adopted an experiential orientation to data interpretation, emphasizing the meaning and meaningfulness as described by the respondents. This is the most appropriate orientation, as the aim of the study was to prioritize respondents' own account of their attitudes and opinions regarding their decision not to have a second child, as opposed to the emphasis on a critical analytical approach that, for example, seeks to uncover biases, inequalities, hidden agendas, or social structural injustice that may have led to their low fertility intentions.

Third, the study adopted a predominantly inductive approach, open-coding the data and emphasizing respondent/data-based meanings over researcher/theory-based ones. We employed a degree of deductive analysis to make sure that open coding produced themes relevant to the research questions and that the meanings emphasized by the respondents and interpreted from the data were also relevant to those questions.

Finally, both semantic and latent coding were adopted. No attempt was undertaken to prioritize semantic coding over latent coding or vice versa. Rather, semantic codes were developed upon the interpretation of meaningful semantic information, whereas latent codes were developed when meaningful latent information was interpreted.

These theoretical assumptions were operationalized through the six-phase analytical process as outlined by Braun and Clarke (2013; 2022): (1) familiarization with the data, (2) coding, (3) generating initial themes, (4) reviewing themes, (5) refining, defining, and naming themes, and (6) writing up. As advised by the methodologies (Braun & Clarke, 2021), the analysis is not a linear process of moving forward through the phases; the researchers move back and forth through the phases as necessary, recursively and iteratively. Braun and Clarke (2013, p. 239) also acknowledge that some of the coding and theme development procedures that have been formalized by numerous well-established qualitative approaches – such as *axial coding* by Straussian's interpretive grounded theory (Strauss & Corbin, 1998) – are in fact similar to that of TA but in a different language. On this basis, and with the methodologists' recommendation for "researchers who prefer more structure to benefit from axial coding" (Braun & Clarke, 2013, p. 241), this study decided to incorporate both the practice and the terminology of axial coding into this six-phase process.

Most importantly, this study subscribed to the principle that the researcher's subjectivity and reflexivity are central to data sense-making, viewing them as an asset rather than a potential threat to knowledge creation (Braun & Clarke, 2019). The reflexivity practices observed by the researchers – through reflexivity journals – include reflecting on the development of themes as well as documenting our values, positionings, choices, and research practices that influenced and shaped the study and the final analysis of the data.

2.2. Data source

"Weibo" is a Chinese common noun for microblog. Due to the popularity of Sina Weibo and the subsequent decommissioning of numerous other Chinese microblogging services (Vic., Tencent Weibo, Sohu Weibo, and NetEase Weibo), it has then been commonly referred to simply as "Weibo." Since then, the common noun "Weibo" has become much like a proper noun that refers specifically to Sina Weibo; ergo, this article has chosen this succinct term to describe this specific microblog site.

The tightly implemented internet censorship has prevented Chinese citizens from accessing alternative social media services, such as Facebook and Twitter, which are accessible to non-Chinese citizens. Besides, in contrast to photo sharing (*e.g.*, Instagram) or short-video hosting (*e.g.*, TikTok) services, Weibo's features, which resemble those of Twitter, offer Chinese netizens a platform to post textual messages that convey personal insights on their topics of interest, especially those on-trend. As a result, Weibo has been the most felicitous choice of data source for our study.

China's most prominent microblogging service, Weibo, has become an essential platform for understanding and analyzing public opinions and social trends within the nation. Since its inception in 2009, Weibo has grown to over 500 million monthly active users (Sina Weibo, 2020), offering a unique window into the collective mindset of Chinese citizens (Millward, 2012). According to Gu (2014, p. 72), Weibo, and social media more broadly, is considered "a bridge of mutual communication" between the government and its citizens, providing a crucial platform for engagement. Similarly, Luo (2014, p. 1306) highlights its role as a go-to space for "gaining insight into the tone of public discussion".

Under the impetus of the platform's rich and accessible source of qualitative data, coupled with its widespread adoption in China, this study found strong evidence that Weibo could offer an invaluable source that enables the capturing of authentic perceptions, opinions, and attitudes toward the nation's family planning policy and the interwoven social phenomena. This motivated this study to explore, through the platform, the factors that contribute to low fertility intentions among Chinese citizens, an undesirable phenomenon despite the country's willful transition from a one-child policy to two- and three-child policies.

2.2.1. Weibo group

Much like Facebook groups, Weibo groups are platforms within the microblogging site that facilitate information exchange on selected topics of interest among members of the group. Among the numerous distinct interest groups are the groups of news media organizations. They are Weibo groups formed by conventional news media to expand their outreach into the digital sphere. The credibility of these groups has been further assured by the verified accounts gained through the stringent organization verification process. These news media groups have been the trusted sources of news and the carefree place for the Chinese to engage in social interactions, evidenced by the 2.4 trillion annual view counts and 6.68 million interaction counts (Sina Weibo, 2020, p. 18). In another similar report, statistics showed that the official Weibo group of these news media outlets had instigated 89% of the country's hotly discussed present affairs (Sina Weibo, 2021, p. 5).

As for the topics surrounding fertility intentions, although news and discourse of plummeting fertility rates are omnipresent across these groups, few have facilitated an open-ended poll that enables their group members to answer fertility intentions questions in their own words, in the comment section below the thread, instead of choosing from a predefined set of options. In this respect, our inquiry revealed that on January 14, 2019, *The Beijing News*'s official Weibo account had raised such a question and invited open-ended responses from its members (The Beijing News, 2019). For this reason, these responses were collected as the dataset for our study.

2.3. Data collection

The discovery of the open-ended poll by The Beijing News's official Weibo account was made through a search of Weibo threads containing keywords, such as "*Bu Sheng Er Tai De Li You*" (Reason for not having a second child), "*Er Tai*" (Second child), "*Er Hai*" (Second baby), "*Sheng Yu*" (Birth), and "*Bu Sheng*" (Childless by choice) over a 5-year time frame from 2019 to 2023. The poll was posted with the hashtag "*#Gei Wo Yi Ge Bu Sheng Er Tai De Li You#*" (Give me a reason for not having a second child). The responses to this question would be the determinants of low fertility intentions, consistent with the study's unit of analysis, that is, Weibo's users who have low fertility intentions. Threads containing only emoticons, punctuation, interjections, or those that mention or talk to other people using "@ username" were excluded from the sample. Similarly, if a person repeatedly posted an identical comment, it was counted only once. Hence, after filtering the invalid, repeated, or incomplete observations, 1023 threads were excluded from the initial retrieval of 1904 threads. A final sample size of 881 responses was included in our analysis. The data obtained included every thread's textual content as well as the respondent's user ID.

In terms of ethical issues, Weibo is regarded as being in the public domain, meaning that the data are freely

accessible to everyone. However, this does not imply that Weibo users have given their consent for researchers to utilize their data (Snee, 2008). Due to the difficulty in requesting informed consent online (Sugiura *et al.*, 2017), no consent forms were sent to the respondents whose threads were extracted. However, this study has taken measures to ensure confidentiality and minimize the potential harm to respondents by not quoting sensitive or identifiable information. The anonymity of all the collected data was maintained throughout the study. Specifically, the usernames of the respondents were removed and replaced with pseudonyms (*e.g.*, Respondent 1, Respondent 2, *etc.*). The data collection process adhered to Weibo's terms of service and was conducted responsibly.

2.4. Analytical framework

Figure 1 shows the analytical framework used in this paper. First of all, the collected data was pre-processed to filter out the ineligible threads. Next, based on the research focus, the data of #Give me a reason for not having a second child# was processed for Chinese word segmentation, and data analysis was carried out using the TA technique. In

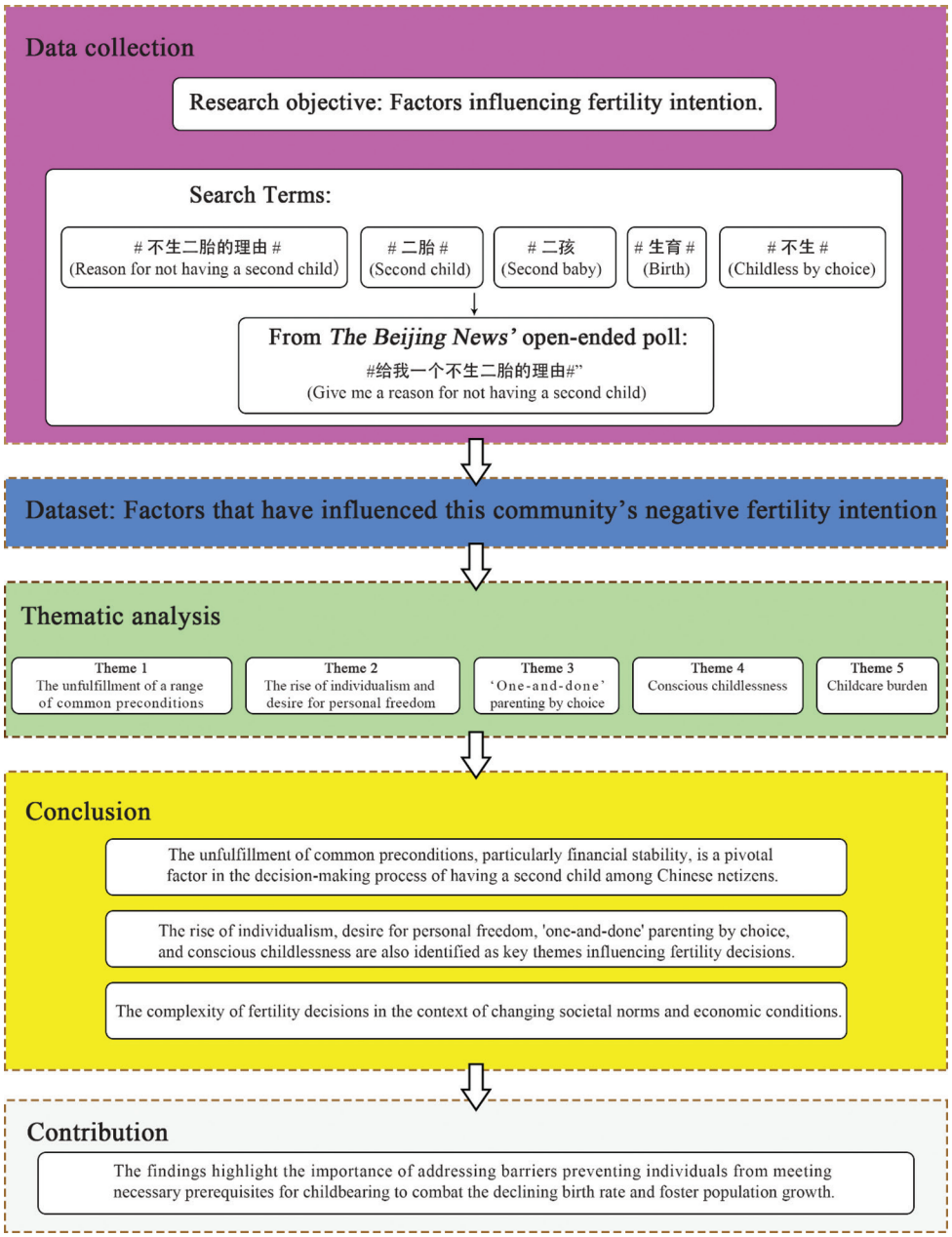

Figure 1. Analytical framework of this study

this way, the influencing factors of low fertility intentions of social media users were obtained, and the conclusions were drawn.

2.5. Coding procedure

The coding procedures were jointly and reflectively performed by two Chinese-speaking authors of the present study throughout the research process where the researchers reflected on own positionality and potential biases to minimize the influence on the interpretation of the data. The process was aided by qualitative data analysis software NVivo 14 to identify themes directly from the data. The two coders started the analysis by working together in the first few coding sessions, looking for themes in the data and juxtaposing the interpretations interactively to enhance the trustworthiness of the analysis. In the initial stages of the coding, content reliability checks were undertaken as two coders coded the same content. Discussions were taken place until an intercoder agreement was reached among the coders. Further reliability checks took place at the time of each new data collection for consistency.

Apart from NVivo, a Word document was used to create a Coding Scheme, which is a table with columns for "Category" and "Description." The coding scheme allowed the coders to be aware of and understand the discovered open codes. The practices of constantly updating the coding scheme were established and continued throughout the analysis process by the two coders, even when they were not working together in real-time. These practices preserved high intercoder agreement and reliability while enabling the coders to work independently on the analysis, which involved the successive development and refinement of codes. The final coding scheme version, shown in Table 2, is the product of these practices. A total of 27 open codes were open-coded and translated into English. These open codes were subjected to axial coding and RTA.

2.6. Development of themes

The development of themes encompasses the four phases of the six-phase analytical process as outlined by Braun and Clarke (2013; 2022), namely, coding, generating themes, reviewing themes, and refining themes. The process began by performing careful line-by-line reading and open-coding of each thread with the aid of qualitative data analysis software Nvivo 14. As presented in Table 2, 27 open codes were developed as a result of the first-layer coding. This process breaks down, examines, compares, conceptualizes, and categorizes the qualitative data (Braun & Clarke, 2013; Strauss & Corbin, 1990). The analysis principle of creating as many open codes as required was upheld to prevent the loss of the subtle differences in meaning as they emerged from the data. Some examples of these open codes included housing unaffordability, longing for freedom, work-family conflict, anti-populational growth, and infertility.

At the second layer of analysis, the open codes were subjected to axial coding. As typically performed in axial coding of qualitative data, the process consists of iterations of comparative analysis and classifications. For instance, we first identified the open codes of "A01: Financial strain" and "A02: Housing unaffordability". Then, by constantly conducting comparisons with other codes from this coding cycle, an axial category of "A: Unfulfilled preconditions" was identified and created. A total of four axial categories were identified from the open codes, namely, unfulfilled preconditions, individualistic value orientations, unconvinced of the traditional view on the benefits of having offspring, and interpersonal conflicts.

While there were found to be 27 open codes and four axial codes from the wide range of responses elicited by The Beijing News's Weibo open-ended poll, only five themes were identified and are presented in this article as the five most compelling parenthood determinants for not having second child among Chinese netizens. Table 3 presents these major themes along with their corresponding thread examples. While a detailed interpretation of all five themes will be provided in the Discussion section, we will justify the development of the two axial themes in this section.

We present these five themes according to order, from most to least prominence. The first and second most predominant themes are two axial-coded categories of *Unfulfilled preconditions* and *Individualistic value orientations*. The *Unfulfilled preconditions* theme emerged from threads along the axial of which the respondents perceived the fulfillment of a range of "preconditions" – ranging from financial strain to genetic dissatisfaction – as constraining their fertility intentions.

A precondition is defined as "something that must happen or exist before it is possible for something else to happen or be done" (Cambridge Dictionary, 2023). During the open coding, we found numerous factors that typically refer to situations where perceived necessary conditions or requirements have not been met. This shared feature among these open codes elicited the development of the axial code. The congruence of these factors under the axial category of unfulfilled preconditions is aligned closely with Chen's (2015) characterization. Respondents of his study referred to the achievement of various contexts when considering the timing of parenthood and desired family size. The contexts included the completion of education, being in secure employment, and having material and social resources for raising children. Chen (2015) categorized these contexts as "*Preconditions*" and described them as

Table 2. Coding scheme

No.	Category	Description
1.	Financial strain	Expressing pressure in meeting the financial obligations for having, raising, and/or nurturing children.
2.	Housing unaffordability	Mentioning challenges in affording the cost of housing services and shelter.
3.	Unmarried	About not yet being married for childbearing.
4.	Insecurity on education	Concerning the cost of education for an additional child.
5.	Medically uninsured	Concerning the costs of medical care for a second child.
6.	Pursuing firstborn	The unfulfilled condition of having a firstborn child before considering having a second.
7.	Genetics dissatisfaction	Expressing dissatisfaction with one's gene, which could be passed down to offspring.
8.	Preference for singlehood	Expressing a preference for being single, unmarried, and consequently having no children.
9.	Hedonism	Prioritizing the pursuit of personal happiness.
10.	Longing for freedom	Expressing a desire for personal liberty and the ability to live a life without constraints or restrictions.
11.	Prioritizing self-care	Prioritizing the pursuit of self-care and personal improvement.
12.	"One-and-done" parenting	Expressing a preference for having only one child.
13.	Voluntary childlessness	Expressing a preference for having no children.
14.	Burden of childcare	Concerning the responsibilities, challenges, and demands associated with raising and caring for children.
15.	Policy-induced reasons	Attributing low fertility intentions to government policies or regulations.
16.	Unconvinced that children will become elderly caregivers	Being suspicious of one of the traditional Chinese views on childrearing that is children who have been raised will look after their parents in their old age.
17.	Unconvinced of healthy sibling relationships	Doubting the benefits of getting a sibling for the child. Having doubts that multiple children will promote positive sibling relationships and support one another for the rest of their lives.
18.	Traumatic experiences about pregnancy and childbirth	Women are expressing the unpleasant experiences they had during their pregnancies and (difficult) labors, as the reason for avoiding going through the same ordeal with another childbirth.
19.	Reason about spousal relationship	Attributing the rejection or postponement of having another child to the status of a spousal relationship or to preserving a happy marriage.
20.	Reason about in-laws' relationship	Attributing the rejection or postponement of having another child to the status of relationship with the in-laws, especially parents-in-law.
21.	Work-family conflicts	Concerning the issues of work-family balance. Refers to the challenges, tensions, and struggle to balance one's responsibilities and commitments in both work and family life.
22.	Pressure to care for the elderly	Expressing stressors or burdens associated with providing care for the elderly, including but not limited to physical, emotional, financial, and temporal pressures.
23.	Anti-population growth	Refers to ideas or efforts aimed at reducing or controlling the growth of the human population.
24.	Workplace discrimination	Expressing concern about possible workplace prejudice over pregnancy and childcaring.
25.	Homosexual	Homosexuality prevents the respondent from having children.
26.	Involuntary childlessness	Mentioning the inability to conceive a child or carry a pregnancy to full term.
27.	Unrelated threads	Threads unrelated to parenthood determinants.

a notion that was constructed and subscribed by some of his respondents as being an ideal context for having children. The notion of preconditions is well-known in the literature on fertility decisions and has always been used as an umbrella term to encompass factors that influence reproductive and parenthood readiness (Bodin *et al*., 2021; Boivin *et al*., 2018; Hviid Malling *et al*., 2022).

The *Individualistic values orientation* theme emerged from threads along the axial of which the respondents expressed strong emphasis on individuality, which is often associated with the belief in personal freedom. Four sub-themes were identified under this axial category, which included having a preference for being single, seeking personal gratification and enjoyment, longing for freedom, and prioritizing self-care.

Individualistic values orientation, as with its broader philosophical concept of *Individualism* defined by Hofstede (2010), refers to a cultural or social orientation that places a high value on individual goals, achievements, rights, freedom, and autonomy. Societies with an individualistic orientation place typically more emphasis on self-expression (Markus & Kitayama, 1991), individual success (Hofstede,

Table 3. Major themes of low fertility intentions emerged from open and axial coding of Weibo threads

Example of threads	Open coding	Axial coding
I can't afford to raise more children.	A01: Financial strain	**A: Unmet preconditions**
Don't have a child and put them through suffering. Even though I started to consider having a second child, the cost of housing discouraged me, forget it.	A02: Housing unaffordability	
I want to have two children, a son, and a daughter. The problem is I'm still looking for my Mr. Right.	A03: Being unmarried	
Giving birth is straightforward, but raising and nurturing a child is not, you need to be rich, educated and even good at handicrafts… the true misery will begin once the school year begins because as the school begins to reduce the childcaring burden, the family burden increases.	A04: Insecurity in education	
It's difficult to get medical treatment.	A05: Medically uninsured	
There is no trace of the first child, let alone the second child.	A06: Pursuing firstborn	
I feel like my genes are not so good that I must have a child to inherit them.	A07: Genetic dissatisfaction	
Why say goodbye to being single?? Being single is happy, thus remaining single can always be happy.	B01: Preference for singlehood	**B: Individualistic values orientation**
Haven't played enough games, or read enough novels, movies, and gossip. Still, I'd like to travel and see the scenery around the world.	B02: Hedonism	
When I'm single, I never expect anyone to come to see me. I'm free and at ease. But if I had a child, he would grow up and go off to live his own life, leaving me back alone but still hoping he would return to see me. Once you've a child, you'll be lingering with worry, you can no longer be carefree or unrestrained. If this is the case for having one child, why suffer twice?	B03: Longing for freedom	
Wanted to be beautiful, to be hot, to be in good shape! In addition, you must work on your personal development.	B04: Prioritizing self-improvement	
Fewer births, better births, and happier lives.	**C: "One-and-done" parenting**	
Forget about the second child, I've no intention of even one child.	**D: Voluntary childlessness**	
I'm going insane just to tutor my only child with homework.	**E: Burden of childcare**	

Note: The major themes of this study are denoted by bold terms.

2001), hedonism (Schwartz, 1994), personal freedom (Sampson, 1977), and personal autonomy (Kagitcibasi, 2005). This concept is often contrasted with collectivism which focuses on group harmony (Hui & Triandis, 1986), cooperation (Sinha & Verma, 1987), and shared goals (Triandis, 1994). Through the lens of Hofstede's (2001) interpretation of individualism, our analysis was able to identify factors that resembled individualistic values. These factors fit within the axial code of *Individualistic values orientation*.

The third to fifth themes were open codes that were found to constitute themes that justified their reporting in this study – *"One-and-done" parenting*, *conscious childlessness*, and the *burden of childcare*.

3. Results

The RTA identified five primary themes explaining Weibo's users' reluctance to have a second child among Weibo users. These themes illuminate the factors contributing to Chinese netizens' low fertility intentions. While the analysis underscores key drivers shaping fertility preferences, it was observed that individuals were nearly evenly divided in their intentions, with approximately half expressing a preference to have only one child and the other half indicating a desire to rather remain childless. This qualitative insight complements the thematic findings by providing an estimation of family compositions reflective of these fertility intentions. Together, these results offer a nuanced understanding of China's declining fertility trends.

3.1. Unmet preconditions significantly determine low fertility intentions

The analysis showed that *Unmet preconditions* were the main factor that led to low second-child fertility intentions. Most respondents cited this as a key barrier to having a second child, believing that completing certain preconditions is the mandatory step before having a second child. When respondents were asked about their reason for not having a second child, they referred to a range of preconditions they felt were necessary before they could start planning and

conceiving. The respondents saw fertility intentions for higher parity births as being constrained by the fulfillment of a range of preconditions, including financial stability, housing affordability, a stable relationship or marriage, the social and material means to provide medical care and education, having the first child, and having a good gene to pass on. These constraints were demonstrated by the emergence of several sub-factors within this theme, each of which underscored different conditions, expectations, and concerns.

Among the sub-factors, the main unmet precondition was financial conditions. The majority (83.7%) of the threads on this theme cited financial instability as the major impediment. Material circumstances were seen by respondents as a critical benchmark to achieve before having another child. This is demonstrated by the following quotes:

Respondent 1:
"I'm telling you, I won't be having another because I can't afford it."

Respondent 2:
"It's mainly a financial issue. If I have surpluses, I can have as many children as I want."

Respondents 1 and 2 highlighted concerns about not being financially secure enough to have a larger family size. Respondent 2 acknowledged in his account that he could have had more children if he had been more comfortable with his finances.

Respondent 3:
"I'm poor enough as it is, why should I force myself and two kids to suffer together?"

The remark made by Respondent 3 emphasized the perceived irresponsibility of having a second child during a period of financial difficulties. Respondent 3 was expressing a fear of the potential struggles their kids would face had she given birth to a second child. The remark implies a contemplation of the ethical and practical aspects of fertility intentions, weighing the responsibility to provide a better life against the harsh realities of her financial condition.

Our analysis also found that this sub-factor does reflect the sentiment that financial stability is not merely about affording the cost of raising children but also about maintaining a decent quality of life or aspiring for a certain lifestyle for the family through financial means, as demonstrated by the following thread by Respondent 4:

Respondent 4:
"I will consider having a child only when I have the same financial ability as the bosses, who manage to send their children abroad."

The remainder of this section will outline some other ancillary preconditions mentioned by the respondents. Housing unaffordability had emerged under this theme, for which, the respondents gave accounts of the housing-related concerns:

Respondent 5:
"It's mainly because the house is too expensive, the kid's meals money has gone to the housing……"

Respondent 5 exemplified the concerns on the practical issue of housing and living environment that some of the respondents consider appropriate and a prerequisite for raising their children. Based on his account, the formation of fertility intentions cannot be examined in isolation from the affordability of housing, and one's difficulty with this is constraining his desire for a second child.

Respondent 6:
"Why? If I get married, I intend to have a second child."

Being unmarried also featured in respondents' accounts of unmet preconditions when responding to the reason for low fertility intentions. Respondent 6 referred to her unmarried status as the reason that had been preventing her from intending to have any children, let alone a second child. The antecedents to this factor may vary from involuntary singlehood – for which one's fertility intention may be constrained by the absence of a childbearing partner – to voluntary singlehood – for which one's fertility intention may be constrained by social norms surrounding non-marital childbearing. Although this study acknowledged these antecedent distinctions between voluntary and involuntary singlehood, it did not seclude them from the data. Refusal to discern these differences did not invalidate *Being unmarried* being the factor for low fertility intentions, as emerged from our data.

Overall, the respondent's accounts on *Unmet preconditions* suggest that they were keen to appear to have planned and thought through – having various preconditions in place – before having a second child. And that the discourse of 'not meeting these preconditions', a subscription to the perceived constraint of parenthood, was cited by respondents in accounting for their low fertility intentions for a second child.

3.2. Individualistic values orientation limits family size

Our analysis revealed that when asked about their reasons for not having a second child, the respondents placed a significant emphasis on individuality. The theme of *Individualistic values orientation* emerged from sub-

themes of having a preference for being single, seeking personal gratification and enjoyment, longing for freedom, and prioritizing self-care. This theme was based on the philosophical concept of *Individualism* defined by Hofstede (2010), which was explained in more detail in section 2.6 (Development of themes).

Although not ranked as the most important in the Weibo poll, the desire to prioritize oneself was frequently cited as a fundamental constraint on family size, particularly limits beyond having one child. The most pronounced sub-factor within this theme is the preference for singlehood. Respondents 7 and 8 provide two stronger examples of how their preference for singlehood is influencing their fertility intentions:

> *Respondent 7:*
> *"I don't even want to have one child, let alone get married...and now you're asking me about a second child."*
>
> *Respondent 8:*
> *"Being single is so good."*

Respondent 7 explicitly expressed a preference for remaining single, highlighting a deliberate choice against traditional life milestones of marriage and parenthood. His statement reflects a personal lifestyle decision that deviates from societal expectations of forming a family unit, encompassing both the rejection of marital life and the idea of having offspring, including the possibility of a second child.

Both statements underscore a deep-rooted inclination toward singlehood and an aversion to the commitments of marriage and childrearing. They highlighted the growing societal trend toward valuing personal autonomy over traditional family structures. It further highlighted the conscious decision to prioritize individualistic values that are always rooted in singlehood, showing a shift in societal values in which individual lifestyle, personal development, and freedom are increasingly valued over adhering to conventional familial roles.

Hedonism stands out as another notable sub-factor. The following statement aptly illustrates this viewpoint:

> *Respondent 9:*
> *"I haven't had enough time to play games, read novels, watch movies and TV, gossip. I still want to travel and see the world in the future."*

Respondent 9's comment reflected a hedonistic perspective, prioritizing personal enjoyment and the pursuit of pleasure. Respondent 9 expresses a desire to continue engaging in leisure activities, such as playing games, reading novels, watching movies and TV, indulging in gossip, and aspiring to travel and see the world, suggesting a significant value placed on these sources of pleasures and experiences, aligning with the principles of hedonism. This lifestyle choice underscores a preference for immediate gratification and the enjoyment of life's pleasures over traditional responsibilities or societal expectations, such as starting a family or raising a child.

Besides, another discourse the respondents used in accounting for their preference for no second child was an appeal for personal freedom. Respondent 10's account makes the strongest reference to this sub-factor:

Respondent 10:

> *"When I'm alone, I never long for someone to visit me; I relish my freedom. But after having a child, and now that he's grown and left to create his world, I find myself alone again, yearning for his return, longing for a visit. Having a child means having worries; the carefree life is no more. Raising one child is challenging enough; I see no reason to endure twice the hardship."*

Respondent 10 expressed contentment with solitude and freedom, revealing a preference for an unencumbered, autonomous lifestyle. In addition, their reluctance to take on the increased worries and responsibilities of raising more children reflects an individualistic values orientation, highlighting a prioritization of personal independence over societal or familial expectations.

Along the same vein, the respondents' reason for not having a second child showed their focus on self-improvement, which was in line with their individualistic values orientation. The account below reflects this perspective:

> *Respondent 11:*
> *"Be beautiful, be sexy, have a great figure, and always strive for self-improvement!"*

Respondent 11's emphatic declaration of prioritizing beauty, sexiness, maintaining a desirable figure, and continual self-improvement highlighted a strong focus on personal growth. This stance resonates with the factor of *Individualistic values orientation*, as it underscores a commitment to self-focused goals and personal aspirations over conventional societal roles, such as parenthood.

Overall, the respondents' accounts suggest that they were keen to orient themselves with individualistic values by valuing their lifestyles, pursuing pleasure, personal freedom, and personal development instead of adhering to conventional familial expectations. These values shaped their low fertility intentions for a second child.

3.3. "One-and-done" parenting by choice

Our analysis showed that there was a conscious decision to limit family size to one child, often referred to as "one-and-done" parenting. This theme suggests a deliberate intention to channel resources, attention, and love toward a single offspring.

One of the most prevalent reasons within this theme is not only the desire to maintain a certain lifestyle but also the belief that nurturing a single, well-raised child is more valuable than having multiple children without the same focus on quality. The sentiment is best encapsulated by the following statement:

> *Respondent 12:*
> *"The simplest point is, that my life isn't just about raising children. Having one child has already brought me fulfillment. I focus on quality, not quantity."*

Respondent 12's account reflected a quality-over-quantity approach, where the emphasis is on providing the best possible upbringing for a single child. This perspective aligns with maintaining personal life satisfaction and ensuring focused parental attention and resources for one child, rather than dividing these among several children.

Another key aspect of this theme is the concern over potential favoritism or inequality between siblings. The following quote perfectly captures this perspective:

> *Respondent 13:*
> *"I don't want to have a second child because I think if I have a second child, it will take away a lot of love that belongs to my daughter. And I'm afraid that if I like one of the children more, what should I do? How unfair it is for the other one."*

Respondent 13 expressed concern about the fairness and emotional division that might arise from having a second child, indicating a preference for focused and equitable parenting.

This theme underscores how the decision to have a second child transcends mere financial or practical considerations and is rooted in a belief and preference for certain family dynamics and child upbringing.

3.4. A conscious choice to remain childless

Our analysis identified a distinct theme of *Voluntary childlessness* among respondents with low fertility intentions. These respondents displayed a clear inclination and agency to remain childless. One respondent articulated a clear preference for marriage without the extension into parenthood, stating:

> *Respondent 14:*
> *"I just want to get married; I don't want to have children. With that money, I can make my wife and parents happy."*

This perspective underscores a deliberate choice to allocate financial resources toward the well-being of existing family members rather than to childrearing.

> *Respondent 15:*
> *"The world is neither very bad nor very good, so there is no particular desire to continue the bloodline."*

Furthermore, Respondent 15 expressed his disinterest in perpetuating his family name and bloodline in a world that failed to excite him. This sentiment reflects a thoughtful consideration of the global context and personal beliefs influencing his fertility intention. The lack of a strong impetus to continue his lineage suggests a nuanced understanding of his choice in procreation.

These accounts highlight *Voluntary childlessness* as a deliberate and reasoned choice, informed by personal priorities, financial considerations, and a broader understanding of the world. Respondents exhibited a clear awareness of their decisions' implications, illustrating that their childlessness is not a byproduct of indecision or external factors, but a conscious lifestyle choice. Moreover, this theme underscores a societal shift in attitudes toward childbearing, no longer viewing it as an obligation but rather as a personal choice shaped by personal values and circumstances.

3.5. Childcare burden leaving little room for additional family expansion

Our research identified a pervasive theme of *Childcare burden* among respondents with low fertility intentions. Respondent 16 encapsulated the drastic lifestyle changes post-parenthood, stating:

> *Respondent 16:*
> *"I haven't seen a movie or slept through the night in 2 years since having my first child."*

This experience highlights the significant impact of childcare on personal leisure and rest, marking a profound shift in daily life priorities and activities. Another respondent detailed the challenges of limited familial support in raising their child, sharing:

> *Respondent 17:*
> *"I've just had one child, and with only my mother's help and no support from my in-laws, it's been so tough. Raising just one has drained all my energy. For the rest of my life, I just want to love my daughter well."*

This narrative underscores the intensive nature of childcare, especially in the absence of a broader support network, and its consequent effect on personal well-being and future family planning. The weight of childcare became even more pronounced without the support of extended family. Respondent 17 vividly illustrated the exhaustion. Such expressions bring to light the sheer magnitude of the task, especially when raising even a single child feels daunting.

Further reinforcing this theme, Respondent 18 described their post-work routine as entirely consumed by childcare responsibilities:

> *Respondent 18:*
> *"After work, I have to look after the child. I also have to manage everything for the child, and I genuinely don't have the energy for a second child."*

This account illustrates the exhaustive nature of balancing a career with the demands of parenting, leaving little room for adding another child to their family.

Overall, these accounts collectively highlight the *Childcare burden* as a significant factor in respondents' decisions against having more children. The narratives reveal a common thread of profound physical and emotional exhaustion, coupled with a drastic reduction in personal time and freedom. Respondents expressed a consistent theme of the overwhelming nature of childcare, shaping their perspectives and decisions regarding expanding their families. This theme underscores the reality of parenting as an all-encompassing, life-altering commitment, influencing individuals' fertility intentions, and family planning.

4. Discussion

This study suggests that there are two key factors driving low fertility intentions among Chinese netizens: Objective and subjective unmet preconditions, as well as individualistic value orientation. These factors are critical in understanding contemporary fertility behaviors and provide important insights for the development of family planning policies that can ensure long-term demographic sustainability. In addition, the study reveals additional complexities in fertility choices, including one-and-done parenting, the conscious decision to remain childless, and the burden of childcare, which are intricately linked to the overarching themes of unmet preconditions and individualistic values orientation.

4.1. Addressing the perceived unmet preconditions: The role of policy in alleviating economic and social-psychological barriers to family expansion

Our findings show that both objective unmet preconditions – such as financial instability, housing unaffordability, and limited access to childcare – and subjective perceptions of these conditions critically shape fertility intentions. For instance, several studies, such as those by Cai (2010), and Brauner-Otto and Geist (2018), have emphasized the need to consider both financial and social preconditions when evaluating childbearing decisions. Respondents in our study frequently cited their inability to secure affordable housing, the high cost of education, and the overall financial burden of raising children as significant reasons for delaying or foregoing family expansion.

What is especially striking is how subjective aspects of unmet preconditions – such as the perceived irresponsibility of having a second child during a period of financial instability and societal pressure to meet intensive parenting standards – compound the objective barriers. Many respondents felt that, despite having access to certain economic resources, the expectations surrounding parenting quality and the need to provide the "best" for their children made them reluctant to expand their families. This aligns with Chen's (2015) research, which suggests that preconditions for childbearing are often set higher due to cultural and societal pressures. In our study, respondents frequently expressed concerns that having more than one child would compromise the quality of care and attention they could provide, a sentiment that mirrors conclusions drawn by demographic scholars such as Berrington (2004), Testa (2012), Ajzen and Klobas (2013) argue that subjective perceptions of resource adequacy, financial readiness, parenting standard, and the ability to provide quality care often lead parents to limit family size. Moreover, echoed by McDonald (2008) and Matysiak *et al.* (2021) findings, even those who met traditional markers of economic stability often expressed feelings of financial insecurity and uncertainty about their ability to provide a stable environment for additional children.

The comments that pertain to the theme of one-and-done parenting by choice also mirrored this subjective perception of unmet preconditions. The finding aligns with the growing trend of "one-and-done" parenting by choice that has been observed in other developed nations, where parents opt to invest heavily in a single child to ensure their success, rather than spreading their resources across multiple children (Balbo *et al.*, 2013).

Policymakers must recognize that addressing unmet preconditions for family expansion requires a multifaceted approach that goes beyond financial incentives. While economic support is undeniably important, it alone cannot resolve the underlying challenges. Social-psychological barriers – including parental expectations, perceived readiness, and societal pressures to meet idealized standards of parenting – play a significant role

in shaping fertility intentions. To the best of this study's understanding, there has been no substantial policy efforts precisely aimed at mitigating these social-psychological barriers. A more holistic strategy is essential, integrating economic, social, and psychological interventions to create an environment where family expansion is both feasible and most imperatively, desirable.

While not explicitly designed as social-psychological interventions, pro-natalist policies in some countries have increasingly emphasized enabling better reconciliation between work and family life (Duvander *et al*., 2010; OECD, 2023). This approach represents a significant departure from materialistic handouts, signaling a shift from superficial, quick-fix measures toward enduring, root-cause solutions. Although critiques may hastily judge the effectiveness of such policies based on year-to-year fluctuations in fertility rates (Dulaney, 2024, October 15; UNFPA, 2019), this study asserts that addressing the underlying issues requires time for sustainable impacts to manifest. A focus on long-term strategies rather than short-term results holds greater promise for fostering lasting change. Moreover, as expounded by Tan (2023, p. 1), "although previous research suggests that pro-natalist policies may only have a modest effect on fertility," positive public perceptions toward work-life policies in Singapore "raise further questions as to whether fertility may decline even further in the absence of these policies."

China can draw valuable lessons from these examples. Sweden's comprehensive family support system and Singapore's pro-natalist policies demonstrate efforts to alleviate both financial and childcare burdens (Tan, 2023; Thévenon, 2011; United Nations, 2015). Similarly, Norway and Sweden provide subsidized childcare, parental leave, and flexible work arrangements that significantly reduce the stress of balancing work and family life (Duvander *et al*., 2010). More importantly, family policies must address non-material factors that influence fertility decisions, such as work-life balance, gender equality, and shared caregiving responsibilities. Countries, such as Denmark and Norway exemplify this approach, introducing measures that alleviate financial strain while reducing the childrearing burdens on parents. Flexible working hours, remote work options, and gender-balanced parental leave have created an environment where career advancement and family growth are viewed as compatible goals (Duvander *et al*., 2010; Oláh *et al*., 2018). Such policies acknowledge that fertility decisions are influenced by a broader range of considerations beyond material resources.

Respondents of this study reported significant struggles in balancing work responsibilities with the emotional demands of childcare, a challenge that deterred many from considering family expansion. This underscores the pressing need for childcare policies that go beyond reducing financial burdens to address the emotional guilt associated with inadequate childcare support. Beyond implementing of affordable childcare system, policymakers must be cognizant and supportive of innovative solutions that could ease both the logistical and emotional challenges of parenting. Such measures include promoting workplace flexibility, facilitating remote work options (Goldscheider *et al*., 2015; Kossek & Thompson, 2016), and establishing workplace childcare facilities (Hegewisch & Gornick, 2011; Kossek *et al*., 2011), which together can substantially improve parents' ability to reconcile work and family responsibilities. Furthermore, regarding social-psychological interventions, this study emphasizes the need for further research to develop well-informed policy recommendations in this area.

The effectiveness of family policies hinges on the steadfast commitment of policymakers to navigate the intricate balance between economic growth and societal well-being. Analogous to other competitive urban societies, China's "rat race" culture – characterized by an unrelenting focus on the pursuit of GDP maximization – often overshadows essential social welfare priorities, including personal well-being, work-life balance, and spiritual satisfaction (Wang & Wang, 2021; Zhang *et al*., 2024). This cultural phenomenon must be seen as the most significant stumbling block to the success of well-intentioned family policies, as it perpetuates an environment where structural pressures and individual anxieties undermine the feasibility of family expansion (Lu, 2023, December 18; Zhou, 2022). To achieve meaningful outcomes, policymakers must balance economic objectives with holistic strategies that prioritize human-centric development and address the root causes of fertility decline.

4.2. Acknowledging the influence of individualistic values orientation on fertility decisions: Reconciling individual autonomy with family planning

The influence of individualistic values orientation on fertility decisions emerged as a critical theme in this study, reflecting the growing challenge of reconciling personal autonomy with traditional expectations of family life. The respondents' accounts suggest that they were keen to orient themselves with individualistic values by valuing their lifestyles, pursuing pleasure, personal freedom, and personal development instead of adhering to conventional familial expectations. This aligned with the characteristics of individualistic values orientation including hedonism (Schwartz, 1994), personal freedom (Sampson, 1977), and personal autonomy (Kagitcibasi, 2005). In addition, respondents, particularly women, are increasingly

prioritizing self-fulfillment, career progression, and personal goals over societal norms related to marriage and childbearing. This aligned with the concept of individualism defined by Hofstede (2010), where individualistic values including individual freedom, autonomy, achievement, and goals are highly prioritized by respondents rather than the collectivism values that hope for family expansion. The shift from collectivism values toward individualistic values often leads to low fertility intentions for a second child and limited family size as individuals navigate the tension between their personal aspirations and broader social expectations (Lesthaeghe, 2010). Yan's (2010) findings on the increasing trend of individualism in Chinese society align with these conclusions, where personal autonomy and self-actualization are prioritized over family expansion.

From a sociological perspective, these dynamics highlight the phenomenon of societal and cultural lag, where the rapid pace of urbanization and globalization outstrips the evolution of societal norms. In China, as in other rapidly urbanizing societies, traditional expectations for family expansion lag behind rising trends of individualism and self-actualization (Bachrach & Morgan, 2013). This misalignment creates friction, particularly for those choosing to delay or forego childbearing altogether, underscoring the need for policies that can reconcile personal autonomy with societal goals for sustainable fertility.

There is a noticeable trace of individualistic values orientation in the theme of conscious choice to remain childless. This decision, rooted in a desire for personal fulfillment and the belief that parenthood would restrict their professional and lifestyle ambitions, exemplifies the broader trend toward individualization described by Kim (1995) and Hofstede (2001). The increasing focus on self-fulfillment redefines family structures and emphasizes the need for fertility policies that respect and accommodate these lifestyle choices.

For policymakers, the challenge lies in designing family planning policies that integrate individual autonomy with the goals of family growth. Traditional pro-natalist policies that emphasize financial incentives alone are unlikely to sway individuals motivated by individualistic values. Instead, policies must promote work-life balance, flexibility, and career progression, allowing individuals to view parenthood as compatible with their personal aspirations rather than an obstacle to self-fulfillment. This approach is strongly supported by the global trend of family-friendly policies that aim to enable individuals to integrate parenthood with their personal ambitions – such as fostering gender equality, flexible work arrangements, and career development opportunities. These policies are designed to enable individuals to balance career aspirations with parenthood without perceiving family life as an obstacle to personal fulfillment. Research consistently shows that when individuals feel supported in their dual roles as professionals and parents, they are more likely to view parenthood as compatible with their personal ambitions (Thévenon, 2011). These policies do more than just incentivize family growth; they create an environment where individuals can thrive both personally and professionally, proving that autonomy and family expansion can coexist (Goldscheider *et al*., 2015).

Moreover, the tension between personal freedom and societal expectations to marry and have children reinforces the need for cultural shifts alongside policy changes (Neyer & Hoem, 2008). Many respondents, particularly women, reported feeling that parenthood would limit their opportunities for self-actualization. Addressing this requires not only policy initiatives that support career development and family planning but also cultural campaigns that promote the idea that parenthood and personal fulfillment can coexist. By fostering a societal mindset where family and career are seen as complementary rather than conflicting, policymakers can reconcile individualistic values with family growth, encouraging sustainable fertility.

Furthermore, the study underscores the importance of reducing the childcare burden, which many respondents identified as a key barrier to expanding their families. Spreading between individualistic desires and the demands of childcare left many respondents feeling they had little room to consider having additional children. Expanding affordable, high-quality childcare services and encouraging shared caregiving responsibilities between parents would significantly alleviate this burden, allowing individuals to pursue both personal fulfillment and family expansion (McDonald, 2008).

4.3. Limitations

The present study and its results have limitations. First, respondents were self-selecting. The individuals who chose to publicly discuss their fertility intentions on Weibo might be systematically different from those who did not. This can potentially introduce self-selection bias into this study. Second, we acknowledge that using Weibo as the sole source for data collection may introduce a bias, as individuals who actively post on the platform might have stronger opinions or be more engaged with the issue compared to the general population. This could result the lack of sample diversity. However, it is important to note that the findings are framed within the Weibo-using population, rather than generalizable to the entire population of China. While the

sample may not represent the entire population, the candid and diverse perspectives captured on Weibo offer valuable insights and serve as a foundation for future research on this important topic. Third, this study relies solely on qualitative data from Weibo and may raise triangulation issues. We recognize that triangulating these findings with additional sources (such as quantitative surveys or in-depth interviews) would offer a broader perspective and further validate the findings. However, this study is exploratory research and aims to capture candid and real-time expressions of fertility intentions from the Weibo population. Therefore, we propose that future research could incorporate mixed methods to enhance the depth and generalizability of the results. Fourth, the interpretation of the content may not be completely in line with the true meaning of the respondent. It relies only on the authors' interpretation when coding these threads, which can sometimes be subjective, inconsistent, or inaccurate. Fin ally, the study did not capture potential gender differences, which could have revealed gender-specific factors affecting the decision to have a second child.

5. Conclusion

This study makes three significant contributions to the existing literature on fertility intentions in China, namely: (1) clarifying inconsistent findings on fertility intentions; (2) advancing the understanding of lifestyle values as drivers of fertility decisions; and (3) integrating social media data for qualitative fertility research.

In response to the dearth of studies utilizing qualitative approaches with social media data, this research leverages online discussions to explore fertility intentions. Social media provides a unique avenue for capturing candid and uninhibited expressions of personal choices and values, less constrained by societal norms than those derived from traditional, physical-world populations. This methodological innovation broadens the scope of research subjects and enhances the literature of fertility research. Coombs *et al.*'s (2024) study, which examined public perspectives on drug use among the homeless population through TA of Twitter data, exemplifies the potential of social media data to uncover nuanced public attitudes.

Moreover, while prior research has acknowledged the role of lifestyle decisions as mediators between socioeconomic or educational factors and fertility intentions, this study foregrounds lifestyle values as primary influences on fertility choices. The research challenges conventional perspectives by emphasizing the growing importance of individualism and lifestyle values – such as the pursuit of personal freedom, career advancement, and self-fulfillment – as key drivers of low fertility intentions. By demonstrating how these values may supersede the traditionally dominant influences of socioeconomic and educational factors, this research offers fresh insights into the role of individualism in family planning and introduces a novel framework for understanding fertility intentions in rapidly urbanizing societies.

In addition, this study categorizes unmet financial and psychological preconditions as critical barriers to family expansion. By addressing how subjective perceptions interact with objective constraints, the research provides a nuanced contribution to the discourse on fertility barriers, enhancing our understanding of the challenges faced by families considering additional children.

The findings underscore the urgent need for family planning policies that align with evolving lifestyle values while fostering a supportive environment for family growth. Comprehensive measures, including flexible work arrangements, affordable childcare, and housing support, are essential. Furthermore, policymakers must address societal pressures and prioritize the psychological well-being of parents to balance personal autonomy with family aspirations. Such policies can effectively promote sustainable population growth while respecting individual goals and accommodating the shifting values of modern Chinese society.

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The authors declare they have no competing interests.

Author contributions

Conceptualization: Haoran Chen, Harn Shian Boo
Data curation: Haoran Chen
Formal analysis: Haoran Chen, Kuang Yee Teng
Investigation: Haoran Chen
Methodology: Haoran Chen, Kuang Yee Teng
Supervision: Harn Shian Boo
Writing – original draft: Haoran Chen, Kuang Yee Teng
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ACCSCIENCE PUBLISHING

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RESEARCH ARTICLE

Factors influencing male fertility in Uganda

Henry Nsobya*, Elizabeth Nansubuga, and Cyprian Misinde

Department of Population Studies, College of Business Management Sciences, Makerere University, Kampala, Uganda

Abstract

Male fertility is an important component of population research. Against this backdrop, this paper aims to examine the factors explaining male fertility changes in Uganda. The authors applied the own-children method, as described by Schoumaker, to understand the prevailing male total fertility rate trends and to select datasets for inclusion during the multivariate analysis, using the Uganda demographic health surveys conducted from 2006 to 2016. A multivariable Poisson decomposition regression model was used to examine factors associated with male fertility changes. This model analyzed data from the 2006 and 2016 surveys only and included a total sample size of 7839 male respondents. The outcome variable for the regression model was children ever born (CEB). The regression model showed that differences related to changes in the proportional composition of characteristics contributed 113% to the change in CEB, compared with the differences due to reproductive behavior, with other factors being kept constant. The most important proportional changes that led to meaningful variability in CEB were observed among the following characteristics: occupation, number of current wives, total number of lifetime partners, type of residence, education, and age at first childbirth. Thus, interventions to delay the formation of cohabitation and marriage unions and the onset of childbirth or fatherhood among adolescents and young men below the age of 25 should be prioritized as potent fertility regulation measures. In addition, the focus on eliminating the lack of education and primary education as the highest levels attained among boys and men should be prioritized to boost a rapid male fertility transition in Uganda.

Keywords: Male fertility; Fertility; Uganda

***Corresponding author:**
Henry Nsobya
(meal@busogahealthforum.org)

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1. Introduction

As the global population continues to grow, it is projected that sub-Saharan African countries are projected to contribute the lion's share of the future increase by 2050 and 2100 (United Nations Department of Economic and Social Affairs, 2022). Importantly, population growth in low-income countries is expected to rise majorly due to heightened births exceeding deaths, as an outcome of the momentum of past high fertility trends, currently entrenched in the prevailing youthful age population structure (United Nations Department of Economic and Social Affairs, 2022).

In the past, researchers in the field of demography have had a protracted debate regarding the viability of studying male fertility and its implications due to concerns about data quality. It is worth noting that the continuous lack of consistent quality data

remains a major challenge to male fertility demographic research. However, the need to make use of the data that are gradually and increasingly becoming available, especially in developing countries, is growing (Joyner *et al*., 2012; Nisén *et al*., 2014; Rendall *et al*., 1999; Schoumaker, 2017; Tragaki & Bagavos, 2014; Zhang, 2011). In regions and countries where estimations of male fertility have been attempted, factors such as lack of knowledge about the existence of biological children, denial of pregnancies and births among men, hostile relationships between the father and the mother at the time of a child's birth and under-sampling of men during surveys (not adequately corrected by sample weights) are mentioned as causes of underestimation of male fertility rates (Joyner *et al*., 2012; Marcia *et al*., 2005; Rendall *et al*., 1999).

Building on the 1994 International Conference on Population and Development declaration, reproductive health research among men, especially in the sub-Saharan Africa region, is gaining ground. However, it primarily focuses on male involvement in supporting skilled birth attendance, antenatal care, family planning, and other sexual and reproductive health services to improve women's health (Kakaire *et al*., 2011; Mangeni *et al*., 2013; Plantin *et al*., 2011; Zhang, 2011). On the contrary, demographic research on male fertility in developing countries continues to be scant, despite its necessity for understanding the factors underlying fertility and transitions among both men and women (Schoumaker, 2017; Zhang, 2011).

Published literature suggests that gender-related fertility differences primarily arise from differences in reproductive sexual practices, perceptions, fertility preferences (influenced by culture and socioeconomic context), and the unclearly defined duration of reproductive years among men (Green & Biddlecom, 2004; Le Goff, 2012; Schoumaker, 2017, 2019; Zhang, 2011). In developing countries, there are persistent patterns of higher fertility rates among males than females (Paget & Timæus, 1994; Schoumaker, 2017; Zhang, 2011). Male total fertility rate (TFRm) estimates from existing studies range between 1.5 and 2 times higher than female rates in selected sub-Saharan African countries (Schoumaker, 2017). Although several reasons have been advanced to explain the differences in male versus female fertility estimates, it is necessary to understand the importance of male dominance or unequal male gender-power relations. These relations permit the supremacy of men over women in regard to decision-making on childbearing, often entwined in ethnic values and polygamy in patriarchal families (Green & Biddlecom, 2004; Nalwadda *et al*., 2010; Ntozi *et al*., 1997; Schoumaker, 2017).

In Uganda, the average annual population growth has been oscillating above 3% for the past couple of decades, while the female TFR trends have consistently remained above the global levels (Kabagenyi *et al*., 2015; Population Reference Bureau, 2022). Estimates indicate that Uganda's female TFR was 4.6 children per woman in 2022, which is two-fold higher than the current global level of 2.3 and the fourth highest rate in the East Africa region, behind the top raking Somalia, Burundi, and Tanzania (Population Reference Bureau, 2022). By 2016, Uganda's female TFR stood at 5.4 children per woman as per the last available Demographic Health Survey (Uganda Bureau of Statistics (UBOS) and ICF, 2018). While there is plentiful availability of published demographic literature on female fertility, this is not the case for male fertility in Uganda. The authors envision that discussing Uganda's population growth and female TFR patterns without reflecting on male fertility dynamics presents a policy, planning, and research dilemma. Thus, this study provides knowledge on factors associated with male fertility changes over time to better understand gender-related fertility differentials and overall fertility dynamics in Uganda.

Earlier attempts to investigate male fertility in Uganda were conducted in the Ankole sub-region of Western Uganda. The results indicated that male fertility was high, with the mean number of children ever born (CEB) from men aged 45 years and above ranging between 10 and 16 children per man during 1984 – 1985 (Ntozi, 1995). However, this particular study does not provide ample up-to-date and nationally representative literature on male fertility in Uganda. Factors associated with male fertility changes in Uganda are not adequately documented. The lack of sufficient published information on male fertility trends and the factors associated with these changes is a huge challenge that limits the understanding of the demography of male fertility and fatherhood behaviors in Uganda. Due to this gap in research, there is a failure to prioritize and plan for effective fertility control strategies and programs where men are targeted as primary beneficiaries to achieve sustainable development.

Hence, this study is important as it uses available Uganda demographic health surveys (UDHS) data to examine male fertility transitions and their associated factors. This study is also useful for future demographic research on male fertility and for providing insights into the planning of programs aimed at improving existing knowledge for promoting fatherhood roles and addressing socially unmet needs among men. Given Uganda's prevailing annual population growth, the findings of this study can inform policymakers about gender-related fertility differentials and fatherhood patterns, thereby enhancing policies on fertility regulation and sustainable development.

1.1. Study conceptual framework

This research was conceptualized based on both Bongaarts' proximate determinants framework and the supply-demand Easterlin's economic framework as modified by (Bongaarts, 1993; 2015). Figure 1 illustrates the conceptual framework designed for this study, visualizing male fertility determinants based on the proximate determinants frameworks. These frameworks can be used to explain the determinants of fertility of any population and are crucial in the determination of fertility levels and differences among populations. For instance, background factors such as education level may influence exposure to sexual activities and unions, indirectly impacting fertility. Changes in sexual activities and unions directly alter fertility levels. A unique feature of the Bongaarts model is the assumption that changes in fertility levels are a direct result of changes in proximate determinants. For example, a change in proximate factors, such as the sexual exposure index, directly impacts fertility levels for a given population (Bongaarts, 2015). Furthermore, Bongaarts (2015) demonstrates that fertility differences among populations at any given time or during trend analysis are entirely dependent on the proximate determinants, through their inhibitory effects. Thus, proximate determinants, such as sexual exposure through marriage, contraception, postpartum infecundability, and abortion, are sufficient and important in explaining fertility variations comprehensively. Based on this evidence, this study examined the association of sexual exposure with fertility levels through variables such as contraceptive use and the duration of cohabitation and marriage.

In addition, the supply-demand economic framework for fertility by Richard Easterlin, as modified by Bongaarts (1993), was used in this study to explain the supply and demand for children, accounting for both economic and sociological approaches to fertility analysis. According to this evidence, the motivation to limit fertility arises only when the supply of children exceeds demand and is influenced by the economic and psychological costs associated with various birth control methods. Thus, in view of this framework, fertility levels are majorly influenced by changes in demand for children (desired fertility) and the implementation of fertility decisions based on either the need to regulate childbearing or the costs of unwanted childbearing (Bongaarts, 1993). This study examined the association between the number of current wives and fertility levels. The model assumes that an individual's decision to marry or have another child largely depends on the labor market conditions experienced during the reproductive period. Therefore, the proximate determinants included in the conceptual framework for this study to examine the factors directly associated with male fertility in Uganda included reported contraceptive use, the number of current wives, and the duration of cohabitation and marriage. The regression model examined the determinants of male fertility by considering the number of CEB to men as the primary study outcome variable. Therefore, this study aimed to examine the socio-

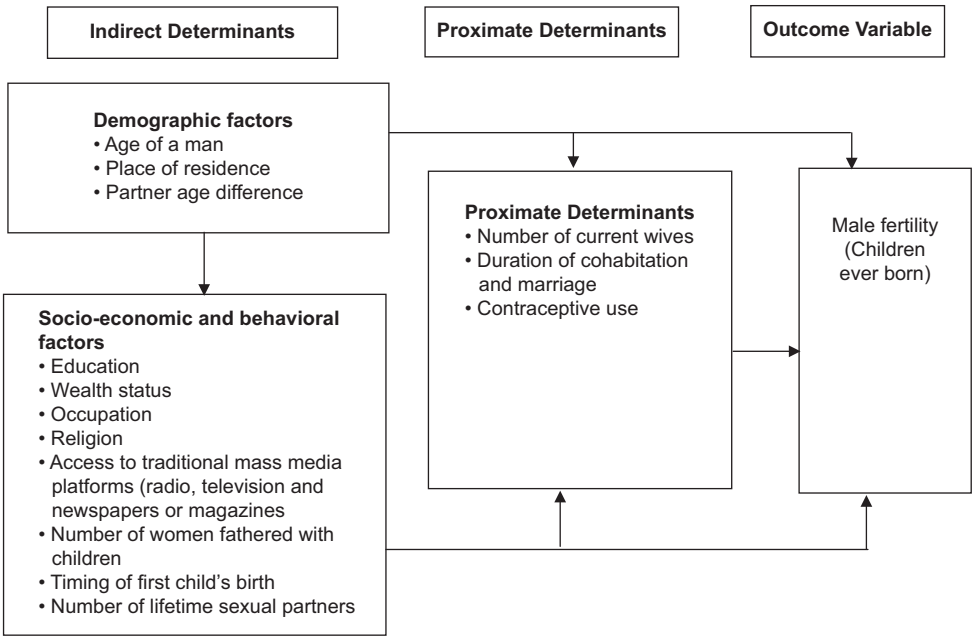

Figure 1. A conceptual framework for determinants of male fertility

demographic and proximate factors associated with male fertility using the 2006 and 2016 UDHS.

2. Data and methods

2.1. Study design and scope

This study used cross-sectional data from the 2006 – 2016 UDHS rounds. These surveys used a two-stage sampling design to generate countrywide representative household samples. The first stage involved the selection of enumeration areas from a list of clusters generated in the 2002 and 2014 Uganda National Population and Housing Census sampling frames. The second sampling stage included randomly selecting households in each cluster from an updated list of eligible households (UBOS and ICF, 2018). Although the authors initially considered using all existing UDHS rounds that included men as respondents to gain substantial insights into male fertility dynamics in Uganda, considerable missing data from non-matching variables in the 2000/2001 survey round led to its exclusion. Thus, only the 2006, 2011, and 2016 survey datasets were used for the estimation of male age-specific fertility rates (ASFRm). For examining the determinants of male fertility, the 2006 and 2016 surveys were analyzed—2006 serving as the baseline and 2016 as the most recent survey dataset.

2.2. Source of data

Secondary data for analysis were obtained from the UDHS conducted in 2006, 2011, and 2016 by the UBOS and ICF International. The Household Recode file provided household schedule data on member characteristics. The Individual Woman's Recode file provided data on child characteristics from the woman's individual full birth history, while the Man's Recode file provided data on men aged 15 – 54 years. The Individual Woman's Recode file was used because the Man's Recode file does not capture the full birth history of male respondents. The own-child method used both the Household and Individual Woman's Recode files, while the regression model for examining determinants used only the Man's Recode file.

2.3. Sample size

During the analysis to examine the determinants of CEB, the sample sizes for men aged 15 – 54 years were 2503 in 2006 and 5336 in 2016. All men who responded to the Man's Recode questionnaire were included in the study, irrespective of whether they had ever had sex. In total, the actual sample size was 7839 male respondents.

2.4. Study variables

The variables included in the conceptual framework are as follows: man's age, religion, place of residence, education level, occupation, wealth status, number of current wives, access to mass media (through television, reading newspapers, and listening to radio), contraceptives use, age of first child's birth, duration of cohabitation and marriage, lifetime sexual partners, number of women with whom men fathered children, and partner age difference. All these variables included in the conceptual framework (Figure 1) were significantly associated with CEB at the bivariate analysis level and were considered for inclusion in the multivariate analysis. During the examination of the determinants, all study variables were recoded into customized categories to simplify and ensure meaningful interpretation of analysis, as shown in Tables 1-3. Partner age difference, age of the respondent, wealth status, and number of women with whom men fathered children were excluded from multivariate analysis due to multicollinearity.

2.5. Data analysis

To guide the selection of the UDHS survey rounds for inclusion in the regression model analysis, the authors applied the own-children method as described by Schoumaker (2017). The results from this application, presented in Table 1 and Figures 2 and 3, are very useful for understanding the trends in prevailing male fertility patterns. In brief, the own-children method (developed by Grabill and Cho in 1965) was used due to its success in estimating current fertility, especially in contexts where vital registration systems are almost non-existent, as is the case in many developing countries such as Uganda (Abbasi-Shavazi, 1997; Dubuc, 2009; Schoumaker, 2017). This method is accurate and recommended for the estimation of current fertility using survey data, as children living with each household member are listed in the household schedules during survey enumeration (Abbasi-Shavazi, 1997; Avery *et al.*, 2013; Dubuc, 2009; Schoumaker, 2017). This method is particularly important for this study because birth histories for men are not regularly recorded, resulting in a lack of available data, unlike for women (Schoumaker, 2017).

In this method, all children aged 0 – 4 years in each household were linked to their fathers if their survival status was known to be alive. All records for children whose biological father's survival status was known to be dead or uncertain were excluded from the analysis. This data were extracted from the Household Recode files for each of the consecutive survey rounds (2006, 2011, and 2016). To control for fertility underestimation due to selection bias from the assumption that all children must have lived with their biological parents at the time of household survey enumeration, an estimation of the age of any surviving fathers who were not living with their biological children

Table 1. Distribution of changes in male ASFRm during the period 2006 – 2016

Age group	2006 (A)	2011	2016 (B)	Rate ratio (RR [B/A])	Percentage change = (RR-1) × 100
15 – 19	0.0215	0.0197	0.0223	1.0372	0.08
20 – 24	0.2099	0.1939	0.1928	0.9185	−1.71
25 – 29	0.3513	0.3199	0.2974	0.8466	−5.39
30 – 34	0.3716	0.3517	0.313	0.8423	−5.86
35 – 39	0.3225	0.325	0.2694	0.8353	−5.31
40 – 44	0.2774	0.2453	0.2253	0.8122	−5.21
45 – 49	0.1859	0.1751	0.1579	0.8494	−2.80
50 – 54	0.1074	0.0973	0.0874	0.8138	−2.00
55 – 59	0.0774	0.0714	0.0569	0.7351	−2.05
60 – 64	0.0471	0.0496	0.032	0.6794	−1.51
65 – 69	0.0362	0.0077	0.0144	0.3978	−2.18
70 – 74	0.0233	0.0052	0.0088	0.3777	−1.45
75 – 79	0.0225	0.0057	0.0036	0.1600	−1.89
∑ASFRm	2.054	1.8675	1.681		
TFRm	10.3	9.3	8.4		

Abbreviations: ASFRm: Age-specific fertility rates; TFRm: Male total fertility rate.

was imputed using the random hot-deck technique and included in the analysis (Abbasi-Shavazi, 1997; Allison, 2001; Dubuc, 2009; Schoumaker, 2017). The imputation was based on the assumption that the age distribution of fathers who did not live with their children at age x at the time of household enumeration was similar to that of fathers who lived with their children at age x. This technique used data from all children aged 0 – 4 years and their biological fathers and mothers who lived in the same households to estimate the age (in years) of hypothetical fathers (those who were alive but not living with their children) at the time of the survey. This technique also estimated the age (in years) of a father when each linked child was born by subtracting the recorded age of the child from that of the father. During this analysis, it was assumed that the bias introduced by excluding children whose biological fathers were either dead or unknown was offset by the inclusion of children not living with their biological fathers at the time of the survey. Thus, this analysis was independent of mortality bias among fathers. Using the Individual Woman's Recode files, this technique estimated the survival probabilities for children at age x years before enumeration for each survey round using female birth histories. Female birth histories were estimated from the date of birth and the survival status of the child variables in the Individual Woman's Recode files. Survival probability is the proportion of surviving children born x years before the survey. Grounded on the assumption that the biological mothers, fathers, and their children aged 0 – 4 years lived in the same households x years before enumeration for each survey, it was implied that the survival probabilities computed from the Individual Woman's Recode file were applicable to men in each household. The Individual Woman's Recode file data were used because data on birth histories among men are not readily available or collected during the UDHS. The estimated survival probabilities were used to estimate the total births at age x among men. This was obtained by multiplying the number of surviving children at age x by the inverse of the corresponding age x survival probability. Exposure to childbirth was computed by summing the duration each man spent in every age group in the past 5 years before the survey. The formula to obtain the ASFRm is shown in Equation 1:

$$\text{Male age specific fertility rates (ASFRm)} = \frac{\sum Total\ Births\ at\ age\ x}{\sum Exposure\ at\ age\ x} \quad \text{(I)}$$

The ASFRm results obtained from the application of Schoumaker's technique were transformed into TFRm estimates as indicated in Equation II and Figure 2:

$$TFRm = 5 \times \sum ASFRmale \quad \text{(II)}$$

Where ASFRm represents estimated births that occurred in each age group per 1000 men.

Descriptive univariate analysis was used to illustrate the distribution of characteristics among men aged 15 – 54 years using the Individual Man's Recode file for the 2006 and 2016 survey rounds. Figure 2 indicates that a fertility transition occurred during the inter-survey period of 2006 – 2016.

Table 2. Distribution of characteristics among male respondents (2006 – 2016)

Variable	2006 (A [%]) (*n*=2,503)	2016 (B [%]) (*n*=5,336)	Percentage change (B-A)
Age at first birth (years)			
≤17	2.9	3.1	0.2
18 – 24	42.2	36.9	−5.3
≥25	16.5	19.1	2.6
No birth	38.4	40.9	2.5
Number of current wives			
No wife	42.5	44.6	2.1
1	47.7	47.5	−0.2
≥2	9.8	7.9	−1.9
Religion			
Catholic	42.1	33.7	−8.4
Protestant-Anglican	37.2	40.4	3.2
Muslim	11.8	13.5	1.7
Pentecostal and others	8.9	12.4	3.5
Education			
No education	5	4.2	−0.8
Primary	65	55.3	−9.7
Secondary and above	30	40.5	10.5
Occupation			
Not working	5	6	1
Clerical/office job	11.7	14.5	2.8
Agriculture	65.5	42.5	−23
Services and manual labor	17.8	37	19.2
Reported contraceptive use			
No	76	60.1	−15.9
Yes	24	39.9	15.9
Partner age difference			
The male is younger or of equal age	4	5.1	1.1
The man is 1 – 4 years older	21.7	20.9	−0.8
The man is ≥5 years older	31.3	29.4	−1.9
The man has no partner	43	44.6	1.6
Watching television			
No	71.7	48.7	−23
Yes	28.3	51.3	23
Reading newspaper			
No	59.8	64.7	4.9
Yes	40.2	35.3	−4.9
Type of residence			
Urban	16.5	24.9	8.4
Rural	83.5	75.1	−8.4
Wealth status			
Poorest	15.8	16.9	1.1
Poorer	21.2	17.7	−3.5
Middle	17.8	19.6	1.8
Richer	21.1	22.1	1
Richest	24.1	23.7	−0.4
Number of mothers to the children fathered			
None	38.4	40.9	2.5
1	35.8	34.8	−1
≥2	25.8	24.3	−1.5
Marital duration			
Never married	36.8	39	2.2
1 – 4 years	12.5	15.2	2.7
5 – 9 years	12.3	12.8	0.5
10 – 14 years	12.8	10	−2.8
≥15 years	25.6	23	−2.6
Number of lifetime partners			
None or one partner	28.7	27.7	−1
2 – 4	35	38.8	3.8
≥5	36.3	33.5	−2.8
Age of respondents (years)			
15 – 19	23.8	24.1	0.3
20 – 24	16	17.8	1.8
25 – 29	14	13.9	−0.1
30 – 34	14.2	13.8	−0.4
35 – 39	12.4	9.2	−3.2
40 – 44	8.4	9.6	1.2
45 – 49	6.5	6	−0.5
50 – 54	4.7	5.6	0.9
Frequency of listening to radio			
None	6.5	12.9	6.4
Irregular listener	6.1	16.3	10.2
Listens everyday	87.4	70.8	−16.6
Total	100	100	

(Cont'd...)

Table 3. Multivariate decomposition Poisson regression of CEB for the period 2006 – 2016

Variable	Due to differences in characteristics E		Due to differences in coefficients C	
	Coefficient	%	Coefficient	%
Age at first birth (years)				
≤17	0		0	
18 – 24	0.003	−0.71	0.001	−0.25
≥25+	−0.004***	0.81	−0.001	0.16
No birth	−0.409***	92.55	0.05	−11.37
Religion				
Catholic	0		0	
Protestant–Anglican	−0.001	0.21	0.002	−0.49
Muslim	0.001*	−0.25	−0.000	0.02
Pentecostal and others	−0.000	0.06	0.000	−0.02
Education				
No education	0.000*	0.18	−0.001	17.3
Primary	0		0	
≥Secondary	−0.005*	1.08	0.001	−0.18
Occupation				
Not working	−0.000	0.00	0.000	−0.04
Clerical/office job	0		0	
Agriculture	−0.020***	4.43	−0.008	1.84
Services and manual labor	0.004	−0.99	−0.003	0.62
Type of residence				
Urban	−0.004*	0.98	−0.001	0.19
Rural	0		0	
Reading newspaper				
No	0		0	
Yes	0.001	−0.25	0.003	−0.66
Listening to radio				
No	0		0	
Irregular listener	0.001	−0.19	−0.001	0.13
Listens everyday	−0.004	1.02	−0.009	2.14
Contraceptive use				
No	0		0	
Yes	−0.003	0.69	0.001	−0.32
Total number of lifetime partners				
None or one partner	0		0	
2 – 4	0.002*	−0.52	−0.003	0.68
≥5	−0.003***	0.64	−0.003	0.73
Number of current wives				
No wife	0		0	
1 wife	−0.001***	0.13	0.003	−0.57
≥2 wives (polygamous)	−0.011***	2.49	0.001	−0.14
Marital duration				
Never married	0		0	
1 – 4 years	0.004*	−0.91	−0.009	1.93
5 – 9 years	0.002***	−0.48	−0.006	1.2
10 – 14 years	−0.020***	4.63	−0.004	0.87
≥15 years	−0.027***	6.21	−0.01	2.16
Watching TV				
No	0		0	
Yes	−0.002	0.59	−0.001	0.17
Constant			0.046	−10.47
CEB	**Coefficient**	**%**		
E	−0.498***	112.7		
C	0.056	−12.7		
R	−0.442***	100		

Notes: Number of observations: 7,839; High-outcome group: 2016; Low-outcome group: 2006; E: Component representing changing characteristics; C: Component representing changing fertility behavior; R: Mean outcome difference due to E and C in the model; *p<0.05; **p<0.01; ***p<0.001.
Abbreviation: CEB: Children ever born.

Thus, both the bivariate and multivariate analyses focused on the 2006 and 2016 surveys. A Kruskal–Wallis H test was used to identify significant independent variables associated with CEB at a 95% confidence level. The assumption is that the differences in CEB are the same within and between according to the independent variable categories. The Kruskal–Wallis H test was used because the dependent variable, CEB, did not satisfy the distributional normality and equal variance assumptions of analysis of variance.

$$\chi^2 = (N-1)\frac{\sum_{a=1}^{k} n_a\left(\bar{r}_a - \bar{r}\right)^2}{\sum_{a=1}^{k}\sum_{j=1}^{na}\left(r_{aj} - \bar{r}\right)^2} \quad \text{(III)}$$

Where n_a represents the number of observations in group a, r_{aj} denotes the rank of observation j from group a, N signifies the total number of observations across all groups, $\bar{r}_a$ is the average rank of all observations in group a, $\bar{r}$ represents the average of all the r_{aj}, and a signifies 1, 2, 3 ……. kth groups.

A multivariate decomposition Poisson regression model was used to examine the factors associated with the changes in male fertility using the Individual Man's Recode

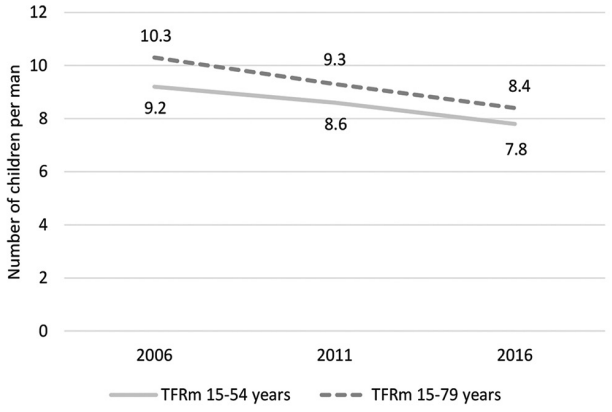

Figure 2. Male fertility trend in the period 2006 – 2016. Abbreviations: TFRm: Male total fertility rate.

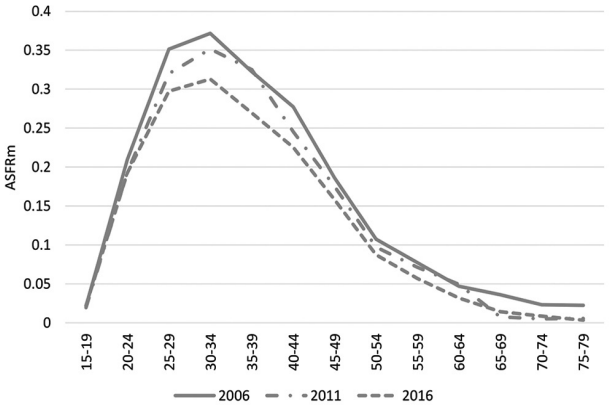

Figure 3. Male age-specific fertility rate variations in the period 2006 – 2016

file as the data source. The number of CEB to men who are aged 15 – 54 years was used as the dependent variable (considered as a count variable) in the regression model. This dependent variable exhibited a Poisson probability distribution pattern for each of the surveys, hence the use of a Poisson regression analysis. Temporal dimensions were introduced in the regression analysis to examine the determinants of male fertility by pooling and merging the Man's Recode data files into a single data file aggregated by the year of the survey. Pooling individual data records is an effective way to introduce temporal analysis dimensions to make trend inferences from repeated surveys with the same variables (Ruspini, 1999).

A decomposition method was used to identify the main sources of change in an outcome variable, CEB, for the 2006 and 2016 survey years in Uganda. A multivariate decomposition for the non-linear response model Poisson regression was used to analyze the pooled study dataset. This dataset was formed by merging or pooling data from the Man's Recode files for the years 2006 and 2016, and the results are shown in Table 3. The results provide insights into the differences in CEB among men between 2006 and 2016. The results are partitioned into components attributable to changes in the composition of characteristics (E) and behavioral influence (C) among men. The results were interpreted using coefficients. The independent variables included proximate and indirect factors, as illustrated in Figure 1. The level of significance considered throughout the analysis was 0.05. The dependent variable, CEB, was a function of a linear combination of exponential predictors and regression coefficients, and the Poisson decomposition model was expressed as follows:

$$Y = F(X\beta) = F\left(e^{x\beta}\right) \quad \text{(IV)}$$

Where Y denotes the $N\times1$ dependent variable vector, X is an $N\times K$ matrix of independent variables, and β is a $K\times1$ vector of coefficients. $F(\cdot)$ is any once-differentiable function mapping a linear combination of $X(X\beta)$ to Y. X represents predictors, and β represents regression coefficients. Equation IV can also be expressed in Equation V as follows:

$$\bar{Y}_B - \bar{Y}_A = F\left(\overline{X_A\beta_A}\right) - F\left(\overline{X_B\beta_B}\right) \quad \text{(V)}$$

where $\bar{Y}_B - \bar{Y}_A$ is the mean difference in CEB comparing 2016 and 2006. 2016 is the comparison group survey year, while 2006 is the reference group survey year. Furthermore, Equation IV is also summarized in Equation VI as follows:

$$\bar{Y}_B - \bar{Y}_A = E + C \quad \text{(VI)}$$

Therefore, E reflects the expected difference if the survey year 2016 was given the distribution of covariates of 2006, while C reflects the expected difference if 2006 experienced 2016's behavioral responses to X. A backward stepwise selection criterion for the independent variables was used to fit the regression model.

3. Results

3.1. Application of the own-children method to compute ASFRm trend patterns for the 2006 – 2016 UDHS rounds

The results, highlighted in Table 1, show a slow decline in the male fertility transition between 2006 and 2016. Figure 3 displays the ASFRm graphs for each survey round. In Figure 2, male fertility estimates were distinctly different among men aged 15 – 79 and those aged 15 – 54 years during the period from 2006 to 2016 ($p > 0.05$). This result indicates that fatherhood among men aged 55 years or older is important in estimating male fertility. Overall, 2016 had the lowest TFRm estimate at 8.4 children per man. TFRm declined slowly by 1.9, from 10.3 in 2006

to 8.4 in 2016. A one-tailed *t*-test was used to examine whether the decline in TFRm between 2006 and 2016 was important. For this test, an assumed mean of 9.33 was derived from the estimated TFRm for each survey (10.3, 9.3, and 8.4). The *t*-test results showed a non-significant decline in TFRm estimates from 2006 to 2016 ($\alpha = 0.000$, $p > 0.05$).

3.2. Distribution of characteristics among respondents in the years 2006 and 2016

The univariate analysis results were used to establish changes in the distribution of respondent characteristics. As shown in Table 2, the proportion of men who attained secondary and higher education increased by 11 percentage points (pp) between the 2006 and 2016 survey periods. In addition, there was a 19-pp increase among those who joined services and manual labor, a 16-pp increase among those who reported contraceptive use, and an increase among those who were dwelling in urban areas and watching television by 8 and 23 pp, respectively. To establish characteristics associated with male fertility, the study employed the Kruskal–Willis H test to compare differences in CEB across independent variable categories. The male fertility transition was observed between 2006 through the years preceding the 2016 survey, although it was not significant. At the bivariate level, the Kruskal–Willis H test indicated that the following independent variables were associated with discernible differences in CEB within and between their categories: Age of a man, place of residence, wealth status, education, number of current wives, reported contraceptive use, access to mass media (television, newspaper, and radio), women with whom children are fathered, lifetime sexual partners, religion, timing of first childbirth, partner age difference, occupation, and duration of cohabitation and marriage ($p < 0.000$).

3.3. Relationship between CEB and determinants of male fertility

Table 3 presents the multivariate Poisson decomposition results, which illustrate the differences in CEB among men between the 2006 and 2016 survey periods. The observed characteristics explain 113% of the change in CEB among men during this period. The decline in male fertility from 2006 to 2016 was primarily attributed to changes observed in the following variables: Age at first childbirth, duration of cohabitation and marriage, occupation, number of current wives, and education attainment. Most importantly, a 3-pp increase in the proportion of men who reported being childless between 2006 and 2016 contributed 93% to the changes in CEB, keeping other factors constant.

Furthermore, men who had their first childbirth at age 25 years and above were more likely to have a reduced CEB than those who had their first childbirth before the age of 17 years, keeping other factors constant. The regression results showed that delaying the onset of childbirth among men was associated with a decline in male fertility. A 5-pp decline in the proportion of men who reported a high duration of cohabitation and marriage (10 years and above) between 2006 and 2016 contributed 11% to the changes in CEB, keeping other factors constant. This finding indicates that the duration of cohabitation and marriage among men is positively associated with male fertility transition. A decline in the proportion of men engaged in agricultural occupations contributed 4% to the changes observed in CEB between 2006 and 2016, keeping other factors constant. This result implies that a decline in the proportion of men engaged in agricultural occupations is positively associated with CEB transition among men.

In addition, a 2-pp decline in the proportion of men with two or more current wives (in polygamous unions) contributed 2% to the change in CEB between 2006 and 2016, keeping other factors constant. An increase in the proportion of men who attained secondary and higher education in 2016 compared to 2006 contributed 1% to the change of CEB among men. Proportional changes in the following characteristics contributed marginally to the change in CEB among men: changes in the total number of lifetime partners, type of residence, and religion. In particular, proportionally increases among Muslim men had a higher likelihood of increasing CEB than any other religion.

4. Discussion

This study had two main objectives: First, to estimate male fertility rates over a span of 15 years, from 2006 to 2016, and second, to examine the factors associated with changes in CEB to better understand male fertility dynamics in Uganda. This study demonstrates that male fertility in Uganda was in a slow-moving transition pace during the study period, primarily due to changes in the proportional composition of characteristics among men. In fact, male fertility was higher than eight children per man, given the prevailing ASFRm from 2006 to 2016. These results are consistent with earlier studies, which indicate that male fertility rates were higher than female rates in many African countries (Schoumaker, 2017). Strongly entrenched pronatalistic socio-cultural norms, values, and behaviors, manifesting as demand for large family size and patriarchy, could plausibly explain why male fertility exceeded eight children per man (Nalwadda *et al*., 2010). Although the association between male and female fertility in Uganda is scantly published, it is important to note that Uganda's female TFR is among the highest in the East African region and was twice over the global average of 2.3 by the year 2022 (Population Reference Bureau, 2022).

In addition, this study demonstrates that the onset of male fertility transition occurred in 2006 and continued through 2016, although the estimated TFRm decline was not significant. Men were found to be highly fertile between the ages of 20 and 44 years, although the trend markedly declines after age 50. It may be argued that the majority of men in Uganda attain satisfaction with childbearing or desired lifetime fertility after reaching the age of 50 years and older. These findings conform to existing evidence indicating that ASFRm among men are likely to increase during the reproductive years, peaking in the 30 – 34 age groups (Tragaki & Bagavos, 2014; Zhang, 2011).

Based on the regression analysis results, changes in male fertility between 2006 and 2016 occurred primarily due to an increase in the proportion of men who had their first child at age 25 or older and those who had attained secondary or higher education. Most importantly, an increase in the proportion of men who delayed childbirth until after age 25 contributed to the transition in CEB. In addition, a higher proportion of men who had attained secondary or higher levels of education were associated with reduced CEB. These findings are comparable to a Nigerian study, which indicated that men with higher education are more likely to have fewer CEB compared to their counterparts who had lower education (Adewole *et al*., 2018). Although changes due to coefficients were not significant in our study, existing literature argues that the influence of education is strongly positive for childbearing outcomes among men (Duvander & Andersson, 2006; Lappegård & Rønsen, 2013; Nisén *et al*., 2017; 2014; Tragaki & Bagavos, 2014). Therefore, the observed change in CEB due to differences in the proportional composition of men supports the literature on male fertility. Specifically, it shows growing potential for either avoiding the onset of fatherhood among adolescents and young men or improving the desire to remain in school to attain secondary and higher education, thereby eventually changing fertility preferences. These are significant indirect determinants of male fertility.

In addition, a reduction in the proportion of polygamous men (those with more than two current wives) and those whose combined duration of cohabitation and marriage was 10 years or more significantly contributed to the changes in CEB during the study period. These proximate factors were found to be responsible for the change in CEB during the study period. Indeed, a decrease in the proportion of men with two or more wives (polygamous marriages) and those who experienced a longer duration of cohabitation and marriage (exceeded 10 years) contributed to a reduced CEB. The results conform to existing literature, which reflects that higher fertility levels are enhanced by polygamous behavior and the early onset of fatherhood (Schoumaker, 2017; Tabutin *et al*., 2020). Previous studies argue that the duration of cohabitation and marriage influences decision-making on the timing of childbearing initiation and lifetime exposure to childbirth and fertility (Manning, 1995; Zhang, 2011). Thus, this study suggests that the decline in CEB is positively associated with delaying the formation of marital unions and cohabitation.

Considering the type of occupation, decreased proportions of men engaged in the agriculture sector contributed to the decline in CEB, while increased proportions of men residing in urban areas also reduced CEB. These are also significant indirect factors associated with male fertility transition and might be key indicators explaining the influence of urbanization on male fertility behavior and decision-making.

In terms of religion, changes in the proportional composition of only Muslim men increased CEB. According to the literature, the influence of religion on CEB is often sustained through the staunch behavioral practices of religious values and norms (Zhang, 2011). It is also argued that polygamy practices, which are predominantly permissible specifically among Muslims, are the main driver of fertility (Adewole *et al*., 2018; Alamri, 2011; Mashhour, 2005). Furthermore, an increase in the proportion of men with multiple lifetime partners had a positive potential for increasing CEB. These results concur with previous studies showing that an increase in the number of lifetime partners is often influenced by remarriages, polygamy, and experiences related to unstable marriages, especially among economically disadvantaged families (Adewole *et al*., 2018; Manlove *et al*., 2008). This study contributes to the emerging literature on multiple-partner fertility in Uganda (Candia & Kisangala, 2021).

In terms of reported contraceptive use, an increase in the proportion of men reporting contraceptive use, either by themselves or by their spouses, did not significantly contribute to a decline in CEB. It is important to note that the increase in contraceptive use among men in Uganda was also previously reported in the literature, although there were no specific discussions on contraceptive use and male fertility (Namasivayam *et al*., 2019). Thus, our findings suggest that the use of highly efficacious modern contraceptive methods remained insufficient and unable to meaningfully drive changes in male fertility between 2006 and 2016. Furthermore, based on literature, contraceptive use often relies on the level of knowledge regarding the method used by spouses; yet, fewer men have such knowledge. This further reinforces the argument that the influence of contraceptive use on male fertility is largely indirect and is often achieved through female partner contraceptive uptake

and knowledge that their spouse(s) are using contraception (Namasivayam *et al*., 2019; Ochako *et al*., 2017). Therefore, interventions should focus on men engaging in discussions on contraceptive use with both health workers and their spouses to demystify myths about contraception, promote male involvement, and advocate for improved partner contraceptive use among couples (Asiimwe *et al*., 2014; Kabagenyi *et al*., 2014; Ochako *et al*., 2017).

To wrap up this discussion, this study addressed the direct and indirect factors responsible for the changes in CEB among men aged 15 – 54 years in Uganda, using data from the 2006 – 2016 survey rounds. However, more research should investigate the dynamics of lifetime male fertility projections and their drivers, especially if men aged 55 years and older are included. Research to further improve understanding of male fertility and its effects on sustainable development outcomes in Uganda is also needed, as current knowledge is very limited.

This study was constrained by several limitations. It used secondary data from cross-sectional surveys, and the analysis was limited to the data available in the UDHS household, woman, and man individual recode data files. The results of this study should be interpreted with caution due to potential data quality inconsistencies associated with demographic health survey data and the limitations of data analysis, which are explained as follows: Essential variables with missing records (such as the age at first childbirth and the number of current wives) were included in the analysis only after assigning pseudo or imputed data to the missing values and recoding them; otherwise, variables with missing data were avoided and excluded during data analysis to reduce bias.

Reconstruction of the ASFRm and TFRm for preceding years of the survey rounds included in this research was important, but this was not undertaken by the authors. Instead, this study focused on the application of the own-children method, as described by Schoumaker, to understand prevailing male fertility trends and to support contextualization of the Poisson decomposition regression model for this study (Schoumaker, 2017). Furthermore, this research did not analyze the determinants of male fertility using the own-children method, which was considered a limitation. Instead of using the ASFRm and TFRm as the dependent variables in the regression model, CEB for men aged 15 – 54 years was used as a proxy.

Another limitation was the inability of this study to analyze completed lifetime fertility using the CEB variable. All data for survey respondents aged 15 – 54 years were included in the analysis; yet, these respondents had not completed their lifetime fertility. In this regard, the authors assume that the quality of CEB fertility analysis improves significantly if the data analyzed includes respondents who have already completed their lifetime fertility span. However, the UDHS Individual Man's Recode data file is limited to respondents below 54 years. Thus, this study did not analyze the causes of changes in the mean number of CEB over the entire lifetime of men in Uganda.

Furthermore, this study could not infer causality given the cross-sectional study design of the UDHS. The authors also acknowledge the possibility of an endogeneity effect in the regression model, possibly due to the inclusion of variables such as contraceptive use and age at first childbirth. During the interpretation of the decomposition regression results, it is worth noting that the distinction between differences due to compositional changes in characteristics and behavior is not without limitations. Reproductive behavior in this study includes independent variables that could also be viewed as indicators of fertility behavior, such as age at first childbirth.

5. Conclusion

The findings of this research are critical for redirecting policies and programs to prioritize men as key beneficiaries in achieving family and national Sustainable Development Goals. The slow male fertility transition observed between 2006 and 2016 was fundamentally attributed to changes in the composition of characteristics among men aged 15 – 54 years, rather than changes in behavioral responses toward lower CEB. Key factors negatively associated with CEB included an increase in the proportion of men who delayed the onset of first childbirth until age 25 or older, attained secondary or higher education, and resided in urban areas. In addition, a decline in the proportion of men who were in polygamous unions and those engaged in agricultural occupations was associated with a reduction in CEB. Therefore, government interventions and policies in Uganda should focus on interventions that delay the formation of cohabitation and marriage unions and the onset of childbirth or fatherhood among adolescents and young men below the age of 25 years. Furthermore, prioritizing the elimination of low educational levels among boys and men is essential for enhancing the achievement of Sustainable Development Goal 4 on quality education. This, in turn, can significantly contribute to a more rapid male fertility transition in Uganda.

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Conflict of interest

On behalf of the authors, the corresponding author declares that there is no conflict of interest to be declared as far as this research is concerned.

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Not applicable.

Availability of data

The datasets are available online and can be accessed by applying through the DHS website. The data analyzed were accessed using the following link: http://www.dhsprogram.com/data/dataset_admin/login_main.cfm

Further disclosure

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RESEARCH ARTICLE

Family image, cultural values, and family policy from a global perspective

Sonja Drobnič*, Johannes Huinink, and Mandy Kusnierz

SOCIUM Research Center on Inequality and Social Policy, University of Bremen, Bremen, Germany

Abstract

The creation, design, and implementation of state policies for families vary across different country contexts. Our focus is on the diverse cultural conditions that can subtly influence the perception, acceptance, or dismissal of specific policy measures. The ways in which states invest in families, and whether and how they consider normative and moral aspects, as well as the roles and behaviors of family members, can differ significantly across societies, even if they are at the same stage of economic development. While this article does not directly establish a causal link between cultural conditions and family policy instruments, we leverage survey data from the World Values Survey and other supplementary information sources to examine attitudes and cultural conceptions of the family, along with broader cultural conditions worldwide. Our descriptive analysis of values and attitudes covers key dimensions, including familiarization/defamiliarization, secularization and emancipative values, gender roles, and openness toward diverse family forms. In addition, we examine societal attitudes toward demographic developments and demonstrate that cultural divisions align to a considerable extent with societal attitudes and governmental views on fertility levels. Importantly, our findings reveal systematic disparities among world regions, emphasizing the idea that distinct cultural traditions and values may be intertwined with specific policy configurations.

Keywords: Family policy; Cultural values; Family image; Fertility rate; Global comparison; World Value Survey

***Corresponding author:**
Sonja Drobnič
(sonja.drobnic@uni-bremen.de)

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1. Introduction

Family policies have a profound impact on the functioning of families, affecting the lives of family members in various ways. While the formation and implementation of family policies can be traced from supranational levels, such as the United Nations (UN), to local, organizational, and company levels (Nieuwenhuis & Van Lancker, 2020a), the most consequential layer remains the nation-state. Nation-states dominate the policymaking and implementation of various family policy measures, as well as comparative research in this field. Ministries dedicated to family affairs or family development exist in many countries, underscoring the state's genuine interest in the functionality of families as vital social institutions.

However, questions arise: how are family policies devised within nation-states? What goals do states pursue, and how do they choose from among numerous policy instruments? In this article, we do not directly examine the intricacies of the decision-

making process in policy formation. Instead, we explore the diversity of country contexts in which policies for families with children are crafted, designed, and executed. Our focus is particularly on the impact of diverse cultural conditions, which can subtly influence the perception and acceptance or dismissal of specific policy measures. While economic development and budgetary constraints undoubtedly influence the extent to which a state can provide support to families – whether in monetary form (e.g., child benefits, baby bonuses), time allocation (e.g., maternity, paternity, and parental leaves), or infrastructure (e.g., childcare and early education) – the direction of state investment in families, consideration of normative and moral aspects, and roles and behaviors of family members can significantly vary across societies, even if they are at the same stage of economic development.

The policy concern, whether to support traditional family forms, prioritize the individual well-being of family members regardless of family models, or promote employment opportunities for all adult family members and gender equality, is not primarily a question of financial capacity. Rather, it may be shaped by broader cultural contexts with diverse values, norms, socio-cultural heritage, codified marriage systems, ethnic and religious diversity, kinship solidarity, societal importance attached to children, filial piety, patriarchy, and gender equality. These cultural factors largely shape the formation of family policy and its specific instruments (Lohmann & Zagel 2018).

Even when policies are in place, one can argue that their effectiveness hinges on their acceptance as legitimate within the cultural and societal context (Neyer, 2021). The adoption of policy instruments from distant cultural settings may prove futile if they do not align with the family system and cultural values of a country. This challenge holds particularly true for family policy due to its normative nature. In contrast to policy fields like health, where goals such as reducing illness and mortality are universally acceptable, family policy goals can be controversial and fraught with obstacles. They can be perceived as governmental intrusions into private family affairs, intertwined with sensitive and emotional aspects, including sexuality, religiosity, deeply embedded ideas on gender roles, and ideological orientation. This complexity is observed even among policymakers, as exemplified by conflicting values in family policy within the United States of America (USA), where politicians take turns "to become "champions" of supporting families in one moment and then turn around and decry government intrusion in family life in the next" (Ooms, 2019, p. 20).

Hence, we contend that exploring cultural conditions worldwide can illuminate the foundations that support, strengthen, or impede the development of family policy. In the following sections, we will examine the concepts of "family" and "policy" as encompassed within "family policy." Thereafter, we will examine international variations in the underlying cultural context related to the family that shape national family policies and present an empirical analysis based on the World Values Survey (WVS) and other data.

While researchers have extensively considered which policies constitute family policy and a consensus is emerging around the definition of family policy, the definition of family itself remains unresolved (Bogenschneider & Corbett, 2010). This lack of resolution is unfortunate because there is a mutual and bidirectional relationship between the conception of family and family policy. The notions of family and family relations, including gender and generational relations, are culturally diverse and affect the formation and development of family policies in contemporary societies. Furthermore, family policy itself shapes perceptions of who qualifies as a family member, what constitutes acceptable family models, and how these definitions evolve over time. Enacted policies catalyze societal change and may impact their own cultural foundations.

1.1 Family

Globally, the family is a universal social institution, serving as one of the fundamental pillars of all societies and bearing responsibility for both biological and social reproduction. However, the cultural conception, definition, and practices of the family have undergone significant transformations over time and can vary significantly between societies (Bau & Fernández, 2021). Following the changes brought about by industrialization and urbanization, which culminated in the dominance of the modern bourgeois family, particularly in Western countries, we have witnessed a process of deinstitutionalization and diversification of family forms and relationships among family members over the past five decades (Lesthaeghe, 2020). This coincides with a transformation in societal perceptions and the cultural image of the family. A similar, though more gradual, change is also observable in other parts of the world where traditional family structures have long prevailed, often influenced by deeply rooted religious belief systems (Furstenberg, 2019; Lesthaeghe, 2020). One key factor contributing to the considerable variation in family policy across nations is the fact that policy measures are founded upon differing conceptions of family and are more or less inclusive in terms of the increasing variety of family forms present in contemporary societies (Lohmann & Zagel 2018).

While there is a general consensus that a family is defined as a relationship between two or more individuals connected by blood, legal bonds, or shared family functions, dissent may arise concerning what or who qualifies as a family and whom the family policy should target. Furthermore, the evolving cultural notion of family has implications for how family is defined in vital statistics, demography, and other purposes carried out by governmental institutions and international organizations (Selzer, 2019; UN, 2011a).

The prototypical norm of a stable nuclear family, with a breadwinning husband and caregiving wife, which served as a basis for policymaking in developed Western countries during the twentieth century, is losing ground even in its countries of origin. This shift is especially evident in light of the diverse family constellations that have emerged, including dual-earner couples, patchwork families, single mothers cohabiting with new partners, single parents with children from multiple partners, children of divorced parents residing interchangeably in two households, same-sex families, co-parents of various sexual orientations who reject a partnership but purposefully conceive and jointly raise children, multi-generational families, skipped generation families, and co-residing kin members, to name a few (Liu & Esteve, 2021). However, the development of diverse family types has not followed a uniform or simultaneous pattern, even when considering only European countries (Huinink, 2010). This diversity becomes considerably more intricate when viewed from a global perspective, considering world regions with vastly distinct cultural traditions and structural conditions. Therborn (2004; 2014) categorized seven major family systems worldwide, which, in his view, are not converging and, in some respects, are rather diverging: the Christian-European family (including New World settlements), Islamic West Asian/North African, South Asian, Southeast Asian, Confucian East Asian, sub-Saharan African, and Creole family patterns. These major family systems correspond closely with world regions, and we will analyze them using survey data in the following sections of this article.

1.2. Policies

The definition and scope of family policy lack precision and universality, making it a concept characterized by fuzziness and variable boundaries. The delineation of policies qualifying as family policies and the notion of what constitutes a family is particularly ambiguous, especially when considering the global perspective beyond the European context and countries typically encompassed in comparative welfare state research.

The term "family policy" emerged in the latter half of the 20th century within European social policy discourse. It was used to describe public policies designed with the intent to influence families or individuals in their family roles. Explicit state responsibility for families developed later than in many other areas of social policy, such as income redistribution and securing the adult life course (Gauthier, 1996). Nevertheless, families had been shaped and affected by legal regulations and public policies long before the concept was introduced in policymaking and research. As noted by Saraceno (2011, p. 2), "Governments' intervention in family matters, regulating what constitutes a family and what obligations family members have to each other, dates back to the formation of nation-states. Access to marriage, the conditions of its dissolution, the distinction between what is a family and what acknowledged family relationships, the distinction between legitimate and illegitimate (later "natural") filiation, gender and intergenerational obligations, whether and how contraception and abortion are allowed, intra-family violence condoned or on the contrary, persecuted – all these became matters of regulation by law."

Early on, family policy was broadly defined as encompassing "everything that government does to or for the family" (Kamerman & Kahn, 1976, p. 183). Similarly, Zimmerman (1995, p. 4) proposed understanding family policy as "a perspective for understanding and thinking about policy in relation to families." Kaufmann (1993) introduced the distinction between explicit and implicit family policy. While many policy measures are motivated by objectives related to the labor market, health, population, or poverty reduction, they inevitably have implicit effects on families. Consequently, family policy intertwines with other specific policy areas, including population policy, education, labor policy, health, and long-term care policy. Explicit family policy, conversely, involves policy measures deliberately targeted at families and the specific needs of family members. Such measures are planned and implemented by public authorities established explicitly for these purposes (Kamerman & Kahn, 1978; Kaufmann, 1993).

Scholars define contemporary family policy as government activities intentionally designed to support families, enhance the well-being of family members, and strengthen family relationships (Bogenschneider, 2006). Recent developments aim to broaden the conceptualization and assess the changes that family policy has undergone in its historical development (Daly, 2020). Nevertheless, even the most recent and comprehensive accounts of research on family policy (Eydal & Rostgaard, 2018; Nieuwenhuis & Van Lancker, 2020b) predominantly focus on Europe

and, to a lesser extent, on other Organization for Economic Cooperation and Development (OECD) countries. The global perspective is emerging but remains a peripheral and underdeveloped area of intellectual inquiry.

In the next section, we will explore the underlying cultural characteristics that shape national contexts and presumably serve as a relevant framework within which family policies are devised. Our analysis will primarily center on state policies related to families with children. While caregiving for older people can also be subsumed under family policy, and historically, this may have been an important part of family responsibilities, this is progressively becoming less central. Countries exhibit substantial variation in the extent to which public policies support informal elder care. However, among the 35 European countries analyzed by Spasova *et al.* (2018), only three have legally mandated family responsibilities for adult children toward their parents, and these regulations are typically situated within the emerging long-term care policy rather than family policy. As such, our primary focus will be on families with young children.

1.3. Cultural variation and family policy

In pursuit of our research objectives, acquiring information on how populations in different countries perceive family policy and the extent of support for such measures would be valuable. Regrettably, comprehensive cross-national data for such assessments are currently unavailable. However, insights from international comparative research on attitudes toward the welfare state reveal that approval of social policy measures and state income redistribution, aimed at reducing inequalities, varies significantly among groups of countries. Support for social policies is shaped not only by individual interests or values but also by country-specific conditions (Dallinger, 2008). It is reasonable to expect that the cultural conception of family and gender roles, which can profoundly influence support for family policy measures, also exhibits substantial variation across societies. This variation has been observed in European countries (Lück & Castrén, 2018; Trommsdorff, 2006; Van Vlimmeren *et al.*, 2017) and is evident in the social legislation of respective societies (Nygren *et al.*, 2018).

We posit that cultural ideals, belief systems, and convictions significantly contribute to shaping the actions of individuals and policymakers, thereby influencing the policy areas that receive the most attention and the selection of policy instruments and configurations in a given society (Lohmann & Zagel, 2018). Along which dimensions are cultural and structural trends likely to affect family policies? We propose that countries differ along the following dimensions, impacting the level and direction of state involvement in regulating family behaviors and relationships: Familiarization versus defamiliarization, secularization and emancipative values, attitudes toward gender roles, and openness toward diverse family forms (Lohmann & Zagel, 2016; Roberts, 2019; Surkyn & Lesthaeghe, 2004). Furthermore, societal attitudes toward demographic development and fertility may influence the objectives and specific direction of family policy.

1.3.1. Familiarization and defamiliarization

The concept of familiarization versus defamiliarization has emerged from extensive discussions within the framework of traditional welfare state typology. It is defined as the extent to which the family is expected to absorb social risks relative to the state. Defamiliarization refers to the degree of support for an individual's independence from family relationships, including the autonomy of women and the reduction of intergenerational dependency (Leitner, 2003; Lohmann & Zagel, 2016). In contrast, familialistic attitudes and policies obligate the family to meet the care needs of its members, thereby fostering dependence on family support for those in need of care. Familialization is a complex concept that, to a large extent, overlaps with the role of gender in providing welfare to family members. In this sense, we concur with Saxonberg (2013, p. 27), who states that "the terms 'familiarization' and 'defamiliarization' are... ambiguous... many scholars use the terms differently, leading to significantly different results." Nevertheless, this concept has proven to be a valuable tool for understanding the development and impact of family-related policy measures, as seen, for example, in Latin American countries (Sátyro & Midaglia, 2021).

1.3.2. Secularization and emancipative values

The relationship between religious beliefs and modernization processes is nuanced and more complex than a straightforward negative correlation between religion and various manifestations of modernization, including family structure and family relations (Kaufmann, 1997). Yet, the cultural foundation within which family relations and family models evolve can be profoundly affected by religious beliefs. Studies examining the role of religion in marital and parent–child relationships identified numerous topics where religion can play a role, including union formation, fertility, spousal roles, marital satisfaction and conflict, divorce, domestic violence, infidelity, pregnancy, parenting, and coping with family distress (Mahoney, 2010; Surkyn & Lesthaeghe, 2004). Even in highly secularized societies, many family-related life course rituals, such as

weddings and funerals, often retain religious contexts. The impact of specific religious beliefs is particularly evident in the socialization of children (Sherkat, 2003). It is, therefore, conceivable that differences in secular and emancipative values also shape the objectives and forms of family policy in various societies.

1.3.3. Gender roles

The roles of women and men in both the family and society have undergone notable transformations in many regions worldwide. One of the most significant trends in recent decades across contemporary societies has been the increasing labor force participation of women, representing a significant departure from traditional norms. However, progress in changing men's roles within the family sphere has lagged behind. Early family policy goals included providing protection for mothers (Son, 2024), although it is worth noting that employment protection for new mothers can also be viewed through the lenses of health and labor market policies. Attitudes toward women as mothers and as workers remain diverse and often lag behind the changing positions of women within the labor market. The direct and indirect costs of childbearing and childrearing continue to be disproportionately borne by women, including the burden of domestic labor (Abramowski, 2020; Treas & Drobnič, 2010). Indicators of gender inequality, such as the Gender Inequality Index or Gender Development Index, persistently highlight the unequal status of women in private, occupational, and political spheres (UN, n.d.). Cultural models governing the division of labor by gender and societal attitudes and norms regarding what men and women should or should not do profoundly impact the opportunities and barriers to equitable participation for both genders, thereby shaping the development of family policy measures.

1.3.4. Openness toward diverse family forms

In many societies, opposite-sex marriage has traditionally served as the cornerstone for establishing new families and connecting existing ones. This institution has provided a legally accepted framework for childbirth, child-rearing, and the creation of familial bonds through in-law relationships. Views on the importance of marriage in forming partnerships, bearing children, divorce, remarriage, and single parenthood vary considerably among individuals (Chambers & Gracia, 2021). In particular, attitudes and legal regulations concerning same-sex partnerships and same-sex families exhibit notable divergence across countries and world regions (Chung, 2021; Pettinicchio, 2012; Roberts, 2019). These variations hold significant implications for the very definition of the family and the inclusivity of family policy measures.

1.3.5. Societal attitudes toward demographic development and fertility

In addition to exploring individual-level attitudes and cultural values associated with the four dimensions discussed earlier, we propose that societal stances on demographic development and the salience of fertility issues in sociopolitical discourse can significantly influence family policy strategies. Societies differ in the level of importance they attach to population trends, even if objectively, they are at the same level of demographic development. This is crucial because it is often hypothesized that demographic pressure can trigger state interventions in families (Böger *et al.*, 2022).

In many countries, there is a keen awareness of population growth or decline in relation to sustainable development agendas and concerns about population control, low fertility rates, aging populations, and a shrinking labor force. Governments themselves hold opinions on intervening in population development, and family policy can serve as a tool for such interventions (UN, 2011b). The specific measures within family policy are, therefore, likely to be influenced by pro- or anti-natalist objectives or an indifferent approach to population development within a given country. Furthermore, it has been argued that family policies supporting the combination of work and parenthood – unlike support for the traditional family with separate gender spheres – could increase fertility in low-fertility countries, probably mediated in part by female labor force participation (Wesolowski & Ferrarini, 2018). Overall, it can be assumed that the perception that fertility rates in a country are (too) low coincides with less conservative cultural values regarding the family and gender roles, both of which tend to favor progressive family policy.

2. Data and methods

Assessing cultural dimensions poses a significant challenge, even more so than evaluating economic, politico-legal, or demographic indicators on a global scale. Cultural indicators rely on the assessment of attitudes and values, which reflect people's states of mind, opinions, emotional responses, and evaluations of specific issues. Typically, this type of data is collected through surveys and is not readily available from national statistical offices.

Despite the proliferation of cross-national surveys in recent decades, their coverage is often limited to well-established cases, primarily within the European Union (EU) and, to a lesser extent, OECD countries. For countries in other world regions, comparative survey data can be scarce. Even when high-quality surveys are conducted in individual countries, comparability across languages, cultures, and contexts becomes a significant hurdle.

The WVS is the only dataset that includes a substantial number of countries globally. The WVS comprises nationwide representative samples of adult populations in participating countries (WVS website: http://www.worldvaluessurvey.org/wvs.jsp). This global research project explores people's values and beliefs, their evolution over time, and their social and political impacts. It places particular emphasis on cultural values, attitudes, and beliefs regarding gender, family, and religion. The dataset spans seven cross-sectional waves, from the initial wave in 1981/1983 to Wave 7, conducted from 2017 to 2021 (Inglehart *et al.*, 2014). Subsequent waves are scheduled every 5 years, with continuous territorial expansion. In total, 104 countries have participated in at least one of the seven waves, although the maximum number of countries participating in a specific year was 60 in Wave 6. We rely on this dataset because it represents the sole source of individual-level data that encompass world regions typically excluded from comparative policy research and cross-country comparisons in general. An additional data source shedding light on societal conditions that may influence the scope and orientation of family policy measures is the UN overview of governments' views and policies on the level of fertility rates in their countries. In the next section, we will compile relevant data from these sources, with a specific focus on describing attitudes for cross-country comparisons.

Our descriptive analysis encompasses 89 countries that participated in the latest three waves of the WVS. For each country, values are extracted from the most recent panel wave in which the country participated. In instances where data were unavailable for Wave 7 (2017 – 2020), values were sourced from Wave 6 (2010 – 2014). In cases where both of the most recent waves lacked data, values were derived from Wave 5 (2005 – 2009). We opted not to incorporate survey waves from more distant periods to ensure that data across different countries correspond to reasonably similar historical periods.

Regrettably, data constraints prevent us from creating single indices for the dimensions of interest. The availability of variables varies across survey waves and participating countries. Attempting to construct indices would result in too many missing cases in the analysis. The exception is the dimension of secularization and emancipative values, which aligns with a subset of the Inglehart–Welzel Cultural Map (Inglehart & Welzel, 2005). This dimension has been systematically assessed over the survey waves, with indices provided in the WVS database, which we gratefully utilize. In addition, we have employed individual variables as indicators of attitudinal patterns assumed to be related to country-specific family policies. We have coded all variables in a manner that aligns with societal trends of modernization: higher values signify more extensive defamiliarization, increased secularization, more egalitarian gender roles, and greater acceptance of diverse family forms.

3. Results

The variables of interest in the WVS pertain to the discussed dimensions likely to influence the development and direction of family policy, which include familiarization and defamiliarization, secularization and emancipative values, gender roles, and openness toward diverse family forms. While these dimensions are distinguished for analytical purposes, it is important to note that many measures may overlap. Nevertheless, we differentiate these dimensions to provide a more systematic overview of the cultural underpinnings of policy instruments.

3.1. Familiarization and defamiliarization

Familialistic attitudes emphasize the importance of the family and advocate for the family to meet the care needs of its members, thereby reinforcing the dependence of individuals in need of care on their families.

Here, we propose to examine the distribution of two variables that can serve as indicators of a country's orientation toward defamiliarization, i.e., the extent to which the approval of familialistic attitudes has lost importance. First, we gauge the significance of the family in a given country based on the question: "For each of the following, indicate how important it is in your life. Would you say it is very important, rather important, not very important, not at all important?" The 1 (very important) to 4 (not at all important)-point scale indicates the degree of defamiliarization. The values have been standardized to express the mean for each country within the range of 0 – 1. The data are not weighted. The positions of countries on this variable are presented in Figure 1. The most remarkable outcome of this overview is the universal importance of family worldwide. In every single country, the overwhelming majority of respondents consider family to be very important. Cross-country differences are small, with scores ranging between 0.00 (Egypt) and 0.10 (Haiti) on the standardized 0 – 1 defamiliarization scale. Within this narrow range, Asian countries, with a few exceptions, tend to be located at the lowest level of defamiliarization, while Latin American and European countries generally have somewhat higher scores on the right-hand side of the graph.

The second indicator of defamiliarization reveals considerably more cross-country diversity, even though the number of countries is unfortunately smaller. The

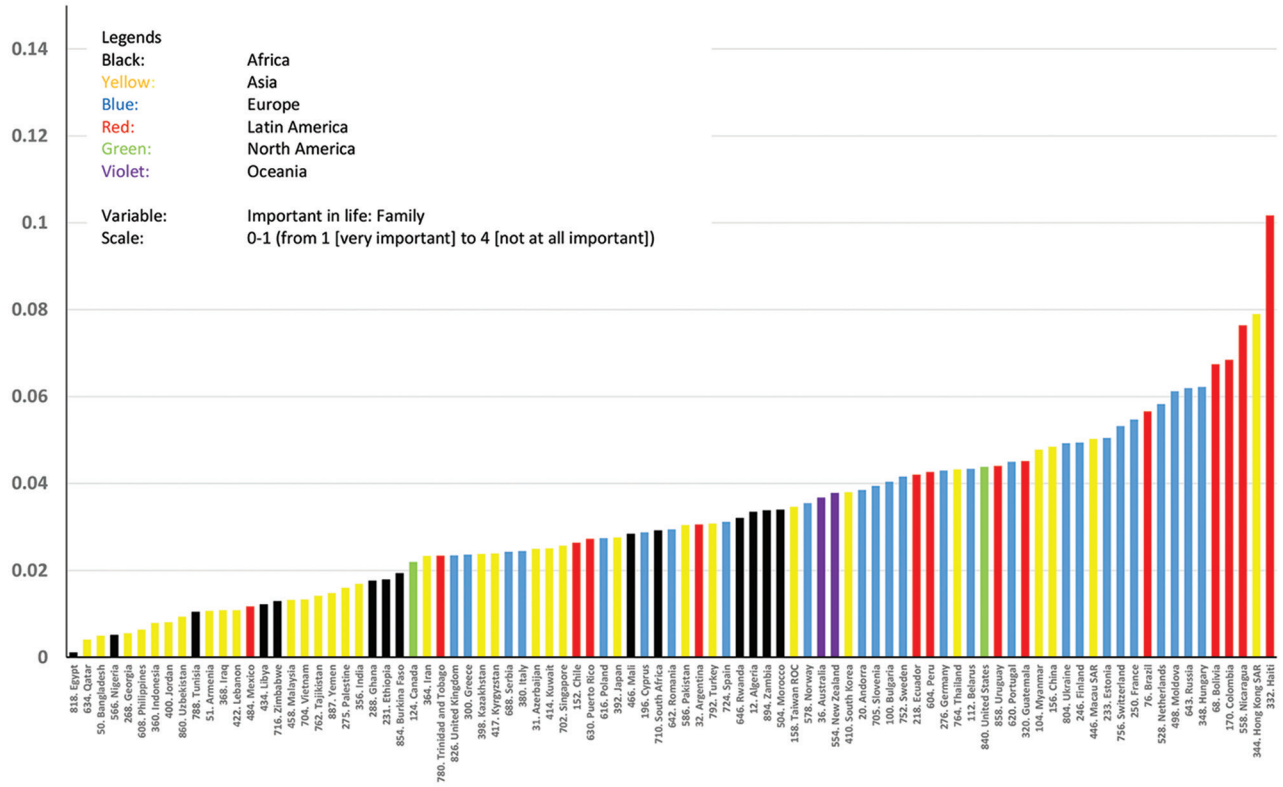

Figure 1. Importance of family in a person's life. Note: Higher score: Lower importance. Source: World Values Survey.

WVS question, "How would you feel about the following statements? Do you agree or disagree with them? Adult children have the duty to provide long-term care for their parents," was measured on a 5-point scale: agree strongly (1), agree (2), neither agree nor disagree (3), disagree (4), and disagree strongly (5), expressing the degree of disagreement, i.e., defamiliarization. This scale was also rescaled to a range of 0 – 1. All African and a significant proportion of Asian countries strongly agree that adult children are responsible for the long-term care of their elderly parents (Figure 2). New Zealand and Australia are the only countries where the mean of standardized respondents' scores slightly exceeds the 0.5 threshold, indicating a tendency to disagree. Other countries with a relatively high level of disagreement include Japan, Germany, and the USA.

Overall, the two indicators of defamiliarization suggest that Asian and African societies tend to exhibit familialism and intergenerational family solidarity. However, it is important to note that this is a very general statement. There is considerable variation within world regions and cultural spheres, with important exceptions. For example, Japan, despite its prevailing Confucian values and culturally grounded intergenerational solidarity, has one of the highest rates of disagreement regarding the obligation of adult children to provide long-term care for their parents. This higher rate of disagreement may be attributed to shifting intergenerational contracts within urban Japanese families in response to the growing availability of public care services for the elderly (Jenike, 2003), which could explain the comparatively high score in the WVS. Nevertheless, many countries in Asia and Africa still adhere to familialism, reinforcing the primacy of familial responsibility, a concept widely accepted by the population and seldom questioned.

3.2. Secularization and emancipative values

A high degree of secularization in society and a propensity toward emancipation indicate a shift away from traditional values. It can be expected that countries whose populations, on average, hold more progressive or conservative values are more likely to adopt correspondingly progressive or conservative family policy models. Evidence of such a relationship has been discovered in East and Southeast Asian countries, where a discernible alignment between the clustering of family policies and the cultural fabric of their respective societies was observed (Tonelli *et al.*, 2021).

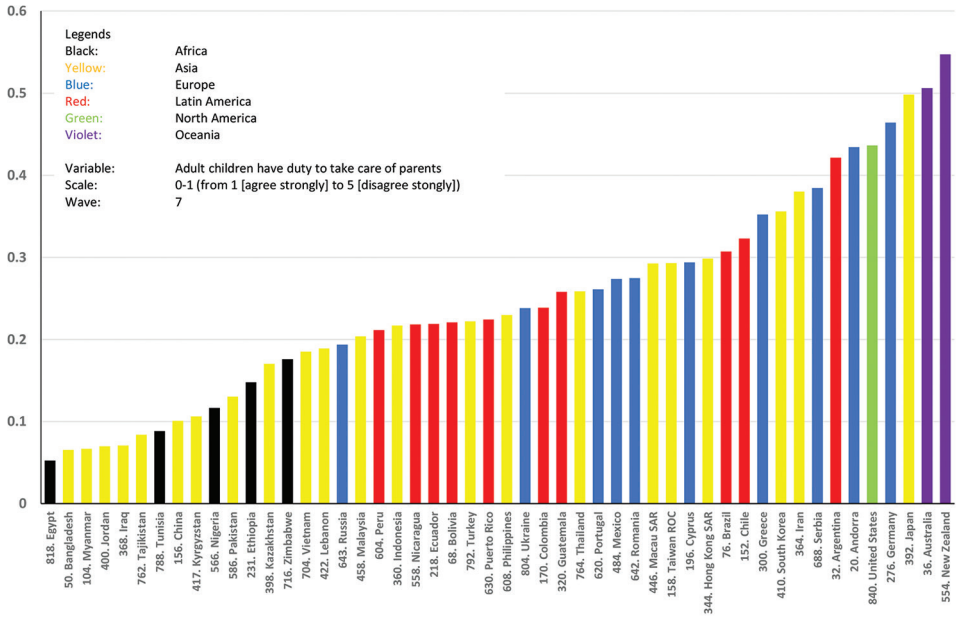

Figure 2. Adult children's responsibility for elderly parents. Note: Higher score: Stronger disagreement. Source: World Values Survey.

The WVS includes a set of composite indices (Welzel, 2013; see also https://www.worldvaluessurvey.org/WVSContents.jsp?CMSID=welzelidx&CMSID=welzelidx). We assess a country's progressivity using Welzel's indicators of disbelief and autonomy, each of which is constructed from three items in the WVS questionnaire. The scores of these indices are standardized and can range from 0 to 1, with higher scores indicating greater levels of secularization and autonomy. Secularization is measured using the sub-index DISBELIEF, which combines information on the importance of religion in a person's life, religiosity, and religious practice. The most notable variation can be found in Asia, ranging from the least secular (Qatar) to countries with the highest DISBELIEF scores, including China, Macau, Hong Kong, and South Korea (Figure 3), echoing the claim that Asia exhibits deep diversity in terms of family systems (Therborn, 2014). European countries and Oceania are generally quite secularized, although Poland, Greece, and Italy score considerably lower on the index, placing them on par with most Latin American countries. In Africa and many Asian countries, particularly Islamic societies, religion and religious practices play a very important role.

To assess the values that are particularly prominent in various societies, the WVS asks about the importance of qualities that children can be encouraged to learn at home. Welzel's sub-index AUTONOMY, which we use as a measure of emancipative values, combines the importance of independence, imagination, and obedience (reversed) as qualities for children (Figure 4). Norway, Sweden, South Korea, and Japan, followed by other European and East Asian countries, top the autonomy index. However, several of these countries also fall in the mid to lower range. Latin American countries generally score lower on this scale, as do African countries, except for South Africa.

3.3. Gender roles

Attitudes toward women's and men's roles in the family continue to vary worldwide, as do attitudes toward women's changing roles in the labor market (Dotti Sani & Quaranta, 2017). The increase in the proportion of married women and mothers who are employed outside the home has often not been accompanied by corresponding changes in societal attitudes and values. Even in countries where women's labor force participation has significantly increased, results indicate that both men and women still prefer a primary familial role for women, especially when young children are present (Alwin *et al.*, 1992), and "liberal-egalitarian" ideologies coexist with a highly unequal gender division of labor in families (Abramowski, 2020). Thus, the underlying notion of the proper societal roles for men and women can undoubtedly influence family policy. Policy instruments can differ substantially based on whether the aim is to support stay-at-home mothers, dual-earner couples, or actively promote men's caregiving roles within the family.

To measure normative factors associated with the care and nurturing of children, we examine attitudes toward female employment and its implications for young children

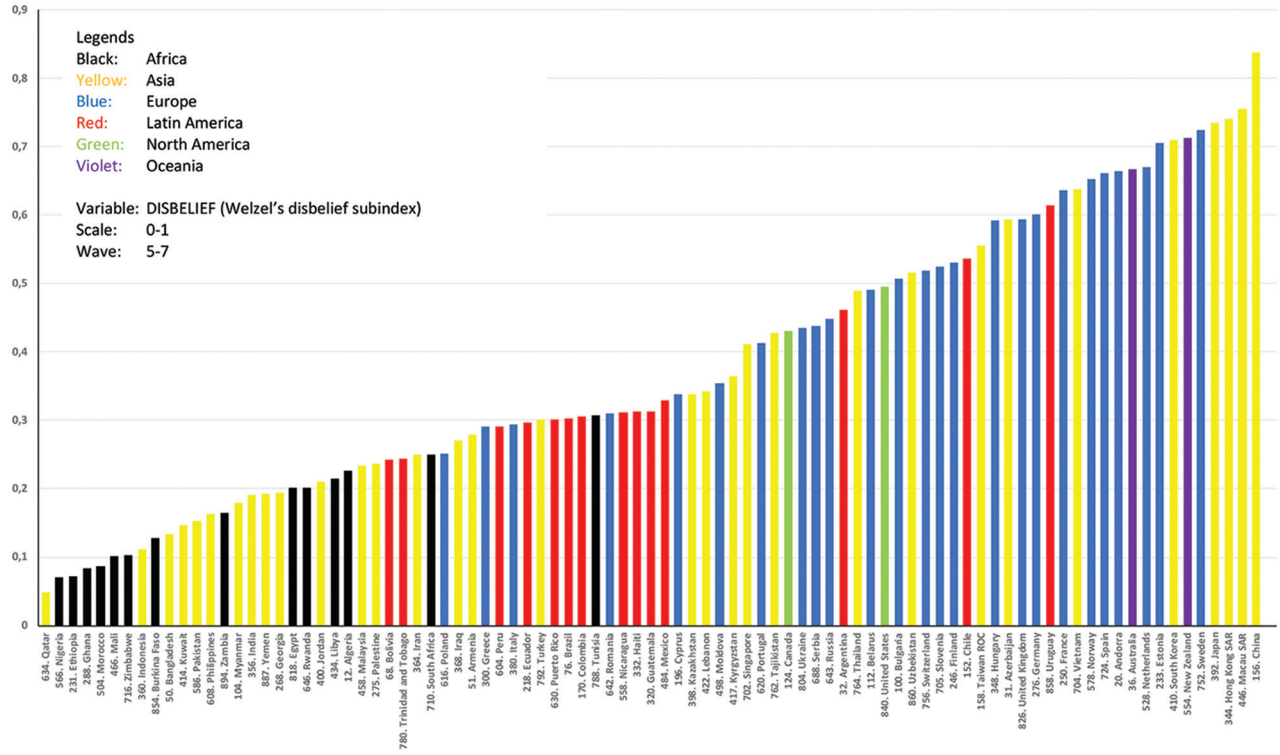

Figure 3. Secularization. Source: World Values Survey (Welzel's sub-index DISBELIEF).

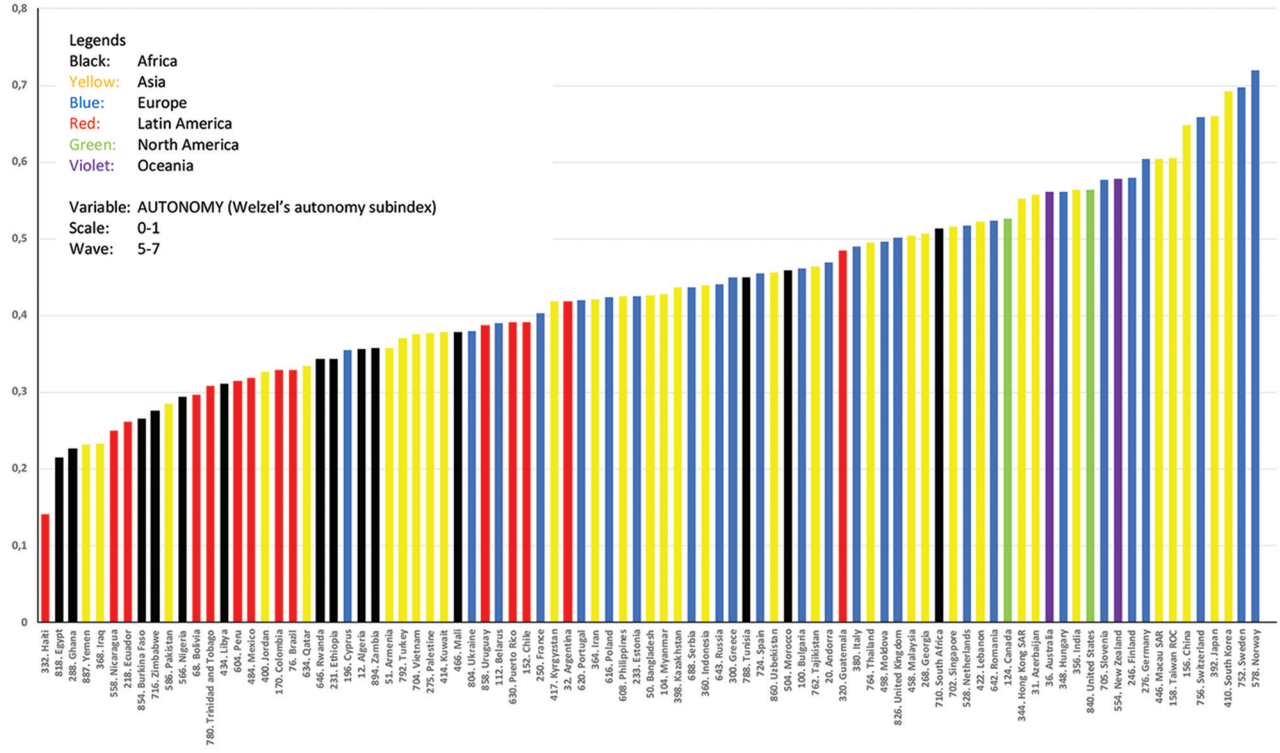

Figure 4. Autonomy as a value to be transmitted to children. Source: World Values Survey (Welzel's sub-index AUTONOMY).

in the WVS. We have selected only indicators that were included in many countries. The WVS asked the following questions: "For each of the following statements I read out, can you tell me how strongly you agree or disagree with each. Do you strongly agree, agree, disagree, or strongly disagree? Being a housewife is just as fulfilling as working for pay," and "When a mother works for pay, the children suffer." The response categories have been rescaled so that the average country values range from 0 to 1. Higher values indicate lower agreement with the statements, signifying a higher acceptance of female employment and, consequently, more gender-egalitarian attitudes.

Figure 5 displays the level of disagreement with the statement that being a housewife is as fulfilling for a woman as working for pay, reflecting support for traditional gender divisions of labor. The dominant impression conveyed in Figure 5 is a wide variation of attitudes, significant diversity within world regions, and disparities among countries often considered culturally similar. No discernible patterns can be observed across continents. For example, respondents in Myanmar largely agree with the statement that housewives have a fulfilled life, but neighboring Thailand mostly disagrees with that statement. Substantial disagreement can also be found in Serbia, Romania, Sweden, and several other European countries, while Hungary, Estonia, and Belarus exhibit the most traditional gender attitudes in this regard. Traditional views on women's roles also apply to North African countries such as Egypt, Tunisia, and Algeria, whereas sub-Saharan African countries, particularly Nigeria and Ghana, view work as an important accomplishment for women. Latin American countries show a wide range of responses, from Puerto Rico, which tends to agree, to Haiti, which displays the greatest disagreement with the statement.

A similar dispersion across world regions is evident for the second indicator. The belief that children suffer when the mother works for pay is most prevalent in Asian countries such as Jordan, Yemen, Pakistan, Qatar, and Bangladesh. In contrast, Taiwan is at the opposite end of the opinion spectrum, surpassing the Netherlands, New Zealand, Zimbabwe, and the USA (Figure 6). A more systematic pattern of responses emerges from the question, "How would you feel about the following statements? Do you agree or disagree with them? If a woman earns more money than her husband, it's almost certain to cause problems." On a 3-point scale, from agree to disagree, responses

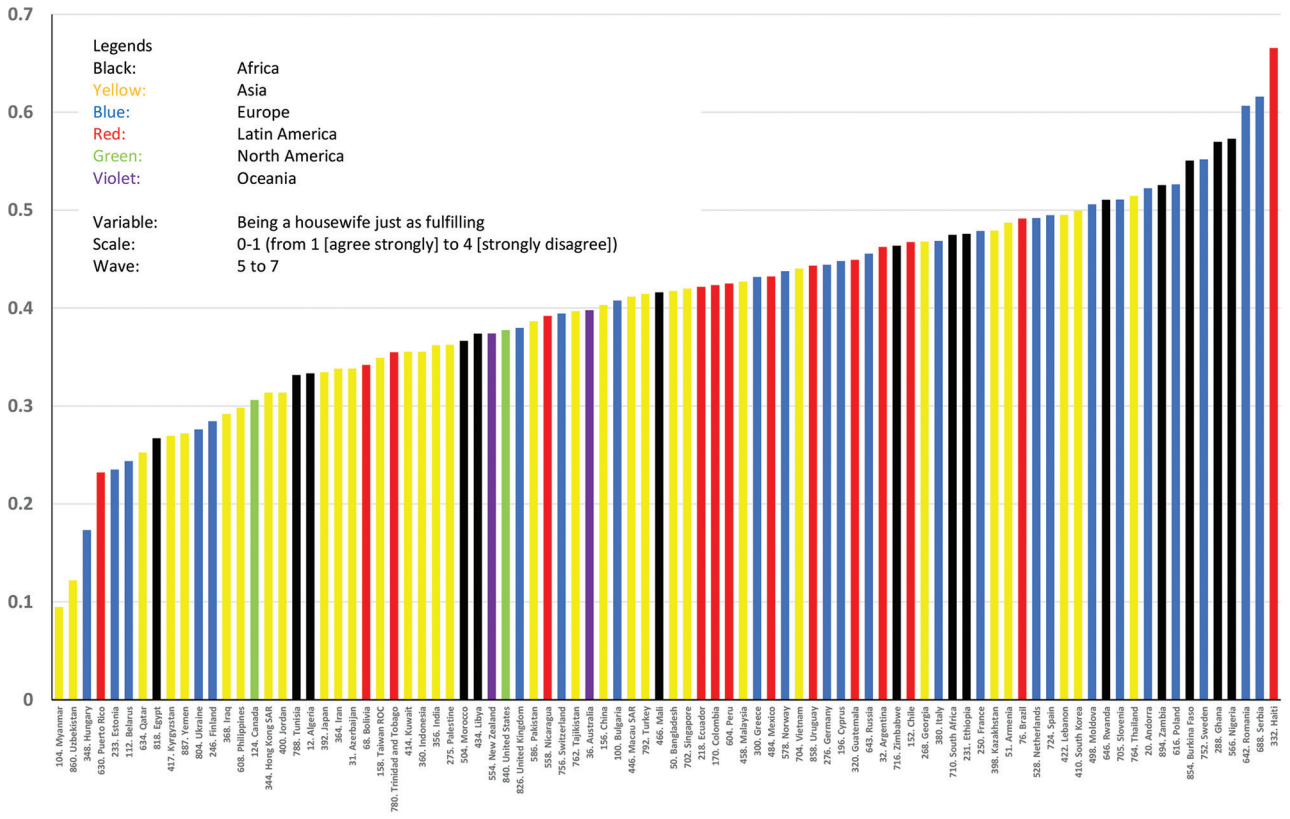

Figure 5. Domestic role of women: Being a housewife is as fulfilling as working for pay. Note: Higher score: Stronger disagreement. Source: World Values Survey.

were rescaled to values between 0 and 1 and are plotted in Figure 7. EU countries, New Zealand, Australia, and the USA tend to disagree with this statement, while respondents in Asian, African, and Latin American countries are more likely to view a female earning advantage as a problem.

We assess a country's progressiveness using Welzel's sub-index on gender equality, which includes attitudes on women's employment ("When jobs are scarce, men should have more right to a job than women"), education ("A university education is more important for a boy than for a girl"), and politics ("On the whole, men make better political leaders than women do") (Welzel, 2013). Examination of the sub-index EQUALITY, rescaled to the range of 0 – 1, reveals that European countries, Australia, New Zealand, and North America exhibit more gender-egalitarian opinions. Latin America, particularly Puerto Rico, also ranks relatively high on this index (Figure 8). Asian countries, with Pakistan at the bottom, and African countries stand out for maintaining high levels of gender inequality in these domains.

3.4. Openness toward diverse family forms

The question is not solely about how family policy can support or hinder the life scripts of wives/mothers and husbands/fathers; it also concerns whether governmental policies acknowledge and include pluralistic family forms in institutional support. We examine the cultural basis for family policy instruments that incorporate non-traditional family arrangements, such as unmarried couples, single parents, and same-sex families.

The first indicator is based on the question: "Please tell me for each of the following actions whether you think it can always be justified, never be justified, or something in between, using this card: Sex before marriage." A 10-point scale, ranging from never to always justifiable, has been rescaled to values between 0 and 1. In many Asian countries, particularly Jordan, Qatar, and Bangladesh, nearly all respondents consider sex before marriage unacceptable and never justified (Figure 9). African countries, such as Libya, Tunisia, and others, also tend to hold extremely restrictive views on pre-marital sexual relationships. On the opposite side of the spectrum are countries where sex before marriage is mostly viewed as justified. European countries, such as Sweden, Slovenia, Germany, the Netherlands, and Andorra are among the most permissive societies in this respect, followed by New Zealand and Australia. Latin America occupies a more central position in the distribution, with Uruguay aligning with European and Oceanian states in its permissive attitudes.

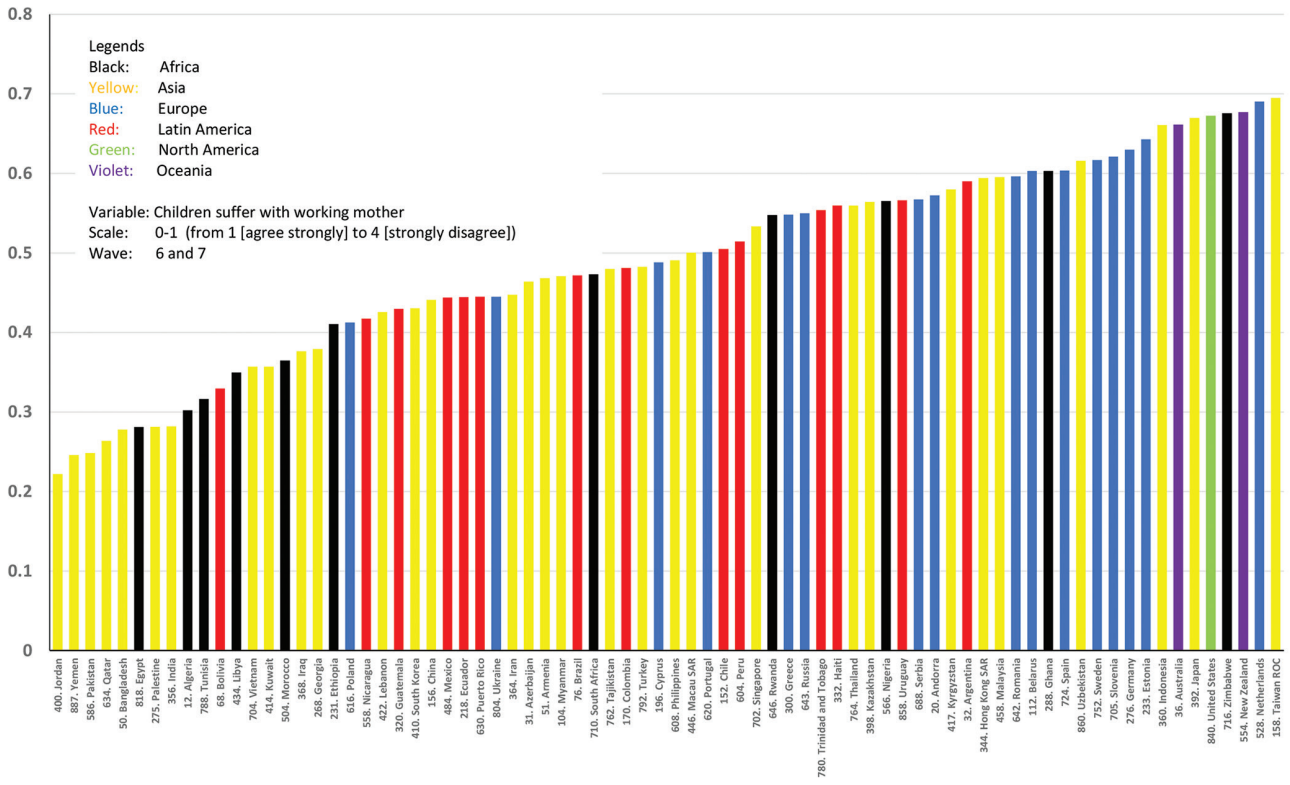

Figure 6. Domestic role of women: When the mother works for pay, the children suffer. Note: Higher score: Stronger disagreement. Source: World Values Survey.

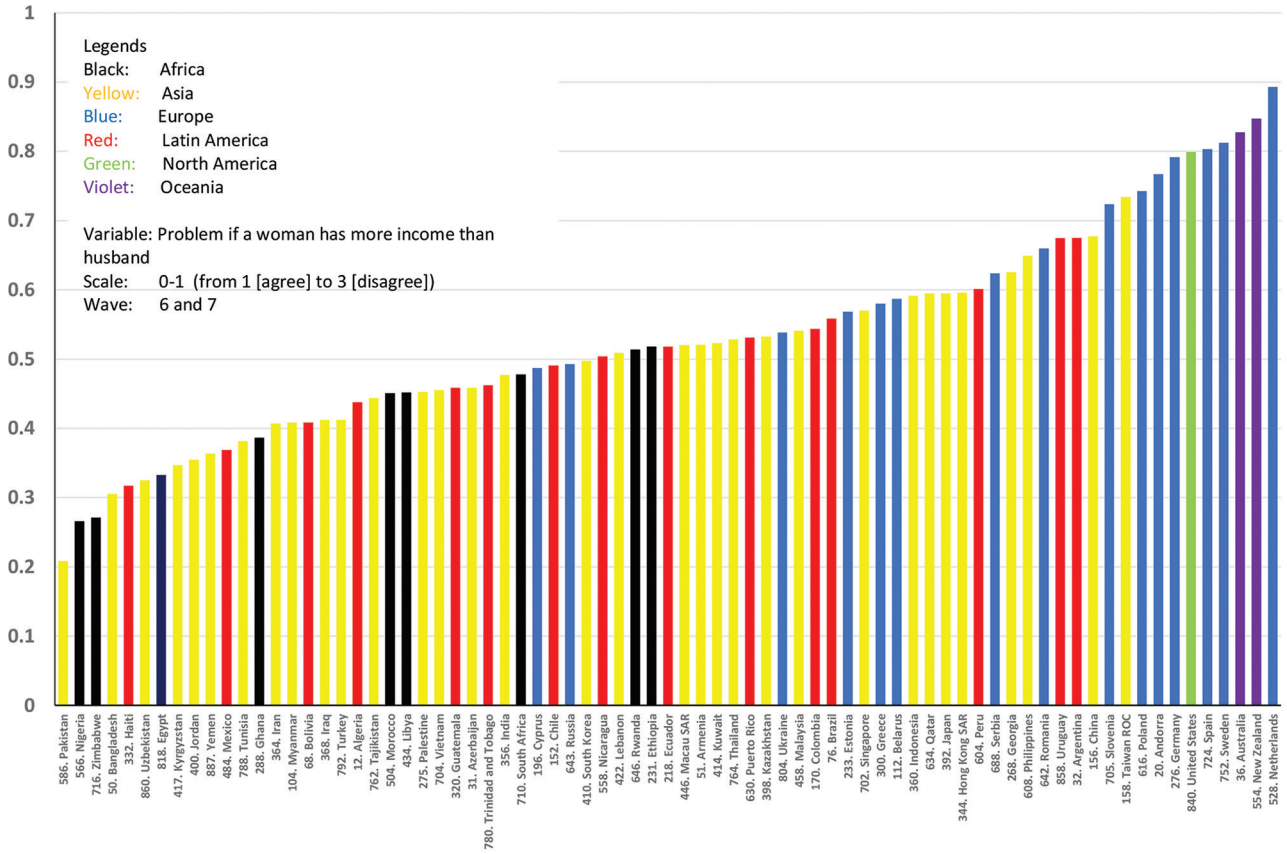

Figure 7. Perception of gendered income inequality. Note: Higher score: Stronger disagreement. Source: World Values Survey.

Compared to the previous question, fewer countries in the WVS implemented the following question: "How would you feel about the following statements? Do you agree or disagree with them? Homosexual couples are as good parents as other couples." The 5-point scale has been reversed to higher values expressing stronger agreement and rescaled to values between 0 and 1. All three African countries – Ethiopia, Nigeria, and Zimbabwe – exhibit the lowest agreement scores (Figure 10). Several European countries also rank very low on the scale, such as Greece, Romania, Serbia, Russia, and Ukraine. Interestingly, societies with the highest scores are widely distributed across continents: Puerto Rico, Germany, New Zealand, the USA, Australia, and Vietnam.

Finally, Welzel's sub-index CHOICE combines three items: homosexuality, abortion, and divorce, and respondents were asked whether these actions can be justified or not. The degree of justifiability was given on a 10-point scale between never and always and was rescaled to values between 0 and 1. The composite index is displayed in Figure 11. All the most tolerant societies are European countries, together with New Zealand and Australia. In contrast, Asian and African societies tend to have the most restrictive attitudes, with India exhibiting particularly conservative views on issues such as homosexuality, abortion, and divorce.

Overall, in terms of geographic distribution, African societies included in the WVS are less open to non-traditional family forms than many countries in other parts of the world. Asian societies tend to view sex before marriage as less justifiable but score fairly high in their view that homosexual couples can be good parents. This perspective is not shared by countries in Southern and Eastern Europe. However, European countries, along with Australia and New Zealand, are the most tolerant societies regarding sex before marriage, as well as freedom of choice in terms of homosexuality, abortion, and divorce.

3.5. Societal attitudes toward demographic development and fertility

In addition to using the VWS data to explore individual-level attitudes, we assess the cultural climate related to demographic development in countries around the world. Population changes and fertility levels are carefully

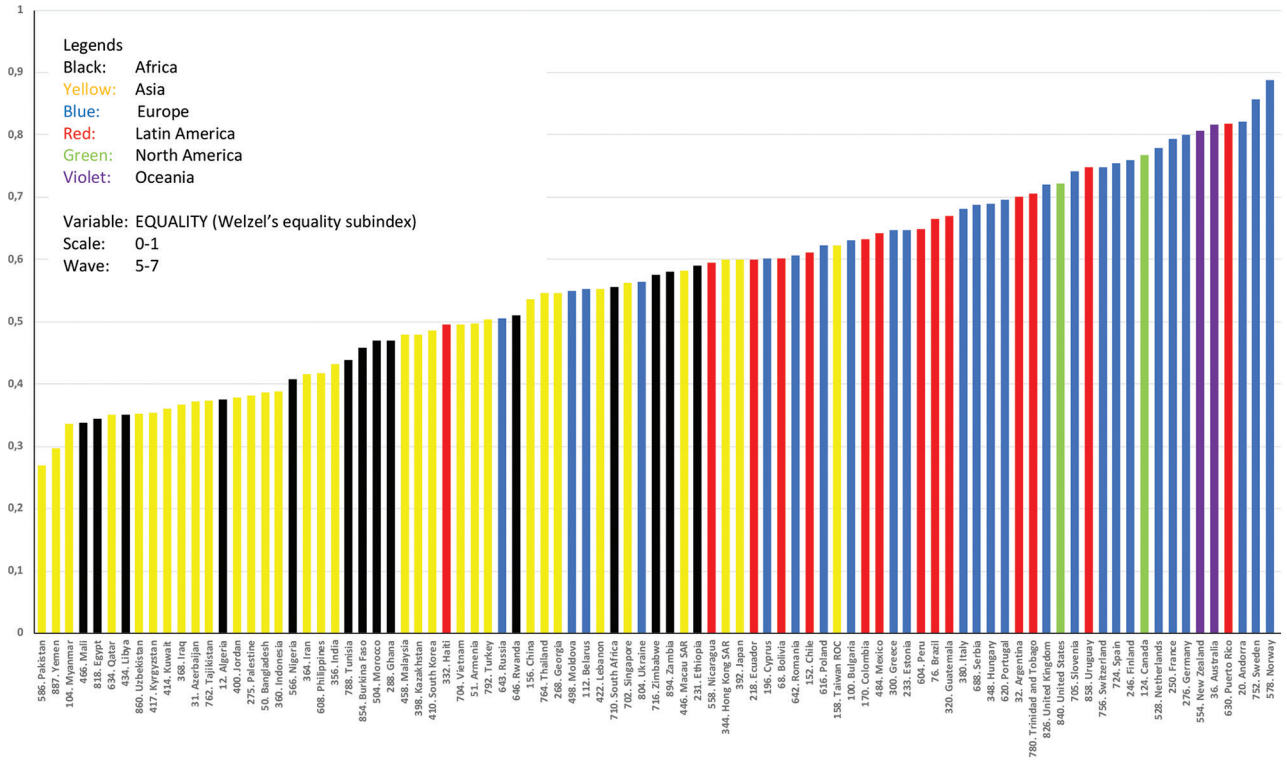

Figure 8. Attitudes toward gender equality in employment, education, and politics.Source: World Values Survey (Welzel's sub-index EQUALITY).

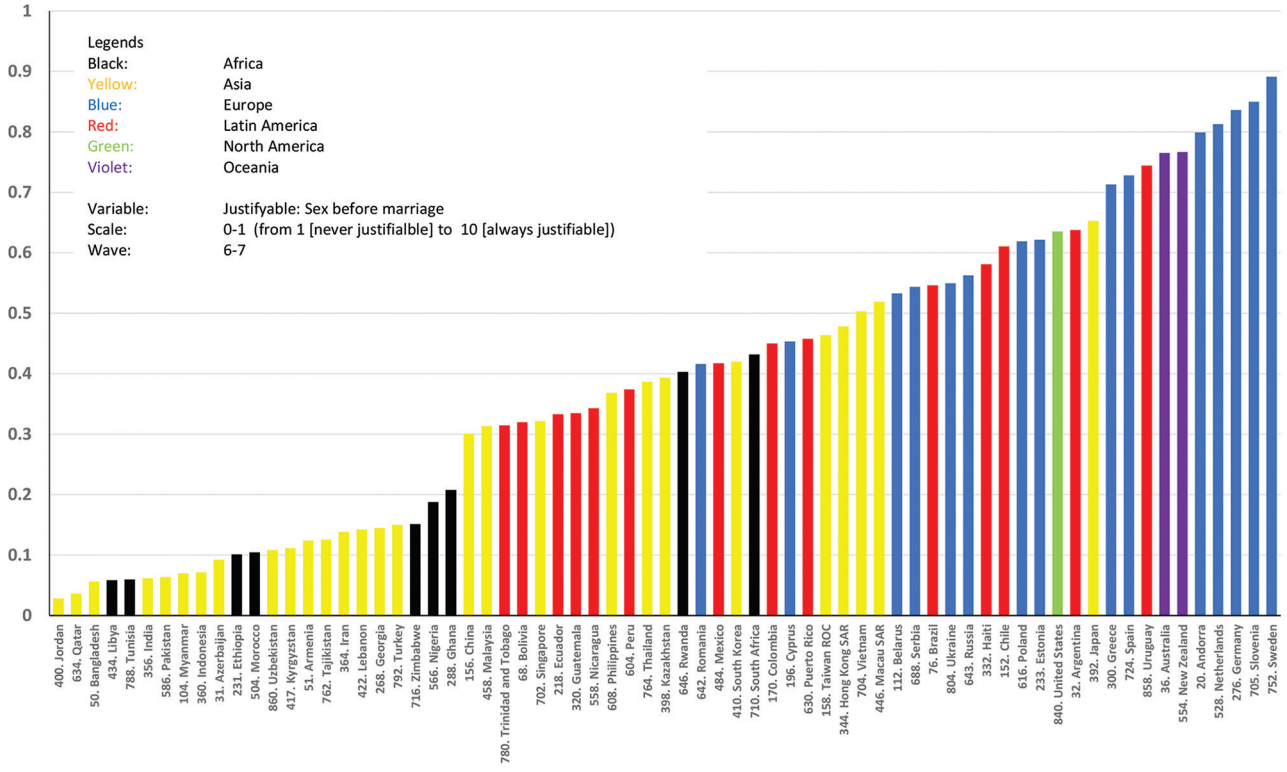

Figure 9. Openness toward pre-marital sex. Source: World Values Survey.

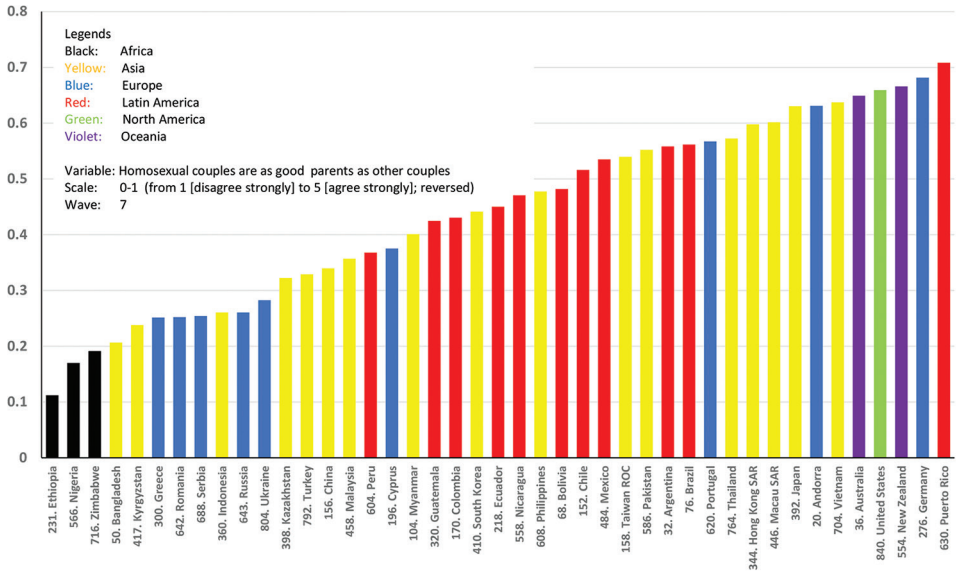

Figure 10. Openness toward same-sex families. Source: World Values Survey.

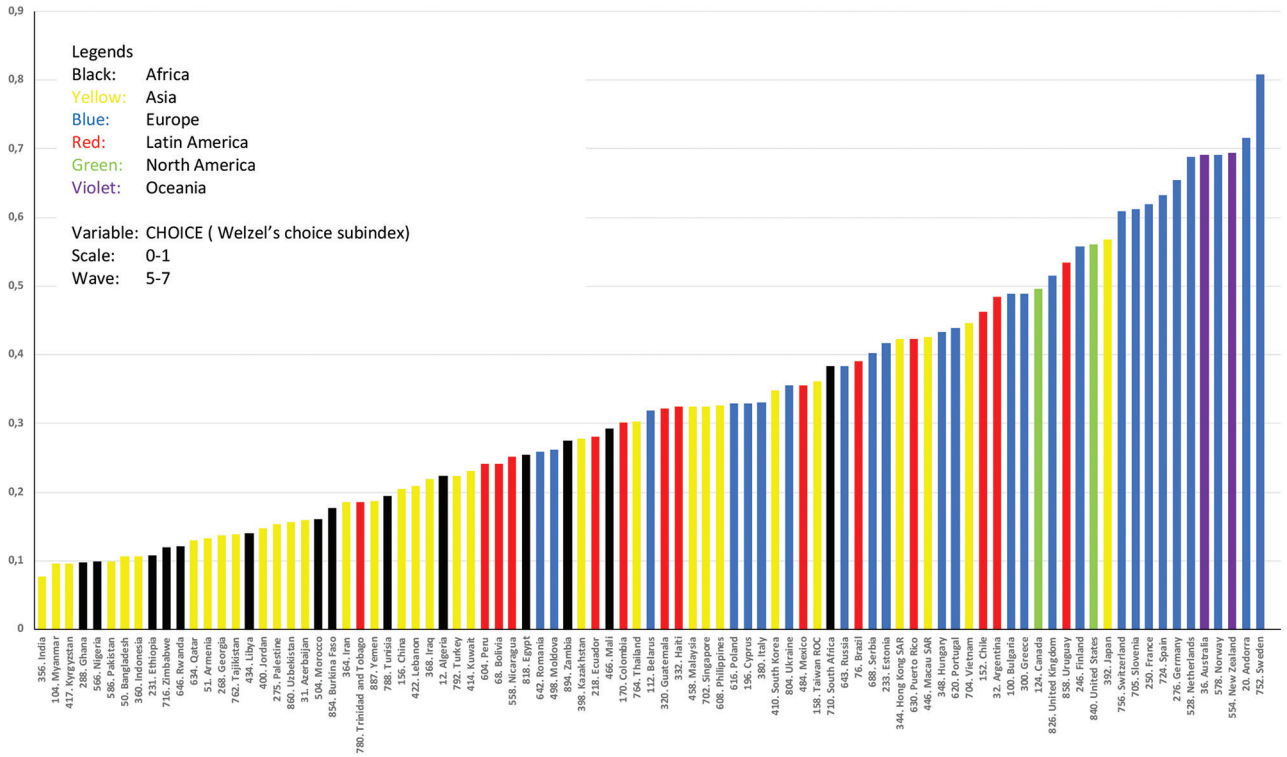

Figure 11. Justification of homosexuality, abortion, and divorce. Source: World Values Survey (Welzel's sub-index CHOICE).

monitored in many countries. In most cases, governments continuously assess population issues and pursue explicit policies to influence fertility rates in their countries. We argue that the perception of low fertility should correspond with less conservative values in a country – both supporting a state's engagement in family policy. Table 1 reports government views as provided to the Population Division of the Department of Economic and Social Affairs of the UN. Most countries actively pursue policies aimed at raising fertility rates, maintaining current levels, or lowering fertility levels if they are deemed too high to achieve specific economic, social, or developmental

goals. Countries also report whether they do not engage in any interventions related to fertility. Among the 195 government reports included in the UN overview (Table 1), 43 countries consider fertility levels to be too low and implement policies aimed at increasing fertility. This is the case with most European countries and a group of Asian countries. Asia is deeply divided in this respect. While some countries still exhibit high fertility rates and aim to lower them, several countries, particularly in East and Southeast Asia, have experienced a remarkable shift in demographic trends in the second half of the 20th century (Chung *et al*., 2021). They transitioned swiftly from very high to the lowest-low fertility rates, and now, faced with rapid population aging, these governments are working to raise fertility levels. A large majority of African countries aim to lower fertility levels, as do some Latin American countries and those in the Caribbean. However, most Latin American governments plan no interventions, similar to the USA and Canada.

Table 1. Government views and policies on the level of fertility in their countries

Continent	Raise	Maintain	Lower	No intervention
Africa	Gabon	Angola, Botswana, Equatorial Guinea, Mauritius, South Africa	Algeria, Benin, Burkina Faso, Burundi, Cape Verde, Comoros, Congo, Côte d'Ivoire, Egypt, Eritrea, Ethiopia, Gambia, Ghana, Guinea, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Sudan, Swaziland, Togo, Tunisia, Uganda, United Republic of Tanzania, Zambia, Zimbabwe	Cameroon, Central African Republic, Chad, Dem. Republic of the Congo, Djibouti, Guinea-Bissau, Libyan Arab Jamahiriya, Sao Tome and Principe, Seychelles, Somalia
Asia	Armenia, Azerbaijan, Cyprus, Georgia, Israel, Japan, Kazakhstan, Kuwait, Mongolia, Qatar, Republic of Korea, Singapore, Turkmenistan	China, Kyrgyzstan, Myanmar, Sri Lanka, Thailand, Turkey, United Arab Emirates, Uzbekistan	Bahrain, Bangladesh, Bhutan, Cambodia, India, Indonesia, Iran (Islamic Republic of), Jordan, Lao People's Dem. Republic, Maldives, Nepal, Oman, Pakistan, Philippines, Syrian Arab Republic, Tajikistan, Vietnam, Yemen	Afghanistan, Brunei Darussalam, Dem. People's Rep. of Korea, Iraq, Lebanon, Malaysia, Saudi Arabia, Timor-Leste
Europe	Austria, Belarus, Bulgaria, Croatia, Czech Republic, Estonia, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Montenegro, Poland, Portugal, Republic of Moldova, Romania, Russian Federation, Serbia, Slovakia, Slovenia, Spain, TFYR Macedonia, Ukraine	Albania, Andorra, Finland, Iceland, Luxembourg, Monaco, Norway		Belgium, Bosnia and Herzegovina, Denmark, Holy See, Ireland, Liechtenstein, Malta, Netherlands, San Marino, Sweden, Switzerland, United Kingdom
Latin America and the Caribbean	Barbados	Panama, Saint Lucia, St. Vincent and the Grenadines, Suriname, Trinidad and Tobago	Colombia, Costa Rica, Dominican Republic, Guatemala, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Peru	Antigua and Barbuda, Argentina, Bahamas, Belize, Bolivia (Plurinational State of), Brazil, Chile, Cuba, Dominica, Ecuador, El Salvador, Grenada, Guyana, Paraguay, Saint Kitts and Nevis, Uruguay, Venezuela (Bolivarian Rep. of)
Northern America				Canada, United States of America
Oceania	Australia, Cook Islands, Niue	Nauru, New Zealand, Tonga	Fiji, Kiribati, Marshall Islands, Micronesia (Federated States of), Papua New Guinea, Samoa, Solomon Islands, Tuvalu, Vanuatu	Palau
All	43	27	74	51

Source: Adapted from United Nations (2011b).

4. Discussion

The aim of this study is to descriptively identify values and attitudes expressed in the WVS and connect them to various underlying dimensions that presumably influence family policies. Mapping family policy configurations worldwide and linking them directly to cultural patterns is beyond the scope of this study. Nonetheless, it is worth noting that on a smaller scale, Tonelli *et al.* (2021) have found that typical cultural traditions and values are associated with specific child-related family policy configurations in East and Southeast Asia. They argue that country clusters with specific family policy configurations differ in their levels of secularization, views on values that families should transmit to their children, and gender-egalitarian values. However, they conclude that more comprehensive policy measures are primarily related to concerns about fertility levels (Tonelli *et al.*, 2021), implicitly aimed at increasing fertility through family policy instruments. Therefore, we also assess societal attitudes related to population development and fertility concerns.

Our study encompasses a broad range of countries with diverse levels of socioeconomic development, modernization, cultural traditions, and value systems. By describing and ranking countries based on attitudes and values expressed in the WVS, our goal is to identify value patterns that can aid our understanding of the various scopes and orientations of family policy measures worldwide. We examine country-specific distributions of responses in the WVS and employ composite indices for emancipative and secular values, which have been theoretically explained and empirically tested for cross-cultural reliability and validity in Welzel (2013). However, we cannot explicitly test the association between cultural values and actual policy instruments.

To summarize the major findings, the perceived importance of family remains very high worldwide, with no noticeable decline over time. However, there is significant variation in perceptions regarding responsibility for elderly family members. New Zealand and Australia lead in terms of defamiliarization, but countries in Asia, Europe, and Latin America vary widely along the defamiliarization scale. On the other hand, African and some Asian countries, including China, emphasize traditional intergenerational family solidarity and a strong familialist orientation, potentially indicating a less perceived need for comprehensive family policy measures. It is unclear from these descriptive data whether value change precedes the expansion of public services for the elderly or if emerging state support influences value change and cultural perceptions of family responsibilities.

The shift away from traditional values is more pronounced in some world regions than others. Composite indices involving secularization and autonomy exhibit a similar trend, with African countries scoring low, Latin America in the mid-range, and Western countries in the high range. Asian societies are diverse, with Islamic Asian countries sharing similarities with Africa, and East Asian countries aligning more closely with Western societies. However, the composite index on gender equality paints a different picture. Latin American countries are moving higher on the gender equality index ranking, displaying more similarities with Western societies. Meanwhile, no Asian country scores high on this indicator; they align with African countries, displaying a low gender equality index. Still, when specific indicators are examined, the neat pattern of Western societies scoring high on gender equality is disrupted. Many European and other Western societies consider the position of a housewife as fulfilling as working for pay, while numerous African countries strongly disagree. Housewifery systems are deeply ingrained in the cultural fabric of Western societies, leading to women's economic dependency and justifying family policy instruments in support of the traditional male breadwinner family model.

Emancipative values also reveal greater cultural acceptance and tolerance of alternative lifestyles and new family forms in Western societies and lower approval in African and many Asian societies. This cultural acceptance and tolerance applies to divorce, abortion, homosexuality, and particularly sex before marriage, which is widely accepted in Europe and Oceania but not justifiable in large parts of Africa and Asia. However, Europeans often disagree that homosexual couples can be as good parents as other couples, drawing a line between personal freedom and family arrangements when it comes to new family forms involving children.

For the sake of simplicity, we present the results grouped by continents. However, these findings broadly correspond to Therborn's (2014) typology of family systems. Following this typology considerably helps in interpreting several observations in the figures. For example, there is significant diversity among Asian societies across various indicators. In his world family system, Therborn (2014) distinguishes between South Asian, Confucian East Asian, and Southeast Asian types of families. In addition, he groups Islamic West Asian families with North African families. These divisions and similarities are reflected in several indicators from the WVS. Likewise, we observe the divide between sub-Saharan African and North African family patterns, the latter being much closer to the Islamic West Asian model. However, it is important to note that while this alignment is observed in several WVS indicators, it is not consistently reflected in all indices. Furthermore, not all family systems (e.g., the Creole family system) can be accurately mapped using WVS data, as the data primarily encompass entire

countries rather than subgroups within countries. As a result, we have organized the results according to major geographic world regions.

The cultural divisions presented here align to a considerable extent with societal attitudes toward demographic processes and governmental views on fertility levels. In a broad sense, secularization, openness toward non-traditional family forms, greater gender equality, and less dependency on intergenerational family solidarity are associated with a completed demographic transition (Lesthaeghe, 2020). Governments in such countries tend to view fertility rates as (too) low and, in many cases, pursue policies to raise them. Within this context, comprehensive family policy instruments that enhance family members' well-being may be seen, at least in part, as pronatalist population strategies. Indeed, it has been demonstrated that the family policy models that lead to an increase in fertility are those that are both generous and incorporate a gender perspective (Gandasegui *et al*., 2021). Conversely, societies with deeply rooted religious norms, patriarchal gender roles, and traditional views on family life are concerned about rapid population growth. A generous family policy might even be perceived as counterproductive in the context of population policy. Furthermore, if family policy measures are perceived as defamiliarizing, altering gender relations, and promoting alternative family forms – actions that are often considered destructive and immoral by citizens – such policy instruments may lack legitimacy and societal support due to their perceived threat to deeply ingrained cultural values.

5. Conclusion

In social policy research, especially in the context of family policy, exploring the relationship between cultural conditions and country-specific policy measures is essential. This aspect has often been neglected, although it could enhance our understanding of the adoption or rejection of specific policy instruments beyond other influencing factors. While contrasting cultural conditions would greatly enhance comparative research, the presence of data limitations and challenges in collecting high-quality data pose significant hurdles in conducting cross-national comparisons.

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Conflict of interest

The authors declare no conflict of interest.

Author contributions

Conceptualization: Sonja Drobnič
Methodology: Johannes Huinink, Mandy Kusnierz
Writing-original draft: Sonja Drobnič
Writing-review & editing: Johannes Huinink

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Not applicable.

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Availability of data

World Value Survey data are available at: https://www.worldvaluessurvey.org

Further disclosure

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ACCSCIENCE PUBLISHING

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RESEARCH ARTICLE

Using discrete choice modeling to understand the drivers of reproductive delay in the United Kingdom

Paula Sheppard*

School of Anthropology and Museum Ethnography, University of Oxford, Oxford, United Kingdom

Abstract

The ideal family size in the UK is, on average, two children. However, there is a fertility gap, the difference between wanted and achieved family size, of around one in three children, which is largely caused by extended delays to reproduction. Standard quantitative methods used to identify what causes these delays have limitations, often relying on macro-level data which conveys little about individual needs, or applying longitudinal methods that produce outdated results because only once people have completed their reproductive years is it possible to infer which life-course factors led to later-age childbearing. This study is the first to overcome these challenges by applying a discrete choice experiment to reveal the barriers that people are facing *right now*. This innovative methodology allows the estimation of the relative importance of the barriers and the distance between them measured in months of reproductive delay. Among other things, the results show that for men and women, partner support was more important than finances or housing, although support means different things depending on the level of education with more educated women prioritizing hands-on fathers and household gender equality, whereas less-educated women strongly desired stable partnerships. Men favored partner readiness and neighborhood quality. These, and the other findings shown here, provide detailed insight into the contemporary causes of delayed fertility in the UK.

Keywords: Fertility gap; Reproductive delay; Reproductive decision-making; Discrete choice; Gender equality; Family size

***Corresponding author:**
Paula Sheppard
(paula.sheppard@anthro.ox.ac.uk)

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1. Introduction

In the United Kingdom, fertility is low with only 1.6 births per woman on average in 2020 (The World Bank, 2022), which is half a birth lower than the 2.1 needed to meet the population replacement rate. Although people wish to have small families, there is also a gap between the family size people say they want, and the number of children many then go on to have. This is known as the "fertility gap" and in the UK the gap measures around one-third of a child; people express a general preference for two-child families (Smallwood & Jeffries, 2003). The fertility gap is primarily driven by the postponement of childbearing (Berrington, 2004; Morgan & Rackin, 2010); in 2020, the age at first birth was 29.1 years for women (Clark, 2022). The increase in rates of late parenthood is also striking; in 2016, 22.3% of births were to mothers over age 35 compared with just

over 6% in 1980 (Heazell *et al*., 2018). Given that female fecundity peaks at around 25 years, and steadily decreases after age 30 (Igarashi *et al*., 2015), postponement for this long means that the window of reproductive opportunity is restricted to only a few fertile years in later adulthood. At this point, people quickly try to achieve their family goals but along with problems of low fecundity, families run higher risks of difficult pregnancies, a higher likelihood of preterm babies, and an increased likelihood of conditions such as Down syndrome and autism spectrum disorder.

The question then is why are people leaving it so late to have children? What are the barriers to reproduction in the UK? Previous work has indicated that educational expansion for women is a leading cause of fertility postponement (Ní Bhrolcháin & Beaujouan, 2012) but this explanation is limited; years of education *per se* is not associated with late childbearing, it is the career pathway that higher education brings, with factors associated with financial security and career precarity likely to be the actual reasons for postponing having children (Berrington, 2004; Billari *et al*., 2006; Testa *et al*., 2016). Higher education for women elevates their position in the professional labor force and this leaves them having to make difficult choices in workplaces that are often unsupportive of motherhood (McDonald, 2000).

However, having a higher education cannot explain all postponement of children because lower-educated women are also delaying childbearing relative to previous generations, although not as much as educated women who are the stronger drivers of this correlation (Beaujouan & Berghammer, 2019). In their cross-national study in Europe, Mills *et al.* (2011) showed that even women with a lower-secondary school education had a mean age at first birth of around 24 or 25 years in most countries, which is older than the average age at finishing university. There is a paucity of literature on the reasons why lower-educated women postpone, which this study aims to redress by examining the barriers to reproduction within educational groups.

Women's educational expansion can be construed as part of a wider, more general, and ideational change that has seen gender equality increase over the past half century, which partly describes the Second Demographic Transition (SDT) (Lesthaeghe, 2014). The primary argument of the SDT theory is that the demographic changes occurring in high-income societies are not driven by economic factors alone but by profound shifts in cultural and value systems. This theory, developed by demographers such as Lesthaeghe and van de Kaa, posits that the initial demographic transition, characterized by declining mortality and fertility rates, is followed by a second phase in which changes in family structures, reproductive behavior, and individual lifestyles are increasingly influenced by post-materialist values. Key elements include increased divorce rates, declines in marriage rates, and shifts in family formation where having children are seen more as optional than a social expectation. It emphasizes the changing role of women including that women postpone fertility as they gain decision-making power and move away from traditional gender norms and changing values, that have been observed across Europe (Surkyn & Lesthaeghe, 2004).

This is related to Gender Revolution Theory (GRT), which focuses on the SDT implications for women, and changes in family dynamics with women occupying more roles outside of the home. Higher-educated women who seek to partner with similarly-educated men face a "marriage squeeze" as women's rates of education exceed men's but they are nevertheless less inclined to "marry down" (Van Bavel, 2012). Once a partner is found; however, negotiations around the equity of childcare ensue. The GRT explains how when women are doubly burdened with childcare and paid work, fertility is expected to be low, but when partners share the unpaid work, fertility should increase (Goldscheider *et al*., 2015; Raybould & Sear, 2020). This is likely to be more relevant for higher-educated women, given their place in the labor force although empirical data on this are lacking for the UK. The GRT explains the transformation of gender roles, which are both a driving force and a result of the changes described by the SDT. The SDT provides a demographic framework for understanding how these shifts in gender roles and family structures have developed over time.

The male fertility gap – the difference between men's desired family size and what they get – is similar to women's in the UK. A study conducted with two of the UK birth cohorts showed that there was a gap of almost half a child for men and only 36% of men had achieved their intended complete family sizes by age 46 (Berrington & Pattaro, 2014). This research also showed a U-shaped educational curve in male fertility: university-educated men and those with no qualifications were more likely to have three children compared with those of intermediate education who had smaller family sizes. There is an implicit assumption in the literature that men's fertility schedules are driven by women's, that is, their partners make the decisions (Kneale & Joshi, 2008). This argument arises from empirical observations that individuals tend to partner with people of similar socioeconomic and educational backgrounds (Erát, 2021; Klesment & Van Bavel, 2015) and the fact that having children tends to be a joint decision between couples (Bernardi & Keim, 2007; Kneale & Joshi, 2008). However, to my knowledge, there are no studies dedicated to examining the reasons behind

the gap for men. Furthermore, there is some evidence suggesting that education is not the main reason for the fertility gap in men (Berrington & Pattaro, 2014, Morgan & Rackin, 2010).

The empirical literature discussed so far is helpful in identifying factors that are associated with fertility timing and drivers of the fertility gap; however, they are almost always retrospective studies (even the longitudinal ones) that correlate socioeconomic characteristics from an individual's past with eventual family timing and size. They are also necessarily out of date because the career trajectories and other decisions that people make over the course of their lives are only investigated once their completed fertility is known. Correlations between completed family size and career and other life milestones tell us about fertility decisions from two or three decades ago, at best. To really understand the factors standing in the way of having a(nother) baby, we need to capture the decision-making process in motion. By applying an innovative methodology, discrete choice experiments (DCEs), we can identify the barriers facing aspirant parents (first time parents or those who want another child) in the UK right now.

One criticism of the fertility gap literature is that stated ideal family sizes are difficult to estimate or may not exist at all. The cognitive-social model (Bachrach & Morgan, 2013) posits that even if they do, it is likely that fertility decisions change over the life course (Bernardi *et al*., 2015). The present study avoids these limitations because the DCE asks people what is standing in the way now. What things do they need to have in place before they feel ready to have a child? This is regardless of what family size they said they wanted when they were younger. This study gathered data from participants who were open to having a(nother) child and the DCE identifies the barriers to that life event, whether or not they are on track to attaining their achieved family size, that is, whether they have a personal fertility gap, or not. Theories of planned behavior and other rational choice models assume that the decision to have a child is calculated and a product of conscious decision-making. While the DCE unavoidably asks people to consciously think of the barriers to their having a child, it also harnesses people's less conscious decisions by presenting the choices in relatively quick succession (see methods) (Hensher, 2014).

This study contributes to our understanding of the drivers of fertility postponement. It applies an innovative methodology, never used before to answer such questions, to identify the barriers to reproduction currently in the UK. Furthermore, this study was conducted for four demographic groups to gain insight into the different priorities between men and women, and those with or without a university degree. Specifically, it addresses the following questions:

(i) What are the barriers to reproduction in the UK?
(ii) How do these barriers rank in importance, and what is the distance between them?
(iii) How much reproductive time could potentially be recuperated if the barriers were removed or reduced?
(iv) How are these different or similar for men and women, and by education?

Here, "reproductive time" refers to the fertile (fecund) period an individual has; the window of reproductive opportunity that is available to attain one's desired family size. Because men, women, and educational groups have different needs, question 4 can only be answered in a partial, more qualitative way. The four demographic groups were administered four different DCEs meaning that systematic comparisons cannot be made across groups although one can still get some insight into the differences.

Ethics approval for this study was granted by the University of Oxford's Ethics Committee (Ref No.: SAME_C1A_21_079).

2. Data and methods

This study was partly conducted as a methodological test case to establish whether DCEs are well-suited to modeling reproductive decision-making. The method is prevalent in the field of health economics where it is applied to better understand patients' and health workers' needs (Oliver *et al*., 2019) and is fundamental to informing health economics policy (van den Broek-Altenburg & Atherly, 2020). DCEs were originally adapted from conjoint analysis, which consumer behavior researchers use to determine which features that consumers want from products where it is not usually cost-effective or practical to develop many prototypes. Political scientists routinely use it for understanding voting behavior and it is also commonly used in transport research. Discrete choice models can be applied to any complex decision-making process but until now have never been applied to understanding fertility behaviour. This study provides the first evidence of DCE efficacy for unpacking the processes that go into reproductive decision-making and ultimately drive reproductive postponement.

2.1. DCE methodology

A DCE is a multidimensional experimental method for eliciting stated preferences. It allows the identification and evaluation of a set of factors relevant to a particular decision-making process, known as *attributes*. It can determine the relative salience of the attributes and estimate how

people trade off more of one attribute for less of another (Cleland *et al.*, 2018; Louviere *et al.*, 2010). An attribute is a component that contributes to making a decision: it is a variable such as financial security, partnership status, and employment status. Each attribute has levels which can be either qualitative, such as partnership status with levels that might be "single," "married," "cohabiting," or quantitative, such as salary or price, but in this case, it is the timing of the baby's arrival in months. This continuous-level attribute can be divided into discrete components for presentation in the DCE instrument and then used to calculate an estimate of *willingness to pay* for each attribute. The underlying assumption is that individuals make choices based on the attributes that make up the "product," in a way that maximizes utility, and by making trade-offs between the attributes (Kjaer *et al.*, 2006). In the application of a DCE, individuals are asked to make a series of choices between alternative hypothetical scenarios (called choice sets); with each choice set being made up of a number of attributes that are split into levels. Table 1 shows an example of a choice set as it looked when presented in the online DCE for this study. Before choosing from each choice set, participants are given qualitative information about what each attribute means. It is impossible to ask participants to make choices from a fully-factorial design where all possible choices are presented as this would mean, for example, for a DCE with five attributes of three levels each, 245 possible choices would be generated (*i.e.*, 3^5). Instead, a D-efficient experimental design is applied, producing a matrix of choice sets large enough to force participants to make trade-offs between the attributes while also being few enough to not be overly cognitively burdensome or time-consuming. The D-efficient design also minimizes the standard errors of the parameter estimates produced from a limited number of choice sets (Rose & Bliemer, 2009). In this study, the DCE was made up of 16 choice sets. The nature of the design and the presentation of the DCE instrument means that people make choices quite quickly and more intuitively than they do when answering direct questions (Hensher, 2014). By doing so, they reveal their actual preferences rather than overthinking the answers or being otherwise influenced, as may be the case when completing regular surveys. Statistical analysis of the resulting choices reveals the underlying preferences of individuals, or their "utility function;" their value beyond their cost.

Table 1. An example of a choice set, presented as part of a battery of 16, to university-educated women in the UK study

	Scenario A	Scenario B
Partner support	My partner is fully involved and happy to share the childcare 50/50.	My partner is supportive but not very hands-on with childcare.
Career costs	I've just started a new job which is promising but will take some time to establish myself.	My career is well-established and I am supported at work.
Friends	My closest friends are all planning babies right now.	My friends are not very baby-oriented and many don't want kids.
Finances	The household finances are secure and I have enough savings.	The household finances are a bit stretched and there is no savings buffer.
Baby timing	The baby will be born 18 months from now.	The baby will be born 3 years from now.
Which scenario is better?	☐	☐

2.2. Willingness-to-pay

DCEs typically model a price or salary variable to measure the maximum amount a consumer is willing to pay (WTP) for a product feature or how much a potential worker values characteristics of a job as measured in salary, that is, how much they would need to be paid to take up the job. In this study, WTP was modeled as the maximum amount of time, in months, an individual is willing to forgo to have their needs met before having a baby. This can also be interpreted as the time that can potentially be recuperated if the barriers to reproduction were lifted.

2.3. Data

The successful design of the DCE depends on the quality and relevance of available data on the experiment attributes, in this case, the barriers to reproduction. In the UK, there are no recent data on this and so we conducted a series of focus groups to learn what people in the UK currently feel is preventing them from attaining their fertility goals. The focus groups generated a rich corpus of qualitative data from men and women, aged 23 – 43, university-educated and not, producing the most current and nuanced data on what the barriers in the UK currently are. The qualitative leg of this study is described fully elsewhere (Brough & Sheppard, 2022). A thematic analysis was applied to the focus group data and the results were used to construct a shortlist of four primary barriers (*i.e.,* the DCE attributes) for each demographic group (men, women, university, or not) with which to design the experimental instruments. Each group expressed different priorities and so there was a different DCE for each group.

The DCEs were administered by SurveyEngine (a multinational company), a company that specializes in

DCE methodology and that provides specialized software to administer the DCEs, secure servers on which to store and move the data, and have a UK nationally representative participant pool. The four DCEs were administered to a sample of 1228 reproductive-age men and women, around half of whom were university-educated (n = 618) and half who were not (n = 610). Fifty-three people who expressed never wanting children or having reached their desired completed family size, and therefore not wanting more children, were screened out, leaving 688 people who stated that they might want (more) children and 485 who definitely do. One participant who reported being 18 years old and also claimed to have already completed a university degree was removed leaving a final sample size of 1174. The decision to remove participants who said they definitely do not want children was because it was the objective of this study to identify the barriers for those who are postponing having a child that they would like to have. However, the reasons those people definitely do not want children may be because they perceive the barriers to be insurmountable and may have had a child or another child, if circumstances were different, should be acknowledged. Unfortunately, these reasons were not discernible from the data collected, and this potential limitation will be taken into account in future research. The screening question that asks if "they definitely do not want children" also means that the data are only representative of the national population that might want to have children.

2.4. Statistical analysis

The DCE was designed using the four most important attributes that emerged from the qualitative work, with each of these being split into three levels denoting (i) an ideal situation, (ii) a less-than-ideal situation, and (iii) a poorer situation. No level was made to be unrealistically high or low. A D-efficient design matrix was generated using the *DCETool* R-package (Perez Troncoso, 2022). D-efficient designs reduce D-error which improves the experimental design by producing minimal overlap of choice sets, well-balanced levels, orthogonality, and utility balance (Rose & Bliemer, 2009). All the DCE attributes and levels were pre-tested for clarity of understanding and relevance. For example, for "partner support" for the university-educated women DCE, the three levels were as follows:

(i) My partner is fully involved and happy to share the childcare 50/50
(ii) My partner is supportive but not very hands-on with childcare
(iii) My partner travels often and leaves the childcare to me.

Full descriptions of all the attributes and their levels are given in the Appendix.

The DCE produces data that can be statistically analyzed to estimate the value of each level of each attribute and infer participant preferences. Here, mixed logit models which allow for preferences to vary across individuals (Hess & Train, 2017) within demographic groups were used. The model is estimated as follows (for example, using non-university women):

$$U_n = V_n + \epsilon_n$$

$$= \beta_1 \times \text{partnership}_{\text{stable}} + \beta_2 \times \text{partnership}_{\text{less stable}} + \beta_3 \times \text{home}_{\text{large}} + \beta_4 \times \text{home}_{\text{smaller}} + \beta_5 \times \text{finances}_{\text{good}} + \beta_6 \times \text{finances}_{\text{ok}} + \beta_7 \times \text{family}_{\text{full support}} + \beta_8 \times \text{family}_{\text{part support}} + \beta_9 \times \text{baby comes}_{6} + \beta_{10} \times \text{baby comes}_{18} + \epsilon_n$$

Where U is the participant's "utility" associated with the scenario presented, V is the deterministic component, and epsilon represents an error term. The data produced are binary with 1 denoting the scenario chosen and 0 denoting the alternative. Statistical analyses were carried out using Stata v.17 (StataCorp, 2021) and the plots were created using ggplot2 in R.

2.4.1. Interpretation of results

Mixed logit models produce odds ratios for each of the levels of the attributes compared with a reference category. In this study, the least appealing level (level 3) is set as the reference category, so the expected outcome is for odds ratios higher than 1, denoting the assumption that people prefer levels 1 and 2 over level 3. Willingness to pay results are given in months with an aggregate number for that level of the attribute with its accompanying upper and lower bounds of 95% confidence intervals. WTP estimates can be negative or positive with slightly different interpretations, although substantively they mean the same. Negative WTP is the estimated additional amount of time needed to compensate for a particular barrier to reproduction, *for example, I would need six more months to be able to get a pay rise before having a baby*. Positive values indicate how much time a person would give up to have the barrier removed, *for example, I would wait six more months before having a baby in order to have a pay rise*. In effect, these can both be understood in terms of how much reproductive time is lost.

2.5. Preliminary tests

This study was partly a methodological test case to address some peripheral questions to aid future data collection and statistical modeling. Before collecting the data, the expectation was that different groups would find the barriers more important at different ages. I expected that university-educated people would not feel they were "delaying" children until they had established a career, likely well into their 20s. For non-university folk, the barriers to having

children might be felt much earlier. However, to avoid simply assigning an arbitrary age to model the DCEs, empirical tests to pinpoint when, in this sample, the timing of the baby's arrival became salient were carried out. To do so, the models were run for different age groups across the whole range of ages from which data were collected (18 – 50 years old) and at the ages when the timing variable (the baby comes in n months) are statistically significant is used as the appropriate range for that group.

The results show that for university-educated women, age 33 was the first age at which the baby-timing estimate became statistically significant, and therefore, all final DCE models were run with women from age 33 to 50 years (n = 160). For non-university women, baby timing was important from the youngest age (18 years) and decreased with age. At age 33, point estimates for baby timing were no longer statistically significant; therefore, only non-university-educated women aged 18 – 33 years were included in the final analysis (n = 184). For university men, the timing of the baby was no longer statistically significant beyond the age of 38 and so models for this group were performed on the subset of men aged 18 to 38 years (n = 181). For non-university men, however, it was less clear. Running the models for subsets of ages revealed that some ages were significant and some ages had non-significant estimates for baby timing but with no clear pattern (i.e., either younger men or older men). Furthermore, models for the very oldest ages (41+) were not statistically significant so these men (n = 231) were removed from the analysis. The model that included *all* non-university men was significant overall, so for robustness, analyses on this sample and the subset were conducted, yielding similar results (Figure A1 in Appendix). Nevertheless, findings for this group should be interpreted with caution because baby timing may not be important for some of the men in this group. This ambivalence about the timing of fatherhood was also noticed in the qualitative component of the study; focus groups with these men suggested that some had not really thought much about the topic, and it took some time to elicit meaningful information from them (Brough & Sheppard, 2022).

The DCEs were piloted on a sample of 60 participants to ensure that the survey was being conducted correctly and that there was minimal drop-out. Given that no issues emerged, no adjustments were made to the study before administering it to the larger sample. Data from the pilot were included in the main study (included in the above-reported sample sizes). Participants at the pilot stage were also given the opportunity to provide free-text feedback, and none of them claimed that the DCE survey was difficult to understand.

3. Results

3.1. University-educated women

Thematic analysis of the focus-group data revealed that the four most important attributes for this group of women were, in order of importance:

(i) Partner support: this was conveyed in the sense of hands-on-ness of their partner, someone who would share childcare duties and be a fully invested co-parent
(ii) Career costs: this was expressed as a concern that taking maternity leave would result in career stagnation or allowing colleagues to overtake them on the career ladder
(iii) Finances: this refers to household finances being stable and sufficient, not simply the amount of personal income
(iv) Friends: these women expressed wanting their friendship circles to also be having babies so that they may share advice, experiences, and play dates.

These attributes were used to design the DCE instrument which was administered online to a nationally representative sample of UK-based women. The DCE results showed an overall similar story to the qualitative findings but with some interesting differences. As shown in Figure 1, the ranking of these attributes by levels revealed that household finances were deemed more important than career progression costs. Partner support was clearly and by far the most important aspect for university women, as was expressed in the focus groups, but now we can see just how large the effect size is. The odds of choosing a scenario with the highest level of partner support were 3.75 times higher than choosing one with having a partner who travels often. Having sufficient and secure household finances was also very strongly desired and then the value of all the other attribute levels taper off to below twice the odds, although they are still significantly higher than the lowest level in all cases except for friendship circles. Ultimately, women did prefer it if most of their friends were having babies but there was no difference between having some friends who were or none who were.

The WTP results tell us how much reproductive time this group of women is giving up by facing these barriers. Figure 2 shows the same ranking of the attribute levels but now with time in months plotted on the X-axis, denoting reproductive postponement. This helps to interpret the DCE in a more intuitive way, as we can compare the different attributes more directly using the same "currency." As suggested by the odds ratios, women value a fully hands-on partner very highly; in terms of reproductive time, they are prepared to give up 91 months (7+ years) to have this attribute. The WTP figures for the other attributes are much lower, ranging from around 1 year for friends having babies to 5 years for financial stability, but the large value for partner support indicates

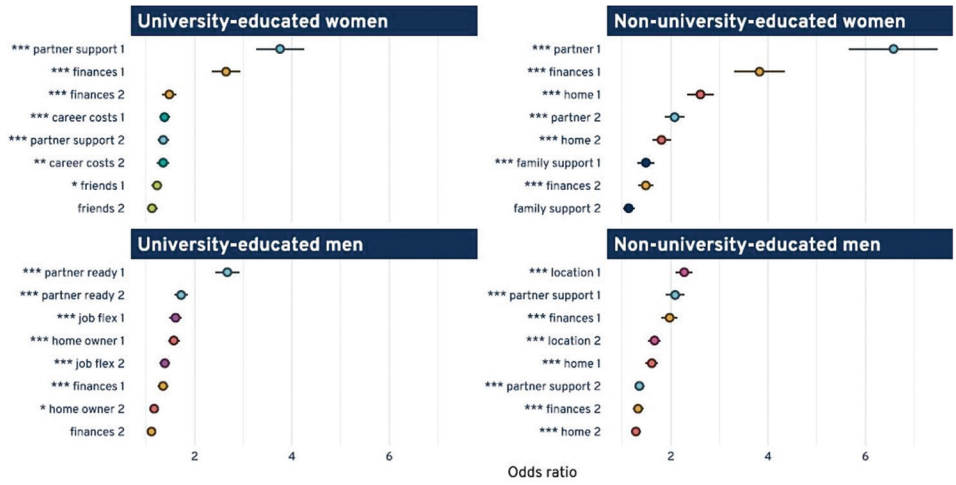

Figure 1. Results of DCE analysis for each demographic group. The odds ratios are interpreted as comparing to the lowest level of the attribute. Attributes were divided into three levels with level 1 being the highest. For example, for university women, the odds ratio for partner support, level 1 is compared to the omitted lowest level of partner support, level 3. Descriptions of each of the levels, as presented in the DCE, can be found in the OSM. *** $p < 0.001$; ** $p < 0.01$; *$p < 0.05$
Abbreviations: DCE: Discrete choice experiment; OSM: Online supplementary material.

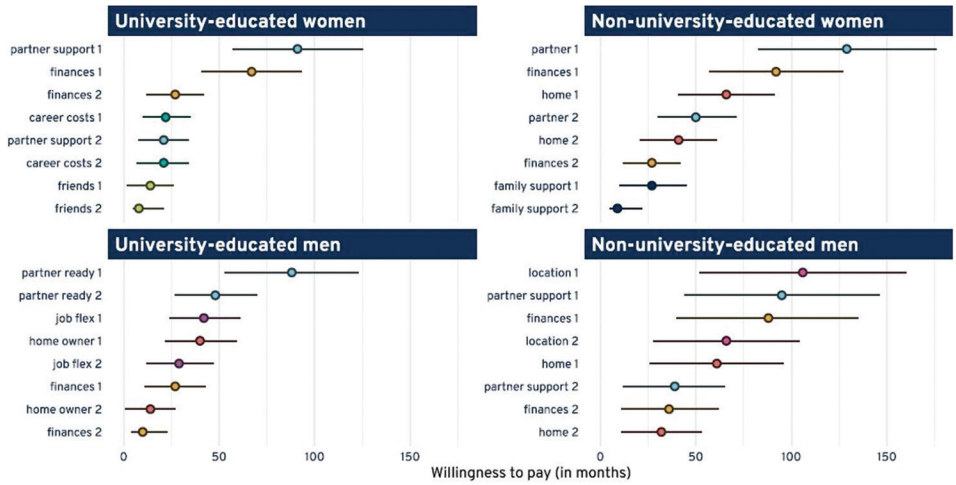

Figure 2. Results of willingness-to-pay analysis for each demographic group. Values are months of reproductive postponement, with 95% confidence intervals

just how important this attribute is, and could explain why we observe such extended delays to fertility, as seen in the demographic data.

3.2. Non-university-educated women

For this group of women, the most important attributes were as follows:

(i) Family support: This was expressed as the availability, ability, and willingness of parents to provide support with childcare such as picking them up from school and babysitting
(ii) Partner: This was about having a stable partnership. It was not framed in terms of hands-on dads but as wanting to be in a committed long-term relationship.
(iii) Home: This referred to having a big enough space for the children "to run around in." It was not important to own the home
(iv) Finances: This was about household finances and the ability to take time off work.

As shown in Figure 1, having a stable relationship was ranked highest in the DCE, followed by financial stability, whereas having a big enough home while family supportiveness ranked last. This is contrary to what we expected from the focus group data. Support from family

was statistically significant, at least for the highest level (parents fully able and willing to help with childcare), but the other attributes were clearly preferred. The lowest partnership level was being single so the large odds ratio for this attribute can be interpreted as a very strong preference to avoid lone parenting. Even being in a fairly new relationship (level 2) was much preferred to being single and was more important than the highest level of family support, suggesting that couple relationships are the highest priority for these women. This is reflected in the WTP results (Figure 2) which show that women are prepared to wait around 10 years (129 months) to have a stable relationship. Recall that the age group of these women was 18 – 33 years so a 10-year delay for a 33-year-old female would push her to her fertility boundaries. Finances were also very important here, with women forgoing around seven reproductive years for financial security.

3.3. University-educated men

Focus group data revealed that the four most important attributes for university men were as follows:

(i) Partner ready: This was framed as the partner being committed to the relationship and ready to have a baby
(ii) Job flexibility: This was about work-life balance and benefits such as a company car and a good holiday allowance
(iii) Home: This was about owning a good home
(iv) Finances: Like other groups, these men wanted financial security but were also concerned about having savings for long-term goals.

We removed three men who claimed to have completed a university degree but who were 19 years old. This left a sample size of 180. The DCE results match the focus group findings very closely. By far, the most important factor was having a supportive partner who was ready for children. All other attributes ranked as expected and were relatively similar in scale with odds ratios between 1.5 and 2. To have a fully supportive and ready partner, university men would give up over 7 years before having a baby. Other things ranged from 1 year for owning a home to 4 years for a supportive partner where the relationship was still quite new compared with a more difficult couple relationship.

3.4. Non-university-educated men

Non-university men expressed their four most important attributes as:

(i) Finances: This was framed in terms of personal income and being able to cover more immediate needs such as buying a car
(ii) Home: This was about home ownership
(iii) Partner support: This was less important than to other groups and was expressed as having a committed relationship and a partner who was ready to have children
(iv) Location: This was the only group to prioritize neighborhood quality and it was expressed as a safe and green environment for children.

Figure 1 shows that neighborhood quality came up as the most important priority for this group of men while partner support was ranked second with finances appearing to be less important than the focus groups suggested. Again, this group was less forthcoming in the qualitative analysis so this discrepancy could be a function of less reliable data to design the DCE with, or it could be that these rankings reflect reality in the larger UK population. As shown in Figure 2, these men are willing to wait around 7 years before committing to fatherhood to live in a safe and child-friendly neighborhood. The confidence intervals for all attribute levels for this group are rather large indicating that there is more uncertainty around the reproductive delay.

As a further exploratory investigation, whether there were differences between people who were starting or growing a family was tested. For women, there was no difference in their priorities nor their ranking of importance, although there were small differences in effect sizes. For childless women, each of the attributes was a little less important than for women who were already mothers. For men, the difference was that baby timing was significant for aspirant first-time fathers only, not for men who were already fathers. However, the rankings of the attributes remained the same across both groups.

4. Discussion

DCE methodology was used to unpack and explore the complex decision-making process underlying the desire for children. Discrete choice modeling is a forward-facing technique that allows us to focus on the decision-making process itself rather than looking back and correlating things in peoples' earlier lives with their eventual fertility outcomes. Using qualitative data to design the experiments, and administering the online experiment to a nationally representative sample of participants, I was able to identify the specific barriers that are of the highest concern to people who want (more) children in the UK today, rank them in order of priority, and estimate the size of the distance between them.

We know that education is correlated with delayed fertility but that observation masks what is going on within educational groups. For women, the two groups showed fascinating differences, for one, the age at which postponement becomes a priority is entirely different. Only at age 33, were university women expressing that the delay in having children was most important which means

that their window of reproductive opportunity is already quite limited. After age 25, fecundity starts to deteriorate and although many women have successful pregnancies in their late thirties and early forties, the risks are still substantially higher than in their 20s (Hadley, 2021). This finding might also shed light on the reasons for unwanted childlessness, which is around 20% for women in the UK (Berrington, 2004); if the reproductive window is only around 10 years and the persistent need for a supportive hands-on partner is not met soon after age 33, then it may simply be too late to conceive. This was the only group for which baby timing became salient later in adulthood; it is possible; however, that there are different priorities at earlier ages that are not covered in this study. Scaling up this research can explore the differences within age groups as well as across educational strata.

All three other demographics showed significant baby-timing estimates from the youngest ages modelled (18 years for non-university and age 21 for university-educated). This finding questions the broad observation that education delays fertility for educated men; baby timing is important from any age (below 38 years) although they do rate their partner's readiness very highly. Given that it is likely that educated men are partnering with educated women (Erát, 2021), the combination of these two findings suggests that women are driving fertility delay in educated men. Although implicit in much fertility research, as far as I am aware, this study provides the first empirical evidence of this phenomenon. This also draws some parallels with partial explanations for the SDT being attributed to ideational change since the 1960s (Lesthaeghe, 2014; Mills *et al*., 2011). Having smaller families, and making individual choices, was seen by some as a feminist response to patriarchal control over female fertility. In line with this, we observe other changes too. These results show that educated women prioritize a hands-on partner very highly, suggesting a move away from the traditional male-breadwinner narrative which is still pervasive in the literature (Bernardi & Keim, 2017) lending full support to the gender revolution notion that fertility will increase as men bear more of the weight of domestic labor (Goldscheider *et al*., 2015). This is not to say finances and material needs are not important; women in both groups rated this priority highly, but not as highly as partner characteristics. For non-university women, the evidence also suggests that partners are more important in terms of availability rather than as providers, although they framed it in terms of commitment rather than hands-on fathering (Brough & Sheppard, 2022). This notion of changing gender norms in family roles is also indirectly supported from the analysis of differences between parents and non-parents. The need for partners, for both groups of women, was more pronounced for those who were already mothers, suggesting perhaps that having experienced the demands of motherhood emphasizes the importance of not doing it alone.

Research on reproductive decision-making is made more difficult by the fact that there is almost always at least one other person, usually a partner, involved in the decision-making process. It is difficult to incorporate this negotiating process in typical survey methods that aim to identify causes of delayed fertility and have been so far, best understood from qualitative work (Bernardi *et al*., 2015). Although the DCE methodology presented here cannot fully encapsulate the negotiating process between couples, we can get a sense of how important partner needs are. For university men, this was particularly important and it was clear that they value highly their partner's readiness for children. University women, likely the partners in question, are prioritizing most highly for hands-on dads. Non-university women were less concerned about their partner's readiness or support but were very concerned about their commitment to the relationship. These findings are in line with other work documenting that a primary reason for remaining childless is "never having met the right person" and this is a common reason given by both men and women (Berrington, 2017).

The main limitation of this work is the relatively small sample size. It was designed as a test case to examine how effective applying this methodology to a novel question would be. As such, it was conducted as a pilot study which could be expanded in future work, in particular, to be able to ask more demographic background questions, such as about respondents' religiosity, and their gender and ethnic identities to test if the barriers people face are mediated by these things. Similarly, a scaled-up study could examine regional or country variation so as to explore how different local policies influence people's needs.

5. Conclusion

Altogether, this study has revealed some of the primary drivers of delayed fertility in the UK. It has also scrutinized the differences between gender and educational groups, which has not been done before. Although finances and housing conditions are important across the board, the most compelling finding is that partner support is highly valued for all demographic groups, although in different ways, and that not having this support is a significant contributor to the observed lengthy postponement of parenthood in the UK.

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Conflict of interest

The author declares that she has no competing interests.

Author contributions

This is a single-authored article.

Ethics approval and consent to participate

Ethics approval for this study was granted by the University of Oxford's Ethics Committee (Ref No.: SAME_C1A_21_079).

Consent for publication

Not applicable.

Availability of data

Data are available from the corresponding author on reasonable request.

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Appendix

Description of attributes as provided in the Online DCE preamble

(A) University-educated women

Partner support

Partnership is implicit in this study, it does not matter if you do not have a partner in real life but how you would feel about the level of support, should you have one. It also does not matter if this is a same-sex or opposite-sex partner. Your own sexuality or gender identity also does not matter.

Career costs

This depicts your career stability and how vulnerable you feel at work, for example, by the impact of taking maternity leave on your career progression.

Friends

This denotes how baby-oriented your personal social circle is.

Finances

This is a measure of how well you feel you can afford to grow your family. It is framed as household finances so it does not only reflect your salary.

Baby timing

This is the amount of time before the new baby arrives. You can think of this as either a first baby or another baby, whatever fits with your situation most.

(B) Non-university-educated women

Family support

This is about how available your family and relatives are to help with childcare. It refers to parents but could also be other relatives such as an aunt or sister.

Home

This is about having enough space for children to run around in, including enough bedrooms and a garden.

Partner

This reflects your relationship status. It does not matter if this is a same-sex partner or opposite sex.

Finances

This is a measure of how well you feel you can afford to grow your family. It is framed as household finances so it does not only reflect your wages; it can be income from anywhere including partner or other relatives as long as it is a regular or reliable contribution to the household.

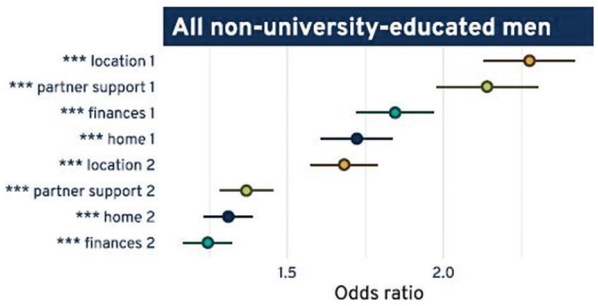

Figure A1. Results for discrete choice experiments analysis on all non-university-educated men

Baby timing

This is the amount of time before the new baby arrives. You can think of this as either a first baby or another baby, whatever fits with your situation most.

(C) University-educated men

Partner support

Partnership is implicit in this study, it does not matter if you do not have a partner in real life, this is about your potential relationship stability, partner support, and readiness for children if you did have one. It also does not matter if this is a same-sex or opposite-sex partner.

Employment

This depicts how supportive and flexible your job is and includes benefits such as a company car or good parental leave for men. It could be your own business or an employer.

Home

This is about home ownership and having a good enough house to raise children.

Finances

This is a measure of how well you feel you can afford to grow your family.

Baby timing

This is the amount of time before the new baby arrives. You can think of this as either a first baby or another baby, whatever fits with your situation most.

(D) Non-university-educated men

Partner support

Partnership is assumed in this study but it does not matter if you do not have a partner in real life. This is about the potential of partner support and their caring for children. It does not matter if this is a same-sex or opposite-sex partner.

Location

This is how safe, green, and child-friendly your neighborhood is.

Housing

This is about having secure housing and a good enough home to raise children.

Finances

This is how well you can afford to buy things such as a car, clothes, or holidays for your family.

Baby timing

This is the amount of time before the new baby arrives. You can think of this as either a first baby or another baby, whatever fits with your situation most.

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RESEARCH ARTICLE

Understanding the shift of family planning in China from the economic perspective

Jianye Liu[1]* and Hongyan Liu[2]

[1]Department of Sociology, Lakehead University, Thunder Bay, Canada

[2]China Population Development Research Centre, Beijing, China

Abstract

Using data from six population censuses in China, this study analyzes the variations in the age structure of the Chinese population from 1953 to 2020. A unique aspect of this research is the redefinition of the old-age population – specifically considering the retired population (aged 55 and over for females and 60 and over for males) – which is tailored to reflect the social realities in China. This approach more accurately represents the economic burden of China's current pension system. Our primary conclusion is that the Chinese population has undergone a dramatic transformation from being predominantly young to increasingly older, largely due to the implementation of family planning policies and overall socioeconomic development. Population aging in China encompasses not only the growing retired demographic but also the aging labor force, marked by an increasing number of individuals exiting the workforce and a decline in those entering. Moreover, the pace of population aging in China is significantly faster than in any other country. In addition, China faces a shrinking labor force and potential negative growth, exacerbated by historically low fertility rates. Finally, the changes in the child, retired, and total dependency ratios from 1953 to 2020 illustrate a rapid increase in public expenditure, driven by the growing weight of the retired population, even though the total dependency ratio in 2020 is lower than it was in 1953.

Keywords: Population census; Family planning policies; Population aging; Retired population; Economic burden; Dependency ratio

***Corresponding author:**
Jianye Liu
(jliu8@lakeheadu.ca)

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1. Introduction

Family planning policies have been widely adopted globally to contend with population changes. In China, the "one-child" policy, implemented in 1979 when the population size was under one billion, successfully slowed down China's population growth; however, this led to unintended consequences such as a gender imbalance and an aging population. Interestingly, when the population size in China reached 1.39 billion in 2015, the "one-child" policy was replaced with the "two-child" policy on January 1, 2016, and more recently, in 2021, replaced with a "three-child" policy when the population size exceeded 1.4 billion (National Bureau of Statistics, 2021). Under the "three-child" policy, married couples are allowed to have up to three children. Through its history, China experienced rapid and unusual shifts in family planning policies: when the population size was smaller (<1 billion), a very strict and coercive "one-child" policy was implemented; while when

the population grew larger (more than 1.4 billion), a much looser "three-child" policy was applied. To our knowledge, China is the first and only country to make such significant policy adjustments within 40 years of human history. This study seeks to understand and explain these remarkable policy changes in China.

A simple explanation is that the "three-child" policy was introduced as a response to concerns about an aging population and a shrinking workforce in China (Follett, 2020). One of the inevitable consequences of the "one-child" policy is population aging, a phenomenon widely documented by researchers in China and worldwide (Follett, 2020; Zhang, 2017; Rajan, 1994; Lee, 2013). Population aging is a prevalent demographic phenomenon and an inescapable consequence of the demographic transition from a state of high fertility and mortality in traditional societies, to one of low fertility and mortality in modern ones. At present, more than one-third of countries globally are experiencing aging populations (Johnston *et al.*, 2016). However, what made the situation in China so grave that the government was determined to abandon its fundamental "one-child" policy?

China's population changes are greatly affected by the family planning policy, which include China's population size, the current low birth-rate, aging population, and the shrinkage of the working-age population, and thus, have a significant impact on economic and social development. The discussion of changes in the family planning policy in this article provides supporting evidence for the background of China's population changes. Drawing on six population censuses from 1953 to 2020 in China, this study endeavors to address this question by analyzing the significant increase in public expenditures on social support resulting from changes in the country's age structure. This paper examines the variation in population age structure over time, considering factors such as the number of population aged 0, the working-age population, child and old-age dependency ratios, senior population size, and more to illustrate the demographic changes in China between the 1st and 7th censuses. Moreover, this research uniquely employs a practical definition of the old-age population – retired individuals – to assess the variation in public expenditures required by these groups. The paper begins with a brief history of family planning policy in China, followed by a discussion of the consequences of its implementation, study data and methods, key findings, and concludes with a discussion of potential implications.

1.1. Brief history of family planning in China

China's family planning policies have alternated between pronatalist and anti-natalist approaches since the establishment of the People's Republic of China in 1949. Initially, the Chinese communist government condemned birth control, banned imports of contraceptives, and encouraged people to have many children. This resulted in high birth rates which coupled with low death rates, leading to rapid natural population growth (Howden & Zhou, 2015). By 1953, with the recommendation of Dr. Yinchu Ma, President of Peking University, family planning policies were approved and recommended by the government, as the population had grown by approximately 100 million, with an annual increase rate of over 2.2% between 1949 and 1953 (Attané, 2002).

However, in 1957, Dr. Ma was widely criticized during the "Anti-Rightist Campaign" and was forced to resign as President of Peking University in 1960. In 1958, Mao Zedong launched the Great Leap Forward and promoted population growth again, claiming it was still better to have more people – resulting in a baby boom in 1962. The Second National Population Census in 1964 revealed a total population of approximately 700 million in mainland China, an increase of 127 million since the first census in 1953. Although family planning was reintroduced in 1962, it proved largely ineffective and was further disrupted by the Cultural Revolution in 1966, resulting in sustained high rates of population growth, the so called "the second childbearing wave" in China. By 1971, with the country's population reaching 852 million, the government began to more effectively promote family planning, causing the annual population growth rate to drop below 2% after 1974. The policies of this era encouraged families to have no more than two children and were summarized in the slogan "Later, Longer, and Fewer." This referred to later marriages and childbearing, larger birth spacing (at least 3 years between births), and lower fertility (no more than two children). Another slogan, "one is not many, two is just right, and three is too many," emphasized population control through setting growth targets for both urban and rural areas.

This policy later evolved into the "one-child" policy in 1979, officially implemented nationwide in 1980, aiming to curb population growth to zero by the year 2000 as the population size approached one billion (Goldman, 2021). The policy was strictly enforced, with exceptions for certain ethnic minorities, rural families, and "two-child" experimental regions such as Jiuquan in Gansu province and Yicheng in Shanxi province (along with four other regions). By 1982, China's population reached one billion, and family planning became a fundamental policy and constitutional duty for every citizen. Subsequent administrations (after Deng Xiaoping's), including those led by Jiang Zemin and Hu Jintao, continued promoting

the "one-child" policy. Local officials were evaluated partly based on their success in ensuring compliance (Yardley, 2008). However, enforcement levels varied, with urban couples generally limited to one child unless they paid significant fines, while rural families were often allowed a second child if the first was a girl. Minority families were typically permitted two or more children (Johnson, 2016; Follett, 2020).

Between 1990 and 2010, China's population grew from 1.13 billion to 1.34 billion, with a very low total fertility rate. By 2008, officials began to consider easing the one-child restriction, although family planning policies remained in place (Yardley, 2008). Restrictions were gradually relaxed, allowing couples with specific qualifications to have two children in 2013, and then being extended to all families where one spouse was an only child in 2014 (Howden & Zhou, 2015).

In 2015, China ended the "one-child" policy, announcing that all married couples would be allowed to have two children starting January 1, 2016 (Buckley, 2015; Attané, 2016; Feng *et al.*, 2019). This policy aimed to address the rapid aging of the labor force and reverse declining birth rates, in light of China's population growth rate being well under the global rate from 2010 to 2015. Despite these changes, having three or more children remained illegal. Women in some areas were still subjected to periodic state-mandated pregnancy tests, potential parents were required to obtain birth permits and single motherhood remained prohibited (Follett, 2020; CECC, 2018; 2019).

During this period, the Ministry of Health and the National Population and Family Planning Commission were merged into the National Health and Family Planning Commission and were later renamed the National Health Commission (State Council, 2013; 2018). This signaled a gradual shift in focus from strict population control to broader health issues related to an aging population (Qi & Wang, 2018). Unlike the "one-child" policy, the "two-child" policy was not a mandatory requirement as it was opened to any eligible families who wished to have a second child. However, the "two-child" policy was not quite successful in increasing the fertility rate in China. An increase in birth rate only occurred in 2016 and the birth rate decreased again in the following years, reaching the lowest point in 2018, with only 16.85 million births (United Nations, 2022). In 2019, the birth rate even reached a 60-year low, which led the Chinese government to argue that the country had no need to be concerned about overpopulation (Leng, 2020).

Because data from the Seventh National Population Census showed only 12 million births in 2020, the lowest number since 1961 (Wee, 2021), in May 2021, the Politburo, the Communist Party's top decision-making body, announced that all Chinese couples would be allowed to have more than two children, ending the "two-child" policy. However, this was not successful in significantly increasing the country's already declining birth rate. By July 2021, all family size limits and penalties for exceeding them were abolished, marking a significant policy shift (Cheng, 2021). When this transition occurred, China's population had reached approximately 1.41 billion, underscoring the government's increasing concern over demographic challenges, and the emergence of the "three-child" policy nationwide.

Overall, China's family planning policies have not followed a linear trajectory. As Rodriguez (2023) observes, the policy process in China has been "circuitous, convoluted, and contested." Over the 70 years since the establishment of the People's Republic of China, the policies have alternated between strict population control measures and more permissive approaches. The transition from the anti-natalist "one-child" policy implemented in 1980, when the population was under one billion, to the pronatalist "three-child" policy in 2021, when the population exceeded 1.4 billion, represents a rare and unprecedented reversal in family planning policy. What prompted such significant policy changes in China?

2. Data and methods

This study has utilized China's census data since the establishment of People's Republic of China in 1949. There have been seven population censuses: conducted in 1953, 1964, 1982, 1990, 2000, 2010, and 2020, respectively[1]. However, the second census in 1964 was excluded from analysis because 4,876,607 individuals (0.702% of the total population) did not report their ages.

The analysis focuses on age- and gender-specific population sizes to examine changes in the following key measures:

- Population aged 0: Defined as the population aged 0 at the timing of the population census.
- Child population: Defined as the population aged 0 – 14.
- Working-age population: Defined as the population aged 15 – 54 for females and 15 – 59 for males.
- Retired population: Defined as the population aged 55 and over for females and 60 and over for males.
- Child dependency ratio: Defined as the ratio of the child population to the working-age population, multiplied by 100. This indicates the number of

[1] The timing of China's population census was July 1 in the census from 1953 to 1990, which has been changed to November 1 since the census in 2000. This change has made the growth rate between 1990 and 2000 a little bit overestimated as the total population in 2000 was counted 4 months late within a 10 year window.

children supported by every 100 working-age individuals.

- Retired dependency ratio: Defined as the ratio of the retired population to the working-age population, multiplied by 100. This indicates the number of retirees supported by every 100 working-age individuals.
- Total dependency ratio: Defined as the sum of the child and retired dependency ratios, indicating the total number of dependents (children and retirees) supported by every 100 working-age individuals.
- Labor-force-entrance group (LF-entrance) or young workers: Defined as the population aged 15 – 24. These individuals provide critical value to the labor force by bringing newly acquired skills and adaptability (Basten & Jiang, 2015).
- Labor-force-exit group (LF-exit) group or older workers: Defined as the population aged 45 – 54 for females and 50 – 59 for males.

While most of these measures are widely used in demographic research, this study introduces a unique definition of the "retired population" based on China's specific retirement regulations. Unlike the United Nations definition of old-age population (65 and over) for both genders, this study defines the retired population as those eligible for pensions under China's compulsory retirement scheme, which sets retirement ages at 60 for men, 50 for female manual laborers (the majority), 55 for female professionals/cadres (including teachers, medical personnel, administrators and other professionals), and 60 for female with high academic ranks. That is, the population eligible to receive pension in China is defined as the population aged 50, 55, or 60 for female urban employees and 60 for male urban employees, urban unemployed residents, and rural residents (Feng *et al.*, 2019; Cai *et al.*, 2018; Peng, 2011). This scheme persisted despite the dramatic socioeconomic transformations over the last seven decades. This definition is more appropriate for this study in assessing the true demand for old-age care and the burden on the pension system, although it may slightly underestimate the retired female population due to early retirements among manual laborers, who make up more than 50% of the total retired female population.

The analysis is divided into two parts: the first part involves a descriptive analysis of the aforementioned measures, utilizing census data to display trends over time. As census data provide complete population counts, hypothesis testing is not required. A notable limitation of this approach is the irregular timing of censuses, which provides data points only for census years and not for the years in between, preventing precise determination of timing when trends change direction.

The second part examines the relationship between the total dependency ratio and relative public expenditures. The variation in weight of child and retired dependency ratios within the total dependency ratio significantly influences public expenditures, as these groups have different needs. High child dependency ratios are associated with increased public spending on education, while high retired dependency ratios require greater public expenditures on healthcare and social security (Kerr & Beaujot, 2016). With the declining child dependency and rising retired dependency ratios, the state would have to prioritize expenditures on health care and social security over education. Research suggests that per capita public expenditures (including health, education, and social security) for the old-age population are two to three times of those for the child population (Kerr & Beaujot, 2016). Assuming (1) per capita public expenditures of child and old-age populations remain constant from 1953 to 2020, (2) these expenditures for the old-age population are 2.5 times of those for the child population, and (3) child public expenditures are set as the baseline (1 unit), the combined per capita public expenditure can be estimated using the following formula:

$$\text{Public expenditure} = \text{Child population} \times 1 + \text{Retired population} \times 2.5 \quad \text{(I)}$$

This formula is only used for relative comparisons under the given assumptions and does not provide absolute financial values or practical meaning. To simplify data presentation, the 1953 census data was used as a baseline for comparison, and the relative sizes of measures as defined above were calculated as ratios of their values to those in 1953. Line charts illustrate these changes, highlighting variations in population structure, public expenditures, and the impact of family planning policies over time.

3. Key findings

3.1. Variation of age structure between 1953 and 2020

From the first census in 1953 to the latest one in 2020, China's total population size increased by 1.48 times, with an annual growth rate of 1.36% based on the assumption of exponential growth over this 67-year period (Figure 1). Growth rates were significantly higher before the implementation of family planning policies than after, including the 10-year Cultural Revolution period (1966 – 1976), a major part of the second childbearing wave in China (Zha, 1991; Wu, 1988; Zhou & Yu, 1992). In addition, China's population growth rate closely mirrored the global population growth rate of approximately 2% before the third census in 1982. However, after the third census,

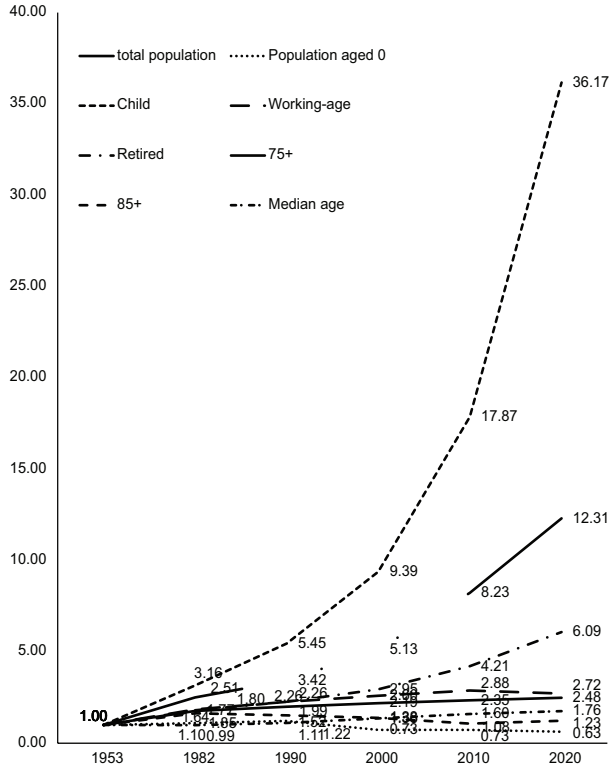

Figure 1. Change of total population, population aged 0, child, working-age, retired, 75+, and 85+ population, and median age between 1953 and 2020 in China
Sources: Census data in 1953, 1982, 1990, 2000, 2010, and 2020 in China.

China's growth rates dropped far below the global averages (1.48%, 0.95%, 0.70%, and 0.56% between censuses), reflecting the significant impact of family planning policies (United Nations, 2022).

The number of population aged 0 increased between 1953 and 1990 but began to decline thereafter. By 2020, the number of aged 0 population was less than two-thirds (63%) of that recorded in the first census, representing a dramatic decline despite a 1.5-fold increase in the total population over the same period. According to the United Nations (2024), the number of aged 0 population in China further declined to 10.46 million, 9.46 million, and 8.90 million in 2021, 2022, and 2023, respectively, compared to 13.4 million in 2020. If this trend continues, the number of aged 0 population in China is projected to decrease significantly and United Nations projections estimate that the total population size in China will decline by 1.26 million from 2021 to 2022 and by 2.6 million from 2022 to 2023 (United Nations, 2024).

The child, working-age, and retired populations in China have grown at vastly different rates between 1953 and 2020. Over this period, the child population (aged 0 – 14) increased by 1.23 times, the working-age population by 1.72 times, and the retired population by more than five times. Similar trends, albeit in opposite directions, are reflected in terms of proportional change as well. The proportion of child population to total population steadily declined, falling from 36.3% in 1953 to 18.0% in 2020. In contrast, the working-age population exhibited a curvilinear trend: its proportion increased until sometime between 2010 and 2020 when it began to decline. This increase was driven by three key factors: the entry into the workforce of the second childbearing wave (those born between 1962 and 1976), the decline in the child population due to family planning policies, and the so-called demographic echo effect, wherein the children of the second childbearing wave cohort (born between 1982 and 1991, the third childbearing wave in China) entered the workforce during the first decade of the 21st century (Wolf Jr. *et al.*, 2011). However, projections indicate that the working-age population peaked between 2008 and 2009 and will continue to decline, assuming retirement ages remain fixed at 60 for both men and women (United Nations, 2022).

The working-age population produces the goods and services that drive China's economy. In 2020, this group accounted for 59.7% of the total population, a relatively large share that provides a temporary economic advantage. However, this proportion is already declining. Between 2010 and 2020, the working-age population fell by 5.8%, and projections suggest that this decline will accelerate to around 6.2% between 2019 and 2035 (Wolf Jr. *et al.*, 2011). Consequently, China's demographic window of opportunity is rapidly closing.

The growth in retired population reflects China's rapid aging process. Between 1953 and 2020, the proportion of retirees grew from around 9% to 22.3% of the total population. This percentage is expected to rise even more rapidly in the future due to sustained low fertility and mortality rates. Using the United Nations standard of 10% to define an "aged" population, China officially became an aging society in 1990, only a little over a decade after implementing the "one-child" policy. As those born in the second childbearing wave transition into retirement, the size of the retired population is expected to continue increasing.

Seniors aged 75 and older have grown significantly, in both absolute and proportional terms. Between 1953 and 2020, their absolute numbers grew by more than 12 times, and their share of the population rose from less than 1% to nearly 5%. The oldest-old population, defined as individuals aged 85 and older, grew at an even faster rate, increasing by more than 36 times in absolute number and

over 14 times in proportion (from 0.08% to 1.09%). They are the fastest-growing age group in the whole population. These trends are expected to accelerate further as the second childbearing wave ages into these groups after 2037. Projections indicate that the proportion of people aged 65 and older will increase from 13.5% in 2020 to 14.3% by 2025 and 21.0% by 2035 (Wolf Jr. *et al.*, 2011). The changing age structure in China predicts a depopulating country owing to decreasing births and increases in the old-age population.

The retired Chinese population has made significant contributions to society through their lifelong work, the playing of caregiving and mentorship roles for younger generations, and the preservation of cultural knowledge and traditions. However, they are also among the most frail and vulnerable groups with unique needs (Kerr & Beaujot, 2016). The growing proportions of people aged 75 and older, and 85 and older mean that China's older population will continue to become more frail and challenging to support. Many of them face physical limitations and require health and home care services. For instance, more than 35% of those aged 75 and older report having three or more chronic conditions, compared to 10% in the 65 and older group (Kerr & Beaujot, 2016). The rapid growth of these aged groups is likely to place additional pressure on healthcare and home care systems. Moreover, the "one-child" policy has exacerbated challenges for eldercare, as an increasing number of seniors no longer live with adult children. This has created demand for alternative housing options, such as senior residences and nursing care facilities (Qian & Li, 2020). Seniors living on their own also face specific needs related to home care, transportation, and security.

The changing age structure of China's population reflects the interaction between social policies and economic development. In the 1950s, 1960s, and 1970s, the young population was a result of pronatalist policies and the demands of a labor-intensive economy. By contrast, the aging population after the 1980s resulted from family planning policies and improved living standards driven by China's economic reforms. Looking forward, the shrinking young population and expanding senior population will shape future demographic and economic trends. The following sections will explore the implications of these trends for the labor force and potential public burdens.

3.2. Labor-force-entrance group vs. labor-force-exit group

The population sizes of the labor-force-entrance (LF-entrance) and labor-force-exit (LF-exit) groups provide important insights into the general trend of the future labor force (Figure 2). In absolute terms, the LF-entrance group increased over time until 1990 but began to decline thereafter, despite overall population growth. In 2020, the LF-entrance group was 51% larger than in 1953. However, in relative terms, the proportion of the LF-entrance population within the total working-age population followed a similar trend but declined sharply. Its value in 2020 was only 55% of that in 1953 (17.3% vs. 10.5%), indicating a significant reduction in its weight within the total labor force and predicting further labor force shrinkage in the coming years.

In contrast, the LF-exit group increased continuously and at a faster pace than the LF-entrance group. Between 1953 and 2020, the LF-exit population grew by 4.67 times, with nearly linear growth after 1990. Moreover, while the proportion of the LF-exit group within the total working-age population initially declined, it began to rise steadily post-1990. By 2020, its weight had increased by 72% compared to 1953 (15.8% in 1953 vs. 27.1% in 2020).

The ratio of the LF-entrance population to the LF-exit population, which indicates labor force growth when the ratio is greater than 1 and decline when it is less than 1, has also varied significantly over time. In 1953, this ratio was 2.01, meaning the LF-entrance population was twice the size of the LF-exit population. The ratio peaked at 2.71 in 1990 before beginning a steep decline. By 2020, the ratio

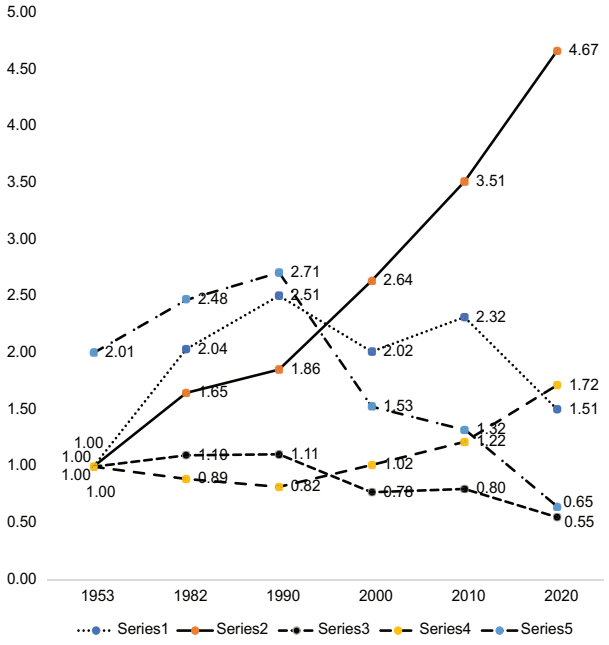

Figure 2. The variation of LF-entrance and LF-exit population by number and proportion out of workers and the ratio of the LF-entrance population to the LF-exit population between 1953 and 2020 in China
Sources: Census data in 1953, 1982, 1990, 2000, 2010, and 2020 in China.
Abbreviation: LF: Labor force.

had dropped to just 0.65, indicating that the LF-entrance population was only 65% of the LF-exit population. Sometime between 2010 and 2020, the LF-exit population overtook the LF-entrance population.

Overall, between 1953 and 2020, the LF-entrance group has consistently shrunk, while the LF-exit group has grown larger. Consequently, the number of workers nearing retirement now exceeds those preparing to enter the labor market. This trend illustrates both the future shrinkage of the labor force and its aging composition. By 2020, the LF-exit group accounted for 27.1% of the working-age population, meaning over a quarter of the current labor force is expected to retire within the next decade – an all-time high in Chinese census history. The aging of the baby boomer cohorts born in the 1960s and 1970s has accelerated both the shrinkage and aging of the working-age population. These trends pose significant challenges for workforce management, including the transfer of institutional knowledge, retention of experienced employees, and the renewal of the labor force. Moreover, the shrinkage of working-age population or labor force could be detrimental to economic growth simply because less people are involved in economic activities. In addition, a shrinking labor force could highly reduce government revenue because there are less and less taxpayers. Furthermore, an aging labor force would undermine economic growth because of lower flexibility, innovativeness, and productivity (Kerr & Beaujot, 2016).

3.3. Child, retired, and total dependency ratios

The changes in the child, retired, and total dependency ratios are predictable given the variations in age structure in China (Figure 3). Between 1953 and 2020, these dependency ratios followed distinct trajectories. The child dependency ratio declined over time, due to decreasing births, driven initially by family planning policies and later by broader social policies and economic development. Specifically, the child dependency ratio decreased by more than 50% between the first and seventh censuses, dropping from 66.4 to 30.1 for every 100 people of labor-force age.

In contrast, the retired dependency ratio exhibited the opposite trend, rising steadily from 16.7 to 37.4 during the same period. This increase was largely due to declining fertility and mortality rates, particularly after 1990. During this time, the total fertility rate fell dramatically, from 6.28 in 1953 to 1.28 in 2020, while life expectancy at birth rose from 46.8 years to 75.3 (United Nations, 2022). The retired dependency ratio surpassed the child dependency ratio around 2012, coinciding with the retirement of individuals born before the implementation of family planning policies in 1978. By 2020, the retired dependency ratio was

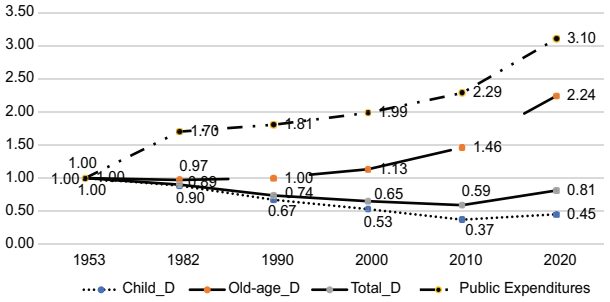

Figure 3. The variation of child, old age, total dependency ratio, and public expenditures between 1953 and 2020 in China
Sources: Census data in 1953, 1982, 1990, 2000, 2010, and 2020 in China.

almost 2.5 times higher than in 1953. This indicates that, if the pension system in China is pay-as-you-go (like the coordinated pension in China), to simply keep the same pension level of those retired, the pension contribution rate of those in the labor force should be more than doubled, which is a big economic burden for the working-age population. While global trends attribute 75% of population aging to fertility decline and the remaining 25% to mortality decline (Kerr & Beaujot, 2016), China's rapid fertility declines due to the coercive "one-child" policy contributed disproportionately to its aging population. The total fertility rate dropped below replacement level in 1991, just over a decade after the policy's implementation (United Nations, 2022), suggesting that fertility decline accounted for much more than 75% of population aging in China.

The total dependency ratio varied over time due to the opposing trends of child and retired dependency rates. Between 1953 and 2020, the total dependency ratio declined initially, reaching its lowest point between 2010 and 2020, before increasing again. However, by 2020, the total dependency ratio was still only 81% of its 1953 level. The composition of the total dependency ratio also changed significantly. In 1953, the retired dependency ratio accounted for 20.1% of the total dependency ratio; by 2020, this share had increased to 55.4%. The gap between the child and retired dependency ratios narrowed over time, with the two becoming equivalent around 2010. By 2020, the retired dependency ratio exceeded the child dependency ratio by 7.27%, establishing itself as the dominant component. Numerous studies document these trends, and it is reasonable to predict their continuation due to persistently low fertility and increasing life expectancy in China (Zhang, 2017; Wolf Jr. *et al.*, 2011). This indicates that the retired dependency ratio will account for an increasingly larger share of the total dependency ratio in the future.

The rising proportion of the working-age population and the declining proportion of the child population, along with the reduction in the total dependency ratio, created a "demographic dividend" in China (Wolf Jr. *et al.*, 2011). This demographic shift, characterized by a growing working-age population, contributes to economic growth by boosting both supply and demand. The reduced child population also facilitated accelerated capital accumulation through lower spending on dependents (Johnston *et al.*, 2016). These demographic changes, spurred by the implementation of family planning policies, resulted in more workers and fewer dependents, thereby improving average living standards. Research indicates that this "demographic dividend" accounted for over one-fourth of per capita GDP growth in China from 1965 to 2005 (Peng, 2011). Other studies estimate that for every 1% decrease in the dependency ratio due to an expanding workforce share, per capita GDP increased by 0.115% (Song *et al.*, 2016). However, the halt in the decline of the total dependency ratio around 2012, coupled with the shrinking working-age population beginning around 2014, marked the end of the "demographic dividend" in China. The aging process has since accelerated, driven by the retirement of the second baby boomer cohort. This shift poses significant challenges as China transitions from a period of demographic advantage to one of demographic constraint.

Will the savings from declining child dependency offset the rising government expenditures on old-age dependency? To address this question, this study uses age-specific population data from China population censuses to estimate the required public expenditure on education, healthcare, and social security. These estimates are based on Formula I and the three assumptions outlined in the methodology section (Figure 3). From Table 3, we can see that while the total dependency ratio in 2020 remains lower than its 1953 level (81%), the shift from child to old-age dependency has driven a significant rise in public expenditure. By 2020, public expenditures were 3.10 times as they were in 1953. This demonstrates that the reduction in the total dependency ratio from 1953 to 2020 does not necessarily translate into a decline in public expenditures or governmental costs. Although assumption (3) is likely close to reality, assumptions (1) and (2) are less realistic. These assumptions do not account for the high inflation rates in China or the rising expenditures on education, healthcare, social security, and other social services. Consequently, the actual costs associated with changes in age structure, dependency ratios, and population aging are significantly higher than these estimates suggested.

In summary, the analyses above indicate that most measures studied in this project – except for the retired population – exhibited an upward trend followed by a decline between 1953 and 2020, regardless of whether they are measured in absolute numbers or proportions. Only the retired population followed a consistent upward trajectory. These trends collectively point to a single outcome: population shrinkage across all measures except the old-age population. Population aging in China reflects not only the growth of the retired population but also the aging of the labor force, as evidenced by the rising labor-force-exit population and the declining labor-force-entrance population. These changes signal a shrinking labor force in the coming years. Furthermore, the "demographic dividend," generated by declining fertility levels and a mass of young workers entering the workforce with relatively few familial responsibilities since the 1979 reforms, has reversed since approximately 2015 (Lee, 2013). The rapid increase in the retired population, particularly among the oldest-old, indicates that social services – including healthcare, social security, and pension systems – will face significantly greater pressure in the near future.

4. Concluding remarks

Using population census data from China, this study conducted a descriptive analysis of the variation in the age structure of the Chinese population from 1953 to 2020. A unique feature of this study is the use of a practical definition of the retired population, operationalized based on the social reality in China – a specific retirement scheme implemented by the Chinese government. This approach clearly reflects the true size of the economic burden on the pension system. The main conclusion of this study is that the Chinese population has transformed dramatically from a young to an old demographic, driven by family planning policies and socioeconomic developments. The pace of population aging in China is significantly faster than in any other countries. Furthermore, with historically low fertility levels, the population faces labor force shrinkage and potential negative growth. Variations in child, retired, and total dependency ratios resulting from the changes in age structure between 1953 and 2020 reveal a rapid increase in public expenditure due to the growing proportion of the retired population, despite the total dependency ratio being lower in 2020 than in 1953. Private costs incurred by individuals and families have been excluded from this study because the focus of this study is about the public burden of population aging in China, while research does indicate that public costs are higher for the aged, private costs tend to be higher for the young (Kerr & Beaujot, 2016). Therefore, population aging involves a shift in the burden from private to public sector, like from education to pension and healthcare. Moreover, the shrinking and aging labor force is becoming a barrier of economic growth

because there are less workers available in the labor market and the structural rigidity associated with aging labor force (Kerr & Beaujot, 2016).

For decades, the Chinese government implemented a series of policies designed to slow the growth of the world's most populous nation, including limiting urban couples to one child. However, the long-term effects of these policies have been the fastest population aging and the sharpest population decline projected for the coming decades, setting the stage for potential demographic and economic crises, as well as threats to social harmony and stability (Myers *et al.*, 2020; Zhang, 2017; Nundy, 2016). While population aging is a common demographic phenomenon, the process in China is distinct, primarily resulting from family planning policies rather than economic development (Buckley, 2013; Rajan, 1994; Yardley, 2008; Myers *et al.*, 2020). The pace of population aging in China far exceeds that of other countries. For instance, it only takes China 30 years for the proportion of individuals aged 65 and older to increase from 5.6% in 1990 to 13.5% in 2020, while it takes Canada 75 years for the similar increase of senior group – from 5.6% in 1931 to 13.3% in 2006 (Kerr & Beaujot, 2016). According to the United Nations, China was classified as an "aging society" in 2015, when the proportion of those aged 65 and older exceeded 10% of the population (United Nations, 2022). This milestone occurred just 35 years after the implementation of the "one-child" policy. Projections from the United Nations Population Division's 2017 medium fertility scenario indicate that the proportion of people aged 65 and older will reach 26.3% of the total population by 2050, assuming a moderate and gradual recovery in fertility rates (Cai *et al.*, 2018).

Another unique aspect of population aging in China is that it remains a developing country. China is becoming the first major nation in history to grow old before achieving moderate wealth (Lee, 2013; Buckley, 2013). The demographic transition in most countries occurs alongside robust economic development, where declining fertility and mortality rates reflect improved living standards. Developed countries in Western Europe and North America experienced long "wealth durations" followed by extended "aging durations" – a process often described as "getting old after getting rich" (GOAR) (Johnston *et al.*, 2016; Song *et al.*, 2016; Zhan, 2013). In these nations, population aging primarily results from economic growth, as highlighted by the slogan from the Third World Population Conference in 1974: "Development is the best contraceptive." These countries also possess necessary – if not always sufficient – economic foundations, including comprehensive social welfare systems, free healthcare, social security, and robust pension schemes, to address the challenges associated with aging populations.

The experience of population aging in China, in contrast to that of developed countries, could be described as "getting old before getting rich" as China remains a developing country, and its aging population is likely unsustainable due to a lack of economic foundation (Myers *et al.*, 2020). When China joined the world's "aged population club" in 2015, its per capita GDP was only $8,016.4 – significantly below the global average of $15,094.4 at the time (World Bank, 2023). Moreover, social welfare coverage in China remains limited and basic. For instance, a recent study by the Organization for Economic Co-operation and Development (OECD) found that 10 – 15% of pension recipients still depend primarily on their children for old-age support, while this figure rises to over 50% for those without a pension (Lee, 2013). Furthermore, despite its limited coverage (due to low economic development), the state's pension liabilities were estimated at $2.7 trillion in 2010 and $2.9 trillion in 2013 (Lee, 2013:59). Without changes to pension policies, liabilities are projected to reach $10.25 trillion by 2033, or nearly 40% of China's GDP if it grows at a rate of 6% annually (Lee, 2013:59). These figures underscore that China is neither economically nor financially prepared to address the challenges of its aging population.

Simultaneously, the social system is transitioning from government-controlled socialism to a quasi-capitalist free-market system, shifting old-age care responsibilities from the state to individuals and families (Howden & Zhou, 2015). Conventionally, elderly individuals in China rely on family members for care. However, with fewer children due to the "one-child" policy, parents may receive less support from their families (Peng, 2011). The policy created the so-called "4-2-1" family structure, where a couple must care for four parents and a child of their own after marriage (Zhan, 2013; Basten & Jiang, 2015). This structure has significant consequences. First, parents of an only child born under the "one-child" policy will have at most one surviving child to support them in old age (a certain number of parents lost their only child because of various reasons, resulting so-called "families losing their only child"). If that child is a daughter adhering to traditional cultural norms, she may prioritize her husband's parents over her own (Wolf Jr. *et al.*, 2011). Second, when the one-child generation becomes adult caregivers, they may simultaneously support four elderly parents and one or two children. This burden forces the one-child generation to work harder to provide both financial support and physical care for their aging parents (Zhan, 2013). While women in these households face fewer childcare responsibilities due to declining fertility, their

opportunities in the workforce may still be constrained by the demands of caregiving, particularly given the lack of siblings to share these responsibilities.

Population aging has broader demographic implications, including fewer births, more deaths, and negative population growth (Kerr & Beaujot, 2016:205). According to the World Population Prospects 2022 (United Nations, 2022), China's population began to decline in 2022. Projections estimate a population reduction of 7.88% (112.3 million) by 2050 and a 46.2% reduction (658.3 million) by 2100 compared to 2020. This decline could create substantial economic challenges. With fewer workers, the government may struggle to finance the needs of a growing elderly population living longer lives. A shrinking working-age population could also reduce consumer spending, further straining the economy in China and beyond. The industrial strategy that China had relied on for decades – leveraging a growing labor force to escape poverty and achieve economic power – can no longer be sustained due to the shrinking labor force and graying population.

Overall, China faces increasing economic challenges associated with its demographic transformation, posing a substantial burden on both Chinese society – characterized by a limited social welfare system – and the working-age population, many of whom are the only child in their families (Wang *et al.*, 2016:84). To slow the pace of population aging and increase the working-age population, the Chinese government has dramatically shifted its family planning policies from population control to pronatalist measures. This shift began with the loosening of the "one-child" policy in 2015, followed by the introduction of the "two-child" policy in 2016. When the "two-child" policy failed to significantly increase fertility rates, the government implemented the "three-child" policy in mid-2021 (Feng *et al.*, 2019; Peng, 2011:586). However, it remains uncertain whether the "three-child" policy can effectively address these demographic challenges. In general, public response to the pronatalist policies has been lukewarm.

Raising a child in China is expensive, and the current working-age population – many of whom are the only child – must simultaneously plan for their parents who are near retirement ages and funding their own children's education. These challenges are compounded by costly daycare services and a pervasive culture of long working hours (Wee, 2021). In addition, many couples now believe that having one child is sufficient, while some express no interest in having children at all. Culturally, individuals of childbearing age in China are not "willing" to have large families due to a perceived lack of benefits or advantages in doing so (Li, 2023; Le & Yang, 2023; Dai & Yan, 2023). This lack of willingness aligns with Coale's three preconditions of fertility change (ready, willing, and able) as outlined in the European Fertility Project. Research suggests that low fertility in China is now more a matter of choice than policy restrictions (Wang *et al.*, 2016; Attané, 2016:530). Thus, the "three-child" policy is unlikely to significantly increase birth rates, as was the case with the "two-child" policy (Wang *et al.*, 2016). Couples who are responsible for supporting two sets of parents and raising a child are understandably reluctant to take on the additional burden of having more children.

Even if the "three-child" policy succeeds, it would take approximately two decades for these children to enter the labor force. In the interim, the child dependency ratio would increase, placing additional pressure on the working-age population to support both children and elderly parents simultaneously (Lee, 2013:55; Cai *et al.*, 2018). Moreover, higher fertility rates would exacerbate environmental pressures and strain natural resources (Basten & Jiang, 2015: S98). Each additional child reduces the resources available to other citizens and will not contribute economically until they reach adulthood (Howden & Zhou, 2015:243). Furthermore, rapid population growth coupled with industrial development over the past 40 years, has already caused water shortages in major cities and a scarcity of arable land nationwide, indicating critical bottlenecks for sustainable development (Peng, 2011:586). To increase fertility by implementing a "three-child" policy will inevitably worsen food supply challenges, water shortages, and environmental degradation as more scarce resources are diverted to supporting a growing population of new births. However, to analyze the specific impacts of family planning shifts on economic growth, government revenue, tax revenue, and social expenditure, we need much more economic and social variables beyond census data used in this project. This is one limitation of this study which should be addressed in the future.

To address the population crisis in China, a straightforward approach to reducing the financial burden on the pension system would be to increase the retirement age, an idea that has garnered broad agreement. The current retirement age in China – 60 for men and 55 for women – was established in the early 1950s when life expectancy at birth was only about 40 years (Cai *et al.*, 2018; Peng, 2011:585). With life expectancy at birth rising to 78.2 years in 2020, raising the retirement age appears feasible. Many countries have already set the retirement age above 60. For instance, Canada's retirement age for both genders is 65 and is set to increase to 67 within 15 years (Kerr & Beaujot, 2016). Extending the retirement age offers a "triple dividend": boosting the labor force, improving

public finances, and providing employers with a smoother transition in replacing retiring workers. In addition, it improves workforce quality and reduces worker-to-retiree ratios in China (Feng *et al.*, 2019). If the retirement age were raised to 65 for both men and women, the proportion of the retired population would drop from 22.3% to 13.5%, and the old-age dependency ratio would decrease from 37.4 to 19.7 retirees per 100 workers in 2020.

In sum, China's population aging process is markedly different from that of Western nations, as its demographic transition has occurred within just one generation. The Chinese government introduced the "three-child" policy in 2021 in the hopes of initiating a baby boom to address the twin crises of an aging population and labor force shortages. However, transitioning from a baby bust to a baby boom requires meeting many of the preconditions mentioned earlier. The baby boom in Western societies between 1946 and 1965 was an exceptional period that deviated from the general trend of demographic transition. It was primarily driven by economic optimism following World War II (Kerr & Beaujot, 2016). In addition, the Western baby boom relied on the sacrifice of women's independence, as many women remained at home to manage households and fulfill traditional roles while men were the breadwinners. Thus, the Western baby boom was predicated on both favorable economic and cultural conditions.

In contemporary China, although it is challenging for women to return to traditional roles of managing the household and leaving the labor market, it is still possible for the government to develop various welfare policies to address the economic demands of childbearing, based on successful policies having been implemented in other countries. In Sweden (Swedish Institute, 2024), for example, when a child is born or adopted, parents are entitled to 480 days of paid parental leave. Each parent is entitled to 240 of those days; a single parent is entitled to a full 480 days. Parents can also choose to transfer up to 45 days of their parental leave to grandparents or family friends. Moreover, if a parent works in Sweden and needs to take days off to care for a sick child, s/he can get compensation through the Swedish Social Insurance Agency. There are also policies geared toward addressing the aging population, such as the Proximity Housing Grant practiced in Singapore (Housing & Development Board, 2024). This is a relocation incentive for children to live closer to their parents ($30,000 to live with your parents/child and $20,000 to live near your parents/child [within 4 km]), which could be adopted in China with the aim to help ease old age care. Furthermore, the advent of the digital age and robots equipped with advanced AI technology will have a very high potential to help reduce some of the burden of caretaking for both the new birth and old. Therefore, while it is unlikely that the fertility rate will significantly increase in the short term, with the implementation of all these pronatalist policies and progress in technology, it could potentially lead to a future shift from a declining fertility toward a gradual upward trend.

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Conflict of interest

The authors declare that they have no competing interests.

Author contributions

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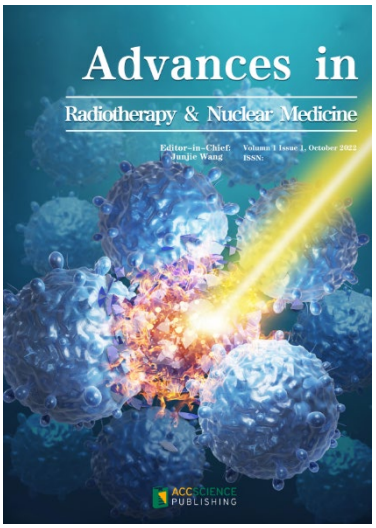

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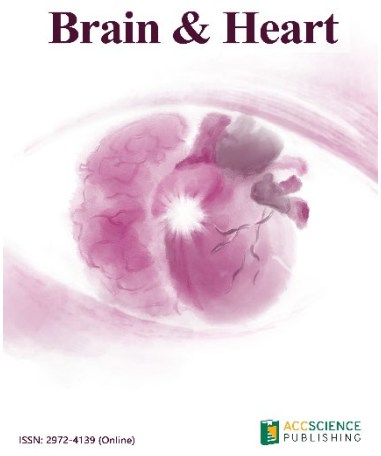

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