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RESEARCH ARTICLE

Factors associated with fertility limiting intention and contraceptive use among currently married men in India

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Abstract: Family planning methods are generally considered as women's responsibility in India. The volumes of research done so far in the family planning methods and reproductive behaviors have kept women at the center of the matter. Consequently, the research on the men's perspective on the same is generally being neglected. The present study intends to address intention of fertility stopping or fertility limiting and contraception behaviors and their associated factors among currently married men aged 20-49 years in India who had at least one living child. The fourth round of the National Family Health Survey in 2015-2016 was used to achieve the study objectives. Descriptive statistics and binary and multinomial logistic regression models were applied to more than 48,000 men who met the requirement. The findings of the analysis indicate that more than three-fourths currently married men did not want another child, and the fertility stopping intention significantly varies by demographics (i.e., men's age, number of children, and sex composition of children), socio-economic characteristics, residence, geographic region, and religion of the respondents together with type of caste and social media exposure. The men's fertility stopping intention was also linked with geographic region, types of religion and castes, and exposure of social media. Result further reveals that only <30% of men who did not want to have another child were using a contraceptive method at the time survey. Among users, female sterilization was the most popular method among married couples in India. Demographic factors, socio-economic characteristics, region and culture, and exposure of social media were all associated with use or not-using and use of a specific conceptive method. Overall, the findings suggest men's fertility stopping intention and their use of contraception are complicated, and it needs to consider men as a target group in fertility regulation interventions. The reproductive health programs aiming to increase uptake of modern contraceptives by sexually active men in India should consider the importance of sex education and ensure access to mass media.

Keywords: Fertility limitation intention; Contraceptive use; Male involvement; Reproductive health; Family planning; India

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1. Introduction

The significance of the use of family planning methods is well documented, not only having improved women and child health but also having added to related issues such as gender equality, better child health, an improved response to HIV, greater education outcomes, and poverty reduction to development agenda (Loaiza, Luchsinger, and Liang, 2016). The higher utilization of contraception has been both an instrumental factor in the demographic transition and an indicator of changes in the attitudes and cultural patterns of society as a whole (Bongaarts, Mauldin, and Phillips, 1990; Van de Kaa, 2001).

Globally, about 48.5% of women in their reproductive ages were using some form of contraception in 2019. However, it was much lower in the least developed regions with only about 29% in Sub Saharan African countries followed by about 34% in Northern Africa and western Asian countries and highest (60%) in Eastern and Southeastern Asian region (United Nation, 2019). According to the United Nation (2019), female sterilization was the most common contraceptive method used worldwide in 2019, accounting for 23.7% among those women with any methods globally, followed by male condom (21.6%), IUDs (17.3%), and pill (16.5%). Male sterilization accounted for 1.8%, and withdrawal accounted for 5.2%. About 27.4% of couples using methods related to men (male sterilization, male condoms, and withdrawal). The highest prevalence of these methods was 36.5% in Europe and Northern America and the lowest share was around 20% in sub-Saharan Africa and Latin America and the Caribbean. Only 10.5% of women of reproductive ages in the Southern Asia countries (India, Nepal, Bangladesh, etc.) were relying on methods that required active male participation such as vasectomy, condoms, periodic abstinence, or withdrawal (United Nation, 2019).

The prevalence of unmet for family planning was 14.2% at the world level in 2019, and it was much higher in the less developed regions with 87 million of women in Southern Asia, 28 million women in Eastern Asia and 23 Million in South-Eastern Asia have unmet need of family planning in 2019 (Kantorová, Wheldon, Ueffing, *et al*., 2020). Moreover, the global number of women in reproductive ages using contraception is projected to rise by 76 million, from 842 million in 2019 to 918 million in 2030 (Kantorová, Wheldon, Ueffing, *et al*., 2020). Growth in the number of contraceptive users is projected to be high for all regions of Africa and in Southern Asia (United Nation, 2019). In line with this vision, India had committed to upsurge of the modern contraceptive usage from 53.1% to 54.3% and ensure that 74% of the demand for modern contraceptives are satisfied by 2020 (GOI, 2017).

However, family planning programs have conventionally focused mainly on women, with the aim to help reduce the burden of unintended pregnancies, overlooking the importance of male participation in family planning programs (Blossfeld and Kiernan, 1995); men have been long considered to be beyond the scope of family planning programs (Cleland, Bernstein, Ezeh, *et al*., 2006). Despite women's increasing influence on household decision-making, their preferences of regarding contraceptive choices and family size may not be translated into practice unless they conform to their husband's wishes (Dahal, Padmadas, and Hinde, 2008). The reasons include that reproduction is primarily a women's issue and that men usually do not take responsibility for reproductive health and family planning (Cleland, Bernstein, Ezeh, *et al*., 2006; Raju and Leonard, 2000; Ha, Jayasuriya, and Owen, 2003).

Fortunately, there is a growing body of research in both Africa and Asia that gender and social norms play a significant role in determining the use of contraceptive, with men playing a greater role in the decision-making (Mishra, Nanda, Speizer, *et al*., 2014; Withers, Dworkin, Zakaras, *et al*., 2015). Many studies further show that women's fertility preferences and contraceptive adoption are influenced by husband's influence on women's decision-making as well as their own attitudes (Beekle, 2006; Bogale, Wondafrash, Tilahun, *et al.*, 2011; Greene and Biddlecom, 2000; Niraula, 1998; Nte, Odu, and Enyindah, *et al.,* 2009; Tuloro, Deressa, Ali, *et al*., 2006). Several studies have also found that men's attitudes toward gender equality are associated with condom use to prevent HIV/AIDS (Bruhin, 2003; Bogale, Wondafrash, Tilahun, *et al*., 2011; Pulerwitz, Amaro, Jong, *et al.,* 2002).

Past studies further asserted that discussion of family planning with a health worker, region, education, wealth index, number of surviving children, exposure to media, men's working status, and fertility preference are the most important determining factors of the contraceptive use among men (Chauhan and Prasad, 2021; Kabagenyi, Ndugga, Wandera, *et al.,* 2014; Kogay and Itua, 2017; Ochako, Temmerman, Mbondo, *et al.,* 2017; Okigbo, Speizer, Corroon, *et al*., 2015). Researches further suggested that contraceptive use is likely to be more operative for women when men are enthusiastically involved by the programs, through any means (Shattuck, Kerner, Gilles, *et al.,* 2011; Terefe and Larson, 1993). The perceptions of community norms and social network also influence the approval of family planning among men (Dynes, Stephenson, Rubardt, *et al*., 2012). In addition, it is found that men with more gender equitable attitudes are more likely to use modern methods (Mishra, Nanda, Speizer, *et al.,* 2014; Chauhan and Prasad, 2021). Similarly, studies conducted in Nepal and Uganda show that fertility intension and fertility preference (>2 children) generally determines by the various demographic, socio-economic, and culture factors of the individuals and communities (Dahal, Padmadas, and Hinde, 2008; Matovu, Makumbi, and Wanyenze, *et al.,* 2017; Paudel and Acharya, 2018; Aung, Soe, and Moh, 2019). In sum, the men's view of their family size, gender preferences, timing of childbirth, length of birth intervals, the usage of contraceptives, and the social and cultural environment where they live affect their reproductive behavior were evidenced to be associated with the contraceptive use (Koffi, Weidert, Bitasse, *et al*., 2018).

Since men are the heads of households, they make decisions around the well-being of their households including decisions on family planning (Adelekan, Omoregie, Edoni, *et al.,* 2014). Men should be deliberated not only as women's partners but also as individuals with diverse reproductive behavior and desires of their own (Greene, Mehta, Pulerwitz,

et al., 2006). It has been seen that husbands often play a critical role in decision-making regarding the timing and number of a couple's births (Kriel, Milford, Cordero, *et al.,* 2019; Link, 2011). Moreover, male involvement in family planning should be viewed in terms of not only the share of male method use but also men's attitudes regarding method choices and family size preferences. To understand the male involvement in the fertility or reproductive process requires a systematic analysis of men's attitudes toward spacing and limiting behavior.

In a developing country like India, most of the decisions regarding family formation are taken care of by men (Forste, 2002). Another reason may be due to India being a patriarchal society; women are subjugated to decide even for their own life, lowering female autonomy, and raising preference for male child. Patriarchy, which exists in both rural and urban parts of India, often ends with husbands dominating the power in determining the use of contraception. Nevertheless, in India, the contraceptive method most often used by women who want to limit their family size is female sterilization (IIPS and ICF, 2017). Although both men and women can have permanent sterilization, vasectomy is a technically easier, safer, and more effective procedure than female sterilization. Furthermore, in India, research on men fertility stopping intention (do not want another child) using the national representative dataset is almost unavailable.

Hence, the present study is an attempted to bridge this gap using nationally representative data set; and further to understand the determinants of fertility stopping intention (do not want another child) among currently married men of India. For that, the focus of this paper is twofold. First, the paper investigates the factors associated with fertility stopping intention among currently married men who had already at least one child. Second, the paper examines factors associated with use of family planning methods among sexually active men in India who have already at least one child and do not want another child (Mason and Smith, 2000). Below we describe the data and methods used for the present research, followed by the results, interpretations of major findings and their implications.

2. Data and Methods

2.1. Data sources

The current study used data from the fourth round of the National Family Health Survey (NFHS-4) conducted during 2015-2016 by the International Institute for Population Sciences (IIPS) Mumbai under the stewardship of the Ministry of Health and Family Welfare (MoHFW), Government of India, covering the 29 states and seven union territories. NFHS is a nationally representative population based survey which collects information on various issues, including but not limited to male and female fertility behavior, family planning use behavior, nutritional status of male, female and children, domestic violence, reproductive health services utilization, and information on communicable and non-communicable diseases. The survey followed a stratified two-stage random sample design using the sampling frame of the 2011 Population Census. The census enumeration block in urban areas and villages in rural areas served as primary sampling unit for this. The response rate of the Survey was 98%, 97%, and 92% for household, ever married women, and ever married men, respectively. Overall, there were 122,051 eligible men aged 15-54 years in households selected. The interviews were completed with 112,122 men, for a response rate of 92%. The detailed methodology of the survey is given elsewhere (IIPS and ICF, 2017).

The study is based on currently married men to investigate their intention for true fertility limit and contraceptive use behaviors. To align with the study aims, out of total married men (70,215 cases), we excluded those men who did not have any living child (8799 cases) at the time of survey. Furthermore, we excluded those cases which replied as "undecided," "he or his partner were sterilized," and "he or his partner declared infecund" (6,556 cases) for fertility preference. In addition, men below the age of 20 years and above 49 years (6706 cases) were also excluded from the study. Thus, our sample for fertility limiting intention analysis comprised 48,166. In analyzing the use of contraceptive methods, we further excluded those men who had intention to have an extra child (11,248 cases), which came up with 36,918 men aged 20-49 years who had at least one living child at the time of survey. It is worth mentioning that the study has not found any case of male sterilization after applying all the exclusion criteria. Therefore, the male sterilization category is not available in our main outcome variables.

2.2. Dependent Variables

Fertility intention and contraception were the outcome variables of the study. Fertility intention was defined whether married man wished to have one child or more regardless of timing. We classified it as dichotomous variable (want to one or more vs. do not want). We focus on the category of not wanting any more child (or wishes to stop having any more child), termed as fertility stopping or limiting intention.

Contraceptive use was defined as current use of any method among all sexually active men (20-49 years) who ever had sex involving not only men's methods but also other types related to women's contraception. Female sterilization is a modern method; however, due to its relatively large proportion, this study classified it as a single category. In other words, the contraceptive methods were categorized into three categories: Modern methods (condoms, pills, injections, implants, and IUDs), female sterilization, and traditional methods. The study used responses from men because men influence the choice of contraceptive methods within their families, which is also consistent with the objectives of this study.

2.3. Factors Associated with Fertility Intention

The study included all major possible demographic and socio-economic variables as independent variables that associated with fertility intention and the contraceptive use based on the existing literature (Cohen, 2000; Haq, Sakib and Talukder, 2017; Banerjee and Trigun, 2020). The demographic variables included respondent's age (20-29 years, 30-39 years, and 40-49 years) and sex composition of living children (all daughters, all sons, equal number of sons and daughters, more daughters than sons, and more sons than daughters). Socio-economic factors included educational attainment (no education, primary school, secondary school, and high school or above), wealth quintile (poorest, poor, middle, rich, and richest), current occupation (not working, professional, clerical/sales/service, agriculture, and manual workers), place of residence (urban vs. rural), and regions (North, Central, East, Northeast, West, and South). A man's education, wealth, and occupation mainly reflect his individual socioeconomic status (SES), whereas current place of residence or region mainly reflect of macro-level of socioeconomic development for a place/community where he was living at the time of survey. To account for the possible religious and cultural influence on fertility intention and contraceptive use, we included types of religions (Hindu, Muslim and others) and Caste (Scheduled Castes, Scheduled Tribes, Other Backward Class, and Others), terms as region, and cultural factors. Finally, we included a variable of social media exposure (no exposure vs. any exposure) to take into account of the possible influence of governmental intervention programs on family planning and modern values.

2.4. Statistical Diagnostic of Data

Descriptive statistics were used for demographic and socioeconomic characteristics on contraception use and fertility intention. In descriptive statistics, the Chi-square test was used to see if there were any differences in family planning method used by selected covariates. For analyzing factors associated with fertility stopping intention, in addition to base regression that included only each of all factors as a predictor, four nested binary logistic regression models were employed among 48,166 married men with at least one child. Model I included demographic variables only. Model II added socio-economic factors into Model I. Model III further included cultural and religious variables. Model IV additionally add exposure to social media. For the contraceptive use, two sets of regression models were employed. The first set examined what factors were associated with use of any contraceptive method among 36,918 men who do not wish to have additional child using binary logistic regression. The second set used multinomial logit regression models to examine associates of use of modern contraceptive method or female sterilization relative to tradition method among 10,562 men who wish to stop having any more children. Similar modeling strategy as for fertility stop intention was used for the contraceptive use. Multicollinearity was not found among independent variables. STATA version 14.1 was used for analysis of this study.

3. Results

3.1. Results for Analyses of Fertility Stopping Intention

The sample distribution of men with at least one living child and their choices on further children is presented in Table 1. Overall, about 78.4% of the married men with least one child at the time of survey did not wish to have one more child regardless of timing. However, the wish for additional child varies by selected covariates among the sample. For example, more than half (54%) married young men (age 20-29 years) wanted to have at least one more children in comparison with only 22% and 5% in ages 30-39 and 40-49 years, respectively. In terms of sex composition of children, more than 90% of married men who had both boys and girls wished to stop to have additional child in comparison with about 68.8% among men with all sons and 46.5% among men with no sons. From the perspective of socio-economic characteristics, except small difference found in urban and rural areas, noticeable differences were found for other characteristics. Differences for cultural and religious characteristics are mild or moderate. The proportion of wishing not to have any more children is similar between men with any social media exposure and those without.

Table 1. Percentage distribution of currently married men aged 20-49 years who had at least one living child, by selected characteristics according to fertility intention, India, 2015-2016.

Background characteristics	N	Wanting more children (N=11,248)	Not wanting more Child (N=36,918)	*P*-value
Total	48,166	21.6	78.4	
Demographic characteristics				
Age (years)				
20-29	9,160	54.0	46.0	
30-39	20,632	22.3	77.7	0.000
40-49	18,374	5.0	95.0	
Number of living children				
1	10,795	63.9	36.1	
2	17,753	11.2	88.8	0.000
3	10,555	6.3	93.7	
4+	9,063	4.9	95.1	
Sex composition of living children				
All daughters	8,384	53.5	46.5	
All sons	13,018	31.2	68.8	
# of sons = # of daughters	12,286	7.0	93.0	0.000
# of daughters > # of sons	7,529	5.2	94.8	
# of sons > # of daughters	6,949	2.8	97.2	
Socioeconomic characteristics				
Educational attainment				
No Education	8,205	16.3	83.7	
Primary school	7,688	18.3	81.7	
Secondary school	26,022	22.3	77.7	0.000
High school or above	6,251	28.7	71.3	
Current occupation				
Not working	2,779	23.3	76.8	
Professional	3,208	26.9	73.1	
Clerical/sales/service	9,852	22.7	77.3	0.000
Agriculture	17,733	18.3	81.7	
Manual workers	14,520	23.0	77.0	
Wealth quintile				
Poorest	8,858	22.6	77.4	
Poorer	10,193	21.1	78.9	
Middle	10,162	20.8	79.2	0.032
Richer	9,520	20.8	79.2	
Richest	9,433	22.8	77.2	
Current residence				
Urban	14,335	22.3	77.7	
Rural	33,831	21.2	78.8	0.073
Regions				
North	10,662	20.4	79.6	
Central	12,426	22.2	77.8	
East	7,978	22.7	77.3	0.000

(Contd...)

Table 1. *(Continued)*.

Background characteristics	N	Wanting more children (N=11,248)	Not wanting more Child (N=36,918)	*P*-value
Northeast	5,573	30.4	69.6	
West	5,522	18.4	81.6	
South	6,005	22.1	77.9	
Religious and cultural factors				
Religion				
Hindu	36,803	20.7	79.3	
Muslim	6,430	27.5	72.5	0.000
Others or no religion	4,933	21.3	78.7	
Caste				
SCs/STs	16,849	22.0	78.0	
OBCs	19,145	21.5	78.5	0.331
Others	9,668	20.8	79.2	
Media exposure				
No exposure	9,744	20.7	79.3	
Any exposure	38,422	21.8	78.2	0.094

(1) *P* values are based on the Wald-Chi-square test from weighted bivariate logistic regression between each single factor and the outcome variable of fertility intention. (2) SCs: Scheduled Castes; STs: Scheduled Tribes; OBCs: Other backward castes. (3) Percentage are weighted and numbers are unweighted. Cases may not be equal due to missing values.

The results of multiple nested logistic regression analyses are presented in Table 2. In this table, four separate models were applied. The results in Model I show that men in ages 30 s and 40 s were 1.55 times (=2.55-1) and 10.04 times more associated with not wishing to have more children as compared to men in 20 s, respectively, which is expected as young men have not had their expected numbers or sexes of children they wishes, while older men who likely have already had desired numbers or sexes of children. These odds ratios were not altered when different other covariates were controlled for. Compared to men with only on child, men with 2, 3, or 4+ children were associated with as much as 8.06, 9.05, and 9.19 times odds of not wishing to have an additional child. These odds ratios were mildly enhanced when other covariates were controlled for. Model I further reveals that men having no son were associated with 71% (=1-0.29) lower odds of not wishing to have more children as compared men whose children were all sons, and the odds ratio was robust across all models regardless of presence of other covariates. This may imply that there is son preference or preference for having both sons and daughters among married men in contemporary India. Interestingly, compared to men with children of all sons, men with children of equal sons and daughters and men with children of more daughters than sons were associated with 40% (=1.40-1) and 34% higher odds of not wishing to have an additional child in Model I. The odds ratio of wishing to stop having more children for men who had more sons than daughter could reach 2.06. The odds ratios for sex composition of children were slightly strengthened when other covariates were adjusted for. These results indicate that compared to men who have both boys and girls, men with children of either all girls or all boys are more likely to wish to have more children, implying that Indian men have strong preference for having both sons and daughters.

The associations between intention of fertility stopping and other covariates are also noteworthy mentioning. For individual SES factors, with an exception for the wealth quintile, the associations between fertility stopping intention and education and occupation were relatively weak or not significant, especially when other sets of covariates were further controlled for. For example, compared to men with no schooling, men with a primary and secondary educational attainment were associated with 13-14% higher odds of not wishing to have one more children when demographic and socio-economic factors were controlled for (Model II); however, when religious and caste factors were further adjusted for, the odd ratios were reduced to non-significance (Models III and IV). One unexpected finding was that there was no difference in fertility intention between men with no schooling and men with high school or above, even when no religious and caste types and social media exposure were adjusted for. Except for the professional category of occupation, no difference was found for other occupational categories in comparison with jobless men. Men in agriculture were associated with 14% higher odds of not wishing to have more children as

Table 2. Odds ratios of wishing to stop wanting more children among currently married men aged 20-49 years who had already at least one living child, India, 2015-2016.

Background characteristics	Model 1	Model 2	Model 3	Model 4
Demographic characteristics				
Age (in years)				
30-39 (20-29)	2.55***	2.47***	2.46***	2.46***
40-49 (20-29)	11.04***	10.94***	10.88***	10.90***
Number of living children				
2 (1)	8.06***	8.51***	9.04***	9.04***
3 (1)	9.05***	10.61***	10.95***	10.94***
4+ (1)	9.19***	11.76***	13.24***	13.27***
Sex composition of living children				
All daughters (all sons)	0.29***	0.29***	0.28***	0.28***
# of sons = # of daughters (all sons)	1.40***	1.40***	1.46***	1.46***
# of daughters > # of sons (all sons)	1.34***	1.33***	1.39***	1.40***
# of sons > # of daughters (all sons)	2.06***	2.13***	2.39***	2.40***
Socioeconomic characteristics				
Educational attainment				
Primary school (no education)		1.13*	1.06	1.05
Secondary school (no education)		1.15**	1.02	0.99
High school or above (no education)		1.10	0.91	0.89
Current occupation				
Not working (manual worker)		1.08	1.09	1.09
Professional (manual worker)		0.88*	0.90	0.90
Clerical/sales/service (manual worker)		0.99	0.96	0.95
Agriculture (manual worker)		1.14***	1.09*	1.09*
Wealth quintile				
Poorer (poorest)		1.33***	1.38***	1.35***
Middle (poorest)		1.59***	1.67***	1.60***
Richer (poorest)		1.79***	1.89***	1.80***
Richest (poorest)		1.91***	1.90***	1.82***
Current residence				
Rural (urban)		1.11**	1.07	1.07
Regions				
Central (North)		1.04	0.83***	0.83***
East (North)		1.11*	0.88*	0.88*
Northeast (North)		0.44***	0.40***	0.40***
West (North)		1.43***	1.10	1.10
South (North)		1.15*	0.93	0.92

(Contd...)

Table 2. *(Continued)*.

Background characteristics	Model 1	Model 2	Model 3	Model 4
Religious and cultural factors				
Religion				
Muslim (Hindu)			0.32***	0.32***
Others or no religion (Hindu)			0.62***	0.62***
Caste				
SCs/STs (others)			0.71***	0.71***
OBCs (others)			0.87**	0.87**
Social media exposure				
Any social media exposure (no)				1.13**
N	48,166	48,092	45,591	45,591
-log likelihood	16,138.2	15,729.9	14,420.6	14,417.0

(1) Category is the parentheses is the reference group. (2) SCs/STs: Scheduled Castes/Scheduled Tribes; OBCs: Other backward castes. (3) "N" is different due to missing values in the predictors (caste and occupation). NA, not applicable. (4) Model 0 refers to models without controlling for any other variable. (5) *$P < 0.05$, **$P < 0.01$, ***$P < 0.001$

compared to manual workers. In terms of wealth quintile, as expected, richer men were associated with higher odds of not wishing to have an additional child regardless of influences of different covariates. Compared to men with the lowest quintile of wealth (the poorest), men in the remaining four quintiles of wealth were associated with 33-91% higher odds of not wishing to have an additional child (Model II). There is gradient effect by wealth quintile. These odds ratios were only slightly not altered when religious and caste factors and social media coverage were further adjusted for (Models III and IV).

For the perspective of macro-level socio-economic development, men from rural areas were associated with 10% higher odds of not wishing to have more children compared to their urban counterparts when demographic and socio-economic factors were controlled (Model II). However, this rural-urban difference was not significant when types of religion and caste were present (Models III and IV). In terms of the subnational variation, when demographic factors and other socioeconomic factors were present, compared to men in Northern India, men in Northeastern India were associated with 56% lower odds of not wishing to have more children, whereas men in Eastern, Western, and Southern India were associated with 11%, 43%, and 14% higher odds of not to wish to have any additional child, respectively. No differences were found between Central India as compared to Northern India (Model II). However, when religious and caste types were controlled for, men in Central, Eastern, and Northeastern India were associated with 17%, 12%, and 40% lower odds of not wishing to have more children, respectively (Models III and IV). The higher odds ratio of not wishing to have more children in men in Western and Southern India as compared to men in Northern India were not significant anymore. Overall, the results of socio-economic factors in different models clearly indicate that religion and caste culture played an important role in regulating men's fertility intention in contemporary India.

In terms of types of religion, compared to men of Hindu, men of Muslim were associated with 68% lower odds of not wishing to have more children when demographic and socio-economic factors were adjusted for. Men of other religions or no religion had 38% lower odds of not wishing to have more children. Furthermore, men in SCs/STs or OBCs were associated with 29% and 14% lower odds of not wishing to have another child compared to men in other categories, respectively. The odds ratios for religion and caste types were not changed when the media exposure was considered. Table 2 further shows that men who had any social media exposure were associated with 13% higher odds of wishing to stop having an additional one child compared to men without of social media exposure when demographic, socioeconomic, and cultural factors were present.

3.2. Results for Analyses of use of Contraceptive Methods

Table 3 presents the distribution of contraceptive use by selected covariates among currently married men who did not want more children. Overall, there were 73% of Indian men who had 1+ child and wished not to have any more child were not using any contraceptive method, with 9.2% using modern methods, 13.4% using female sterilization, and 4.4% using traditional methods. Differences in using contraceptive methods varied for all study variables due to large sample size. For instance, compared to men in 30 s and 40 s, men in 20 s tended to have a greater proportion of not using any

Table 3. Distribution of currently married men who did not want more children and had already at least one living child by current contraceptive choices according to selected background characteristics, India, 2015-2016.

Background characteristics	N	Not using	Modern methods	Female sterilization	Traditional methods	*P*-value
Total	36,918	73.0	9.2	13.4	4.4	
Demographic characteristics						
Age (years)						
20-29	3,980	79.4	9.3	7.1	4.1	
30-39	15,647	72.1	10.8	12.8	4.3	0.000
40-49	17,291	72.2	7.6	15.6	4.5	
Number of living children						
1	3,424	76.7	13.2	4.4	5.7	
2	15,254	69.0	10.5	16.1	4.5	0.000
3	9,706	72.0	7.9	15.9	4.2	
4+	8,534	77.5	6.3	11.7	4.5	
Sex composition of the living children						
All daughters	3,435	74.6	11.5	9.0	4.9	
All sons	8,596	71.4	10.3	13.7	4.5	
# of sons = # of daughters	11,199	70.0	9.8	15.4	4.8	0.000
# of daughters > # of sons	7,035	73.8	8.0	13.8	4.3	
# of sons > # of daughters	6,653	74.4	6.8	14.6	4.1	
Socio-economic characteristics						
Educational attainment						
No Education	6,731	74.8	5.9	14.7	4.7	
Primary school	6,154	73.0	7.7	15.8	3.4	0.000
Secondary school	19,647	72.9	9.5	13.1	4.5	
High school or above	4,386	71.0	14.3	9.8	5.0	
Current occupation						
Not working	2,078	78.6	9.6	8.6	3.2	
Professional	2,326	70.1	15.6	9.6	4.8	
Clerical/sales/service	7,438	71.0	10.8	12.8	5.4	0.000
Agriculture	14,085	73.9	6.8	15.7	3.7	
Manual workers	10,936	70.3	9.9	14.6	5.2	
Wealth quintile						
Poorest	6,728	77.9	5.9	11.8	4.4	
Poorer	7,794	71.9	8.6	14.3	5.2	0.000
Middle	7,881	71.8	8.3	16.1	3.8	
Richer	7,363	72.3	9.6	14.1	4.0	
Richest	7,152	68.7	13.2	12.7	5.4	
Current residence						
Urban	10,865	73.1	11.2	11.2	4.5	0.000
Rural	26,053	73.0	8.1	14.6	4.3	
Region						
North	8,341	63.5	13.4	17.1	6.0	
Central	9,706	75.2	8.0	10.8	6.0	

(Contd..)

Table 3. *(Continued)*

Background characteristics	N	Not using	Modern methods	Female sterilization	Traditional methods	*P*-value
East	6,078	65.8	13.3	13.5	7.4	
Northeast	3,677	53.5	26.3	7.7	12.5	0.000
West	4,448	76.8	8.1	13.7	1.4	
South	4,668	79.3	3.2	16.3	1.2	
Religious and cultural factors						
Religion						
Hindu	28,944	73.2	8.2	14.3	4.3	
Muslim	4,512	70.0	15.2	9.2	5.6	0.000
Others or no religion	3,462	61.4	14.2	17.7	6.7	
Caste						
SCs/STs	12,513	71.7	8.0	15.5	4.8	
OBCs	15,023	75.4	7.8	13.1	3.6	0.000
Others	7,603	68.1	12.6	13.7	5.6	
Media exposure						
No exposure	7,571	78.6	5.8	10.8	4.9	
Any exposure	29,347	70.9	10.1	14.6	4.5	0.000

(1) *P* values are based on the Wald-Chi-square test from weighted multinomial logistic regression between each single factor and the outcome variable of fertility intention. (2) SCs: Scheduled Caste; STs: Scheduled Tribes; OBCs: Other backward castes. (3) Percentage are weighted and number are unweighted. Cases may not be equal due to missing values

contraceptive methods (79% vs. 72%); older men also had a mildly higher proportion of using female sterilization than young men (15.6% for ages 40s, 12.8% for ages 30s vs. 7.1% for ages 20s).

The results for factors associated with using contraceptive methods used versus not-using among married men with 1+ child and not wishing to have more children are presented in Panel A of Table 4, and the results for factors associated with using modern or female sterilization methods relative to the traditional method were presented in Panels B and C. The results in Panels B and C were derived from multinomial logit analyses in terms of relative risk ratios (RRRs) among men married men with 1+ child and not wishing to have more children. For the sake of simplicity and easiness of presentation and the similarity between Models II to IV, only the results from Model I and Model IV are presented here. The results of Models 0, II and III are presented in Appendix Table A1-A3.

For demographic factors, generally speaking, compared to their counterparts in ages 20s with 1+ child and wishing to stop having any more child, men in ages 30s or 40s were associated with 50-54% higher odds of using contraceptive methods (Model I in Panel A); and among those using contraception, men in ages 30s or 40s were associated with 47-79% higher likelihood of using female sterilization relative to a traditional method compared to men in ages 20s (Model I in Panel C). Such results were only slightly altered yet still significant even when adjusting for a wide array of covariates. There was no difference in use of a modern method relative to a traditional method when all covariates were adjusted for, although men in ages 30s were associated with higher likelihood of using a modern method. In comparison with men with 1 child, men with 2 or 3 children were associated 31% and 17% higher odds of using a contraceptive method and these odds were enhanced when other factors were present, whereas men with 4+ children were associated with 18% lower odds of using a method yet not significant when other factors were adjusted for. Among men using a contraceptive method, men with more children were associated with higher likelihood of using female sterilization instead of a traditional method. There was no difference in relative risk between using a modern method and using a traditional method for men of different children, especially when other covariates were adjusted for. Men with all daughters were associated with 17% lower odds of using a contraceptive method and such lower odds ratio was mildly reduced to 11% yet still significant when all study variables were controlled for. In comparison with men with all sons, men with other compositions of children's sex were associated with lower likelihood of using female sterilization instead of a tradition method and such patterns were robust when other factors were present.

In terms of socio-economic characteristics, although men with more education were associated with higher odds of using a contraception without controlling for any other factor (see Model 0 in Appendix Table A1), these associations

Table 4. Odds ratios (ORs) and relative risk ratios (RRRs) of use of specific contraceptive methods by major study variables in men aged 20-49 who did not have fertility intention for additional child and had at least one living child, India, 2015-2016.

Background characteristics	Panel A		Panel B		Panel C	
	Any method versus not using (ORs)		Modern versus traditional (RRRs)		Female sterilization versus traditional (RRRs)	
	Model I	Model IV	Model I	Model IV	Model I	Model IV
Demographic characteristics						
Age (in years)						
30-39 (20-29)	1.50***	1.45***	1.23*	1.19	1.47***	1.64***
40-49 (20-29)	1.54***	1.49***	0.88	0.82	1.79***	2.12***
Number of living children						
2 (1)	1.31***	1.38***	1.00	1.04	3.96***	3.85***
3 (1)	1.17**	1.24***	0.78	0.88	4.65***	5.32***
4+ (1)	0.82***	0.92	0.64***	0.77	3.43***	4.46***
Sex composition of living children						
All daughters (all sons)	0.83***	0.89*	1.10	1.04	0.52***	0.42***
# of sons = # of daughters (all sons)	1.02	0.99	0.98	0.94	0.78**	0.72***
# of daughters > # of sons (all sons)	1.02	1.00	1.10	1.00	0.71**	0.56***
# of sons > # of daughters (all sons)	0.96	0.97	1.03	1.04	0.85	0.81
Socio-economic characteristics						
Educational attainment						
Primary school (no education)		1.01		1.29*		1.21
Secondary school (no education)		0.94		1.20		0.74***
High school or above (no education)		0.95		1.41*		0.54***
Current occupation						
Not working (manual worker)		0.69***		1.49**		1.19
Professional (manual worker)		0.83**		1.42**		1.03
Clerical/sales/service (manual worker)		0.79***		1.14		0.97
Agriculture (manual worker)		0.78***		1.23**		1.37***
Wealth quintile						
Poorer (poorest)		1.29***		0.96		0.91
Middle (poorest)		1.30***		1.16		0.99
Richer (poorest)		1.36***		1.08		0.83
Richest (poorest)		1.66***		1.06		0.70*
Current residence						
Rural (urban)		1.14***		0.79**		1.02
Regions						
Central (North)		0.72***		0.61***		0.59***
East (North)		0.68***		0.77**		0.43***
Northeast (North)		1.01		0.77**		0.15***
West (North)		0.57***		1.82***		2.79***
South (North)		0.42***		0.83		4.32***
Religious and cultural factors						
Religion						
Muslim (Hindu)		0.91*		1.44***		0.35***
Others or no religion (Hindu)		1.10*		0.87		0.86

(Contd..)

Table 4. *(Continued)*

Background characteristics	Panel A		Panel B		Panel C	
	Any method versus not using (ORs)		Modern versus traditional (RRRs)		Female sterilization versus traditional (RRRs)	
	Model I	Model IV	Model I	Model IV	Model I	Model IV
Caste						
SCs/STs (others)		0.89**		1.06		1.35***
OBCs (others)		0.83***		1.09		1.21**
Social media exposure						
Any media exposure (no)		1.33***		1.42***		1.45***
N	36,918	35,086	10,562	9,900	10,562	9,900
-log likelihood	21,922.47	20,176.52	10,563.26	8,889.04	10,563.26	8,889.03

(1) The relative risk ratios based on multinomial logit models after taking traditional method as the base group. (2) Category is the parentheses reference group. SCs/STs: Scheduled Caste/Scheduled Tribes; OBCs: Other backward castes. (3) "N" is different due to missing values in the predictors (caste and occupation). (4) *$P < 0.05$, **$P < 0.01$, ***$P < 0.001$.

were not significant when demographic and other socio-economic factors or other factors were controlled for (see Model II in Appendix Table A1 and Model IV in Panel A in Table 4). Nevertheless, men with higher education were associated with lower likelihood of using female sterilization and higher likelihood of using a modern method instead of a traditional method. Compared to manual workers, men in other occupational categories were associated lower 17-31% odds of using a contraception in Model IV (Panel A), but they were associated with higher likelihood of using a modern method instead of a traditional method (except for men in the services sector) (Panel B), and men in agricultural sector were associated with higher likelihood of using female sterilization (Panel C). The higher income the higher the odds of using a contraception; however, there was no difference in using a specific method: Modern, traditional, or female sterilization. When no other factor was present, men in rural areas were associated with 7% lower odds of using a contraception (Model 0 in Appendix Table A1). However, when demographic and socioeconomic factors were present, men in rural areas were associated with 14% higher odds of using a contraception (Panel A), but they were associated with 21% lower likelihood of using a modern method instead of traditional method (Panel B). Compared to men in Northern India, men in other parts were associated with lower odds of using a contraception when no other factor was adjusted for (Model 0 in Appendix Table A1). Such patterns did not change with one exception for Northeastern India when all study variables were controlled for (Panel A in Table 4). Among men using a method, compared to men in Northern India, men in Central, Eastern, and Northeastern India were 23-39% lower likely to use a modern method and 41-85% lower likely to use female sterilization relative to using a traditional method, whereas men in Western India were 82% and 179% more likely to use a modern method or female sterilization relative to using a traditional method. For men in Southern India, they were 3.32 times more likely to use female sterilization relative to using a traditional method than men in Northern India, although men in these two regions had no difference in using a modern method relative to using a traditional method.

From the perspective religion and caste types, compared to men of Hindu, men of Muslim, and other religions were associated with 9% and 41% higher odds of using a method when no other factor was present (Model 0 in Appendix Table A1). However, when demographic and socio-economic factors and caste type were controlled for, men of Muslim were associated with 9% lower odds of using a contraception. The higher odds associated with men of other religions or no religion was also reduced to 10%. Overall, these findings suggest men of other religions or no religion was more likely to use a contraceptive method. When men choosing to use a contraceptive method, men of Muslim in comparison with men of Hindu were 44% more likely to use female sterilization yet 65% less likely to use a modern method instead of using a traditional method. Although men of other religions or no religion were 31% less likely to use female sterilization compared to men of Hindu (Model 0 in Appendix Table A3), such difference was not significant when demographic and socio-economic factors were controlled for (Panel C in Table 4). Compared to men in other categories, men in SCs/STs and OBCs were associated with 11% and 17% lower odds of using a method. There is no difference between these three groups of the sample in using a modern method relative to using a traditional method when demographic and socio-economic factors were adjusted for, but men in SCs/STs and OBCs were 35% and 20% likely to use female sterilization relative to a traditional method compared to me in others.

Finally, compared with men without social media exposure, men with social media exposure were associated with 33% higher odds of using a contraceptive method when all other variables were controlled for. The former was also 42%

more likely to use a modern method and 45% more likely to use female sterilization relative to using a traditional method than the latter.

4. Discussion

Population scientists have focused their study on fertility mainly on the fertility behavior of women while paying little attention to the role of men and the implication of their participation on fertility and population growth. However, there is evidence to show that men's participation in women's sexual and reproductive health is an important determinant of a positive reproductive health outcome for their partners and children (Assaf and Deavis, 2018) that men's influence on the desired number of children within the household is also vital for family planning, and that couples together can protect reproductive health by confirming the effective family planning method use, avoiding sexually transmitted diseases, and stabilizing fertility behavior (Koffi, Weidert, Bitasse, *et al*., 2018).

Using the fourth round of the National Family Health Survey (NFHS-4) data, the primary purposes of the present study are to investigate factors associated with the fertility stopping intention among currently married men of India who had at least one living child and factors associated with family planning method uses among currently married men of India who had at least one living child and had no intention to have another child. In our knowledge, this research is among the first that has systematically examined both men's fertility intention and contraceptive uses and their associated factors in a single research.

The findings of this study show that about 78% of the currently married men aged 20-49 with 1+ child in contemporary India did not wish to have any more child, yet more than 70% of these men did not use any contraceptive method. This is a clear indication of the higher unmet need of the family planning among reproductive couples (Dahal, Padmadas and Hinde, 2008) of India that need to be address through providing the basket of choices of contraceptive methods.

Regarding the factors associated with fertility intention and contraceptive use, we found that demographic, socioeconomic, religious and cultural, and social media exposure factors played a significant role in determining men's fertility intention as well as contraceptive use. Specifically, the odds ratios of not wishing to having any more child increased with age and the likelihood of using contraceptive method also increases with age, which is likely because older men had already had desired numbers and/or sex composition of children than younger men who have not had time to have their expected numbers and/or sex composition of children. This is also the case for the factor of the number of children.

The results further show that men having both girls and boys were associated with higher odds of not wishing to have another child compared to men either having all sons or having all daughters and that men having no sons were less like to stop having another child compared to men having all sons. This suggests that the sex composition of children plays a significant role in determining the men's fertility intention in contemporary India. In terms of contraceptive use, men with all daughters were less likely to use modern methods and less likely to use female sterilization, which is justifiable since they still wish to have more children. Nevertheless, men who intended to not have children were more likely to use contraception compared to those who intended to have more children (Roy, Ram, Nangia, *et al*., 2003), which is also consistent to our supplementary analysis using the NFHS-4 (not shown). Thus, understanding fertility intention and family planning use behavior of population can be another way to identify populations with higher need and less use of family planning than general population.

The finding that more educational attainment of men was associated with lower odds of not wishing to have one additional child is unexpected. This might be because illiterate men have already achieved the desired level of family size they desired as the age at marriage and the age at childbearing are lower among illiterates than among their counterparts more years of schooling (Chauhan, Sekher, Kumar, *et al*., 2020; Ní Bhrolcháin and Beaujouan, 2012). A closer examination the causes including whether there is a bias in sampling is clearly needed to further shed light on this. Men with more education tend to use modern spacing method instead of female sterilization and traditional methods. One reason is possibly that they have more access to modern methods. This finding is in line with previous findings (Dwivedi, Ram and Reshmi, 2007; Paudel and Acharya, 2018).

The occupation of the men influences the use of contraception (Kamal, 2000). Previous studies demonstrated that men in agrarian subsistence economies prefer large numbers of children both as a source of labor and economic gain, and as a source of prestige (Bankole and Singh, 1998; Blacker, Opiyo, Jasseh, *et al*., 2005; Ayhan, Gözükara, and Koruk, 2017; Hardee, Croce-Galis, and Gay, 2017). It is thus possible that men in the agricultural sector were more likely to wish to stop having one additional child, which is reflected in our findings (Kock and Prost, 2017). Our findings also show that men in the agricultural sector were associated with lower odds of using contraception (Adanikin, McGrath and Padmadas, 2017; Dral, Tolani, Smet, *et al*., 2018).). This implies a large unmet need among this group of population.

By contrast, we found that jobless men were less like to wish to stop having more children and were less likely to use a contraceptive method. This finding is similar to the one for men of the poorest, which is also consistent with previous studies (Ochako, Temmerman, Mbondo, *et al.,* 2017; Chauhan and Nagarajan, 2019). Jobless men and the poorest men are in the bottom of social class and are the most vulnerable groups. They have limited resources to access family planning services. More social efforts and interventions are needed to promote family planning programs among these socially vulnerable populations. Compared to men in manufactural sectors, men in other sectors (including jobless men) are more likely to use modern methods instead of traditional methods. Men working in professional and skilled non-manual sector come mostly from the middle social class and are inclined to start childbearing relatively later than their counterparts, have small family size in a short period of time, and then limit fertility by choosing effective modern methods, particularly sterilization (Padmadas, Hutter, and Willekens, 2004).

Men from rural areas were more likely not to wish to have more children and were less likely to use a contraceptive method; and men in rural areas were more likely use female sterilization instead of traditional methods and less likely use modern methods of contraception than traditional methods compared to men in urban area (see Appendix). The findings are expected because of rigorous implementations of family planning programs in rural areas than urban areas through front line health workers and lower availability of suitable and socially accepted basket of choice of modern method of contraceptive.

One interesting finding is the large geographic variation in fertility stopping intention and the use of contraceptive methods. Men in Central, Eastern, and Northeastern India who did not want another child were less likely to stop having any additional child than their counterparts in Northern India and the former was also less likely to use modern methods and female sterilization relative to traditional methods than the latter. By contrast, men in Western and Southern regions were more likely to not wish to have more children, although such higher odds of wishing to terminate their childbearing were not significant when religious or cultural factors were controlled for. We further found that compared to men in Northern India, men in all other regions were less likely to use any of contraceptive methods than their counterparts, and that men in Central, Eastern, and Northeastern were less likely to use modern and female sterilization methods whereas men in Western and Southern India were more likely to use female sterilization relative to additional methods. The physical access to reproductive health services is generally poor in northern and eastern regions (Singh, Pallikadavath, Ram, *et al.,* 2012). Further, earlier studies demonstrated that Southern States have implemented the family planning programs in most effective manner than other parts of the country (Rajna, Kulkarni and Thenmozhi, 2005), which could explain the higher likelihood of use of female sterilization. However, more studies are needed to focus on age-specific or cohort-specific analyses with integration of other factors that are associated with fertility intention and use of contraceptive methods to further explore regional differences over time.

Although the proportion of men who did not want one more child was higher among Muslims (27.5%) and other religions or no religion (21.3%) compared to that of men of Hindu (20.7%), men of Muslims and men of other religions or no religion had much lower odds to stop having another child when all conditions were equal. Men of Muslim were associated with lower use of contraception, and especially the female sterilization method. These indicate that the demographic or socio-economic composition among different religions is large, and that the family planning practice among Muslims religion is relatively low (De Oliveira, Dias and Padmadas, 2014). The use of family planning methods is lower and unmet need for family planning is higher among Muslims and they have low access to services from government sources in rural areas, as Muslims belonging in low literacy and poor socio-economic condition (Bhagat and Praharaj, 2005; Ghosh, 2018). Compared to men in other religions or no religion, men of Hindu were less than to use a contraceptive method, indicating that religion still play a certain role in influencing people's family planning behaviors (De Oliveira, Dias and Padmadas, 2014). Our finding that men belonging to different religious groups use different contraceptive methods is line with the existing literature. For example, female sterilization was reported to be lowest among the Muslims compared to other religious groups. The fertility behavior and family planning use are very sensitive issue from the religious point of view because it is influenced by deeply rooted socio-cultural values and belief system. Moreover, in some of the communities use of family planning is considered as sinful (Iyer, 2002; Muttreja and Singh, 2018).

Men in SCs/STs and OBCs were associated with lower odds of wishing not to have one more child and less likely to use a contraceptive method compared to men in other groups, although they were more likely to use female sterilization. These findings are consistent with previous studies (De Oliveira, Dias, and Padmadas, 2014). Men from SCs/STs and OBCs are more likely to use female sterilization, this might be because of these group have less or no information related to family planning methods than other caste groups; also public health workers tend to be biased in favor of the wealthier and socially advantage groups to provide the information of health-care services utilization (Singh, Pallikadavath, Ram, *et al*., 2012). Further, in India caste can be consider as a proxy of economic status of the household, therefore, financial

and related opportunity costs might exclude these sections from accessing modern contraceptive methods. Although modern contraceptives are available free of cost in public sectors, family planning services offered through public sectors primarily focus on promoting permanent methods. Incentive provided for female sterilization can also be one of the reasons for higher use of female sterilization as contraceptive use.

Finally, we found that men who had some exposure to social media had higher odds of wishing to stop having an additional child and to use a contraceptive method in comparison with men without social media exposure. These findings indicate that social media exposure could help change people's views and family planning behaviors. The governments, non-governmental organizations, stockholders, and private sectors of family planning should work together to promote significance of family planning and implement some intervention projects.

Like other studies, the present study also has some shortcomings and strengths. First, as this study was based only on currently married young men aged 20-49 who had at least one living child at the time of survey, the information from unmarried men and from other ages were missing. Second, the study was based on a cross-sectional dataset; hence, only associations between predictors and outcome variables were analyzed. Their causal relationships are still unclear. Third, only information on fertility stopping intention was analyzed without any exploration whether the linkages between such intention and subsequent childbearing behaviors. Fourth, data on availability and/or accessibility to family planning services were not included in modeling of use of contraceptive methods; as such we were not able to determine whether the use of a specific contraceptive method (or not-using of any method) was because of husband's (or couple's) decision or because of the unavailability of family planning services. Fifth, relatedly, we only examined factors associated with fertility stopping intention and the use of family planning method from men's perspective, we were also not able to determine or quantify the men's role in decision-making in fertility intention and the use of contraceptive methods.

Despite this shortcoming, the main strength of the paper is that it dealt with the men's fertility stopping intentions and their contraceptive use and choice, an area that has been largely overlooked in the Indian context using the nationally representative data set. The findings of the present study could be vital not only to the Government of India but also to other stakeholders working on the field of family planning to suggest programs that would influence the contraceptive use and decisions among currently married men. Furthermore, the study tried to contribute to the discussion of men's place/status in reproductive health research. More sophisticated studies that overcome above shortcomings for different age groups, birth cohorts using longitudinal studies are clearly warranted to systematically investigate the dynamics of fertility stopping intention and the use of contraceptive methods across space and time.

To regulate population growth, the findings of the study suggest a need for programs that can help in reducing the gender preferences and promote the family planning use. Specifically, intervention programs should target individuals with fewer or no sons and those men who are likely to be young and, by implication, to have high fertility desire, and target individuals who have not yet attained their desired family sizes as well as non-users of family planning to ensure that those who do not desire any more children do not get unwanted pregnancies. Since previous family planning programs and recently launched Mission *Parivar Vikas* for substantially increasing access to contraceptives and family planning services focusing on women in 146 high fertility districts of India, about 87% of the funds available for family planning have been directed toward terminal methods with 95.8% of such amount for female sterilization (Financial Management Report, 2016-2017), which may indicate that funds for promoting male sterilization methods should be increased. Overall, our findings suggest that men are an important target group in fertility regulation interventions.

5. Conclusion

Using the fourth round of the National Family Health Survey conducted in 2015-2016, the present study found that around 78% of currently married Indian men aged 20-49 who already have had at least one child did not want another child. Men in older cohort, having more children, having more sons than daughters, being richer, from Northern India, or having media exposure were more likely not to want another child. However, more than 70% of these men did not use any contraceptive method, which indicates a high level of unmet need family planning among this population. Additional analyses showed that demographic factors, socio-economic characteristics, region and culture, and exposure of social media were all associated with use of a specific conceptive method. More efforts must be focused on strategies to enhance men's awareness of contraceptives by providing them with basket of choice of family planning with proper information on the advantages and disadvantages of specific methods. Furthermore, programs need to target men on the basis of number of children already have and children sex composition. As men's fertility intentions, reproductive preferences, and their attitude toward family planning also influence the fertility behavior of their wives and their attitude toward the use of contraceptives, family planning programs need to target young men precisely at all levels to increase the use of contraception to achieve the country's reproductive health goals and eventually achieve the SDGs-3 and 5.

Conflicts of Interest

The authors have no conflicts of interest to declare.

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Authors' Contributions

Conceived and designed the experiments and analyzed the data: B.G. Chauhan, R. Rawat Wrote the paper: N.N. Tirkey, S.K. Chauhan.

Ethical Approval

Not applicable as this study involves the analysis of secondary data collected by the DHS program (NFHS-4).

Availability of Supporting Data

Data utilized to this paper are from secondary sources and available to the public. The data can be freely accessed from the DHS website https://www.dhsprogram.com/methodology/survey/survey-display-355.cfm.

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Appendix

Table A1. Odds ratios of use of any method versus not using contraceptive method by major study variables in men aged 20-49 who did not have fertility intention for additional child, India, 2015-2016.

Background characteristics	Model 0	Model I	Model II	Model III	Model IV
Demographic characteristics					
Age (in years)					
30-39 (20-29)	1.45***	1.50***	1.47***	1.45***	1.45***
40-49 (20-29)	1.40***	1.54***	1.50***	1.49***	1.49***
Number of living children					
2 (1)	1.41***	1.31***	1.38***	1.39***	1.38***
3 (1)	1.27***	1.17**	1.23***	1.25***	1.24***
4+ (1)	0.93	0.82***	0.90	0.92	0.92
Sex composition of living children					
All daughters (all sons)	0.80***	0.83***	0.90*	0.89*	0.89*
# of sons = # of daughters (all sons)	1.04	1.02	1.01	1.00	0.99
# of daughters > # of sons (all sons)	0.89***	1.02	1.01	0.99	1.00
# of sons > # of daughters (all sons)	0.87***	0.96	0.96	0.97	0.97
Socio-economic characteristics					
Educational attainment					
Primary school (no education)	1.12**		1.03	1.04	1.01
Secondary school (no education)	1.23***		0.98	0.99	0.94
High school or above (no education)	1.41***		1.01	1.01	0.95
Current occupation					
Not working (manual worker)	0.66***		0.67***	0.69***	0.69***
Professional (manual worker)	1.03		0.83***	0.83**	0.83**
Clerical/sales/service (manual worker)	0.90**		0.80***	0.79***	0.79***
Agriculture (manual worker)	0.74***		0.77***	0.77***	0.78***
Wealth quintile					
Poorer (poorest)	1.41***		1.35***	1.38***	1.29***
Middle (poorest)	1.52***		1.45***	1.45***	1.30***
Richer (poorest)	1.57***		1.51***	1.53***	1.36***
Richest (poorest)	2.02***		1.87***	1.86***	1.66***
Current residence					
Rural (urban)	0.93**		1.14***	1.14***	1.14***
Regions					
Central (North)	0.57***		0.68***	0.72***	0.72***
East (North)	0.53***		0.67***	0.68***	0.68***
Northeast (North)	0.90**		1.05	1.01	1.01
West (North)	0.54***		0.55***	0.57***	0.57***
South (North)	0.41***		0.41***	0.44***	0.42***
Religious and cultural factors					
Religion					
Muslim (Hindu)	1.09*			0.90*	0.91*
Others or no religion (Hindu)	1.41***			1.09*	1.10*
Caste					
SCs/STs (others)	0.76***			0.89**	0.89**
OBCs (others)	0.67***			0.82***	0.83***
Social media exposure					
Any social media exposure (no)	1.56***				1.33***
N	NA	36,918	36,863	35,086	35,086
-log likelihood	NA	21,922.47	21,382.86	20,206.5	20,176.52

(1) The odds ratio is based on logistic models. Category is the parentheses is the reference group. (2) SCs/STs: Scheduled Castes/Scheduled Tribes; OBCs: Other backward castes. (3) "N" is different due to missing values in the predictors (caste and occupation). "NA," not applicable. (4) Model 0 refers to results without controlling any other variable. (5) *$P < 0.05$, **$P < 0.01$, ***$P < 0.001$

Table A2. Relative risk ratios of use of modern method versus traditional contraceptive method by major study variables in men aged 20-49 who did not have fertility intention for additional child, India, 2015-2016.

Background characteristics	Model 0	Model I	Model II	Model III	Model IV
Demographic characteristics					
Age (in years)					
30-39 (20-29)	1.17	1.23*	1.12	1.18	1.19
40-49 (20-29)	0.80*	0.88	0.76**	0.82	0.82
Number of living children					
2 (1)	0.98	1.00	1.09	1.04	1.04
3 (1)	0.80*	0.78	0.92	0.88	0.88
4+ (1)	0.62***	0.64***	0.86	0.77	0.77
Sex composition of living children					
All daughters (all sons)	1.06	1.10	1.06	1.04	1.04
# of sons = # of daughters (all sons)	0.94	0.98	0.94	0.93	0.94
# of daughters > # of sons (all sons)	0.79**	1.10	1.08	1.00	1.00
# of sons > # of daughters (all sons)	0.76**	1.03	1.07	1.04	1.04
Socio-economic characteristics					
Educational attainment					
Primary school (no education)	1.33**		1.22	1.34*	1.29*
Secondary school (no education)	1.39***		1.10	1.28*	1.20
High school or above (no education)	1.96***		1.36*	1.50**	1.41*
Current occupation					
Not working (manual worker)	1.47**		1.46**	1.50**	1.49**
Professional (manual worker)	1.60***		1.26	1.43**	1.42**
Clerical/sales/service (manual worker)	1.21*		1.07	1.15	1.14
Agriculture (manual worker)	1.04		1.13	1.22*	1.23**
Wealth quintile					
Poorer (poorest)	1.19		1.09	1.04	0.96
Middle (poorest)	1.53***		1.28*	1.32*	1.16
Richer (poorest)	1.58***		1.23	1.25	1.08
Richest (poorest)	1.85***		1.27	1.22	1.06
Current residence					
Rural (urban)	0.74***		0.81**	0.78**	0.79**
Regions					
Central (North)	0.64***		0.67***	0.60***	0.61***
East (North)	0.77**		0.84	0.76**	0.77**
Northeast (North)	0.80**		0.92	0.77**	0.77**
West (North)	2.16***		2.09***	1.82***	1.82***
South (North)	1.09		1.01	0.84	0.83
Religious and cultural factors					
Religion					
Muslim (Hindu)	1.19*			1.42***	1.44***
Others (Hindu)	0.94			0.87	0.87
Caste					
SCs/STs (others)	0.76***			1.06	1.06
OBCs (others)	0.89*			1.10	1.09
Social media exposure					
Any social media exposure (no)	1.74***				1.42***
N	NA	10,562	10,551	9,900	9,900
-log likelihood	NA	10,563.26	9,742.43	8,898.83	8,889.04

(1) The relative risk ratios based on multinomial logit models after taking using traditional methods as the base group. Category is the parentheses is the reference group. (2) SC/ST: Scheduled Caste/Scheduled Tribes; OBC: Other backward castes. (3) "N" is different due to missing values in the predictors (caste and occupation). "NA," not applicable. (4) Model 0 refers to results without controlling any other variable. (5) *$P < 0.05$, **$P < 0.01$, ***$P < 0.001$

Table A3. Relative risk ratios of use of female sterilization versus traditional method by major study variables in men aged 20-49 who did not have fertility intention for additional child, India, 2015-2016.

Background characteristics	Model 0	Model I	Model II	Model III	Model IV
Demographic characteristics					
Age (in years)					
30-39 (20-29)	1.51***	1.47***	1.54***	1.62***	1.64***
40-49 (20-29)	1.80***	1.79***	1.98***	2.09***	2.12***
Number of living children					
2 (1)	3.73***	3.96***	3.73***	3.86***	3.85***
3 (1)	4.39***	4.65***	4.79***	5.31***	5.32***
4+ (1)	3.29***	3.43***	3.70***	4.40***	4.46***
Sex composition of living children					
All daughters (all sons)	0.54***	0.52***	0.47***	0.42***	0.42***
# of sons = # of daughters (all sons)	1.01	0.78**	0.76**	0.71***	0.72***
# of daughters > # of sons (all sons)	1.01	0.71**	0.63***	0.56***	0.56***
# of sons > # of daughters (all sons)	1.26**	0.85	0.84	0.80	0.81
Socio-economic characteristics					
Educational attainment					
Primary school (no education)	1.21		1.29*	1.25*	1.21
Secondary school (no education)	0.81**		0.84*	0.79**	0.74***
High school or above (no education)	0.58***		0.64***	0.58***	0.54***
Current occupation					
Not working (manual worker)	1.09		1.18	1.21	1.19
Professional (manual worker)	0.72**		0.95	1.04	1.03
Clerical/sales/service (manual worker)	0.81**		0.90	0.98	0.97
Agriculture (manual worker)	1.35***		1.33***	1.36***	1.37***
Wealth quintile					
Poorer (poorest)	0.94		0.91	1.00	0.91
Middle (poorest)	1.23*		1.00	1.15	0.99
Richer (poorest)	1.06		0.84	0.97	0.83
Richest (poorest)	0.89		0.77*	0.82	0.70*
Current residence					
Rural (urban)	1.20**		1.10	1.00	1.02
Regions					
Central (North)	0.79***		0.69***	0.59***	0.59***
East (North)	0.58***		0.50***	0.42***	0.43***
Northeast (North)	0.22***		0.18***	0.15***	0.15***
West (North)	3.35***		3.31***	2.79***	2.79***
South (North)	4.25***		4.76***	4.40***	4.32***
Religious and cultural factors					
Religion					
Muslim (Hindu)	0.39***			0.35***	0.35***
Others or no religion (Hindu)	0.69***			0.86	0.86
Caste					
SCs/STs (others)	1.36***			1.36***	1.35***
OBCs (others)	1.43***			1.21**	1.21*
Social media exposure					
Any social media exposure (no)	1.29***				1.45***
N	NA	10,562	10,551	9,900	9,900
-log likelihood	NA	10,563.26	9,742.43	8,898.83	8,889.03

(1) The relative risk ratios based on multinomial logit models after taking using traditional methods as the base group. Category is the parentheses is the reference group. (2) SC/ST: Scheduled Caste/Scheduled Tribes; OBC: Other backward castes. (3) "N" is different due to missing values in the predictors (caste and occupation). "NA," not applicable. (4) Model 0 refers to results without controlling any other variable. (5) *$P < 0.05$, **$P < 0.01$, ***$P < 0.001$

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RESEARCH ARTICLE

Application of a breakpoint model to population growth in Türkiye

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Abstract: Using data from the Macrotrends database, this paper investigated the change and differences in population growth (POPG) as a result of the impact of its key determinants employing a breakpoint model. A regression analysis confirms the presence of persistent differences in the POPG in Türkiye over the period 1965 – 2021. Using the Bai-Perron sequential breakpoint method, four statistically significant breaks at 1976, 1984, 2004, and 2013 and consequently to that five regimes were ascertained. The results clearly show a worthy of attention difference in the mean of the crude death rate, total fertility rate, as well as net migration rate within all of these five regimes. Furthermore, the results reveal clear evidence that the POPG is characterized with statistically different trends compared to the period prior and after the years of breaks and different regimes. This indicates that circumstances affecting the mortality, migrations, and fertility in terms of the number of live births and deaths as well as migration trends in the country before and after these indicated years in Türkiye have been largely influenced by the different dynamics of the socioeconomic conditions and different contexts in Turkish society.

Keywords: Population growth rate; Total fertility rate; Crude mortality rate; Net rate of migration; Breakpoint model; Türkiye

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1. Introduction

One of the fundamental equations in demography research specifies that a population grows or declines in size as the result of the combined effect of births, deaths, in-migration, and out-migration (Weinstein and Pillai, 2016). Consequently, given demographic definitions, demographers define the "growth" as all change in the size of a population or other aggregate measures even when an absolute loss or no change occurs, or when there is zero (negative) population growth (POPG). In general, decline in POPG can be associated heavily with the decreasing surplus of births more than deaths. As discussed by Avdeev *et al*. (2011), in the recent decades, the increasing differences in POPG rates in Europe are not due to natural increase but to net migration. As claimed by Bongaarts and Bulatao (1999), the future course in population size is determined by the decisive factors as the future trends in fertility and mortality, migration movements, as well as by the current population structure by age. Hence, natural growth is a result of fertility, mortality, and momentum. The current population structure by age determines future POPG, this alluding to the phenomenon demographic "momentum." In other words, population momentum signifies that a population that increases continues to increase in size further for some more years later than its fertility shift to replacement level fertility (Schoen, 2018). Thus, according to Horiuchi and Preston (1988), the present population age structure is a result of the population rates of fertility, mortality, and migration in the past.

According to a more common formulation given in Preston, Heuveline, and Guillot (2001), the term refers to the fact that a POPG does not depend only on current levels of fertility and mortality but also on the age structure of the population which, in turn, is an inheritance of the fertility and mortality in the past. In this regard, Horiuchi (1995)

points out that the population momentum shows the difference's effects between actual and inherited growth rates of the final size of the stationary population, or the path to steady increase. Populations whose fertility is significantly below replacement level and whose age distribution did not have time to fully adjust to the new fertility regime will tend to have high values of unstable momentum (Espenshade, Olgiati, and Levin, 2011). It is expected that the population in areas with a rapid ageing process will have a natural growth under effect of the general mortality rate, that is, will gradually increase even if the general rate of birth is stable. Migrations are often considered as the key factor of POPG or decline at a regional or at a country level making an influence on population change of the regions or countries where migration happens. As an especially significant kind of movement, in the reasoning of Ediev and Yüceşahin (2016), migrations could be considered in two aspects. As argued from a pure demographic standpoint, migration component jointly with natural increase determines the extent and POPG rate. Differently from the purely demographic standpoint, the second aspect refers to the impact of migrations on population change usually at two places: The origin and destination of the migration movement. Especially in places with clearly visible regional fertility differences, largely in low fertility regions, migration may be a driver to compensate for lower births (Ediev and Yüceşahin, 2016). As a consequence, the region of destination may offset for its POPG. Furthermore, Lee (2011) explains that international migration could have an indirect effect on POPG at the global level and that it undoubtedly does affect POPG in many more developed countries, where low fertility in any other way would cause a population decrease. As a matter of fact, immigration is sometimes considered as a means to reduce population aging. In line with this, Lee (2011) adds further that it is more difficult to make predictions of net immigration than for fertility or mortality, because indeed immigration is more sensitive to differences in economic growth, political and military disruption, and policy changes. This study attempts to find an answer to the question whether and how much the POPG change in Türkiye varies as a consequence of observations of its key determinants within a breakpoint model for the period 1965 – 2021. Starting from June 2022, Turkey was replaced by Türkiye as its official name. Thus, the aim of this paper is to consider the breakpoint model as capable of capturing the structural changes of the POPG for Türkiye.

One of the reasons for specifying the initial period in 1965 for our research work is to say that the period between 1968 and 1971 in Türkiye was interesting for a lot of reasons. Thus, prior this period, there was not such a rising social protest initiated by students, workers, farmers, teachers, and administrative workers. It is considered that there was not enough interest for these social movements by the academic experts and the extant literature. Namely, the research paper of Alper (2010) attempted to provide mostly a political clarification for the social protests of 1968 – 1971. Thus, his explanation suggests that the shift in the balance of power of political groups has led to a prolonged elite conflict between the Kemalist bureaucracy and the center-right political elite, which has provided significant opportunities to under-represented groups to organize and raise their voices. In this regard, Pekesen (2014) adds that as in other countries in the world, during the 1960s, Türkiye also experienced substantial social changes, mass mobilization, and many-sided forms of public protests. The fast pace urbanization and the migration from rural regions to the industrial cities beginning in the 1950s changed severely the structure of society and the political environment as well. Consequently, the state and its weak social welfare system have not been able to manage unemployment and widespread poverty. Governments in the 1960s in Türkiye and opposition parties such as the Republican People Party were obviously not able to respond to the growing dissatisfaction and deprivation among considerable important parts of the population (Pekesen, 2014). As a second reason for choosing this period is that during this period, Türkiye was already covered with the second demographic transition, when the fertility rate reached a high level and the mortality rate decreased (Figure 1).

Overall, our findings represent an important contribution in POPG dynamics relative to Türkiye. Therefore, somehow related to the previous sentence, the actual motivation for doing this research is expanding the empirical research with inclusion of the breakpoint methodology to explore the changes in POPG for Türkiye. The rest of the research paper is organized in the following way: Section 1.1. defines the theoretical background of this research study and Section 1.2. introduces the trend and development of the POPG in Türkiye. Furthermore, Section 2 shows the data and methods approach. Section 3 presents the practical results of the application of the breakpoint model for Türkiye, while in Section 4, the gained results are discussed. Section 5 provides conclusions.

1.1. Theoretical background

During the process of demographic transition, populations change from a condition of high levels of mortality and fertility to a context with low levels of mortality and fertility (Lee, 2011). The "classic" demographic transition or also known as first demographic transition makes reference to the past events of decreases in mortality and fertility, seen since the 18th century ahead in some of the European populations and with continuity until the present time in most of the developing societies (Lesthaeghe, 2014). Hence, the first demographic transition is supposed to finish when there will be an older stationary population that will correspond with replacement fertility, that is, 2.1 children on average, with zero POPG,

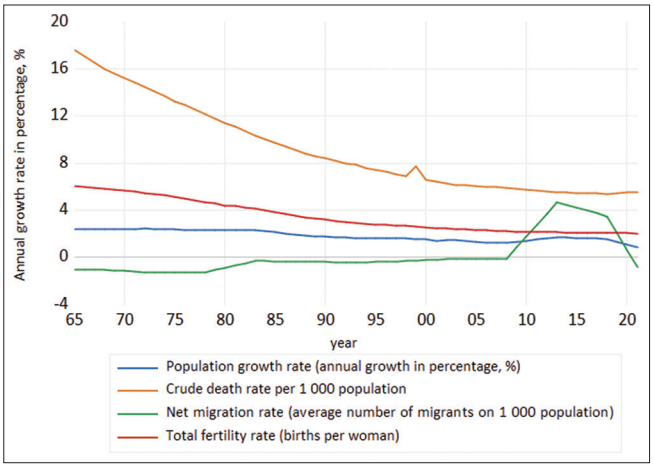

Figure 1. Population growth rate, total fertility rate, crude death rate, and net migration rate in Türkiye, 1965 – 2021. Source: Author's design based on real data.

and an average level of life expectancy higher than 70 years. The point of view of the second demographic transition, jointly developed by Lesthaeghe and van de Kaa in 1986 (Lesthaeghe, 2014) in opposite, does not see such a balance as an ending. To a certain extent, the founders of the second demographic transition stated that new progressive processes since 1970s onward may bring about sustainable sub-replacement fertility, a new partnerships and unions differently from the marriage, relationships with no strings attached and with little interest for marriage and procreation, and an absence of a stationary population. Furthermore, if there are no additional new migrants, the population will face declines in sizes and would also be much older than it is foreseen by the first demographic transition. Therefore, this situation would be as a result of the less fertility and the substantial further longevity gains. In general, as stated by Lesthaeghe (2014), the second demographic transition points to a different new challenges in a society, which include challenges related with more advanced aging, the integrating of immigrants, adjustment to new cultures, more risk to stability of the partnerships, many different kinds household, and more poverty or exclusion among particular kinds of household, for instance, single persons at different ages and single parents. During the first demographic transition, as fertility declined that there was not an enormous pressure for emotional and financial investment in the child, that is, in that part, the parents were somehow relieved. While during the second demographic transition, the motivation was self-realization of an adult within the role or way of life as a parent or completely successful and fulfilled adult (Lesthaeghe, 2011).

According to Lee (2011) usually, first mortality starts to decline and continues to decline gradually and with stable pace, and then later a fast-moving decline in fertility starts which in a longer period of time, for example, more than 2 decades, may change from a high level to a relatively lower level. The changes in these vital rates usually bring about substantial changes in the population size and its age structure as well as in the POPG rate. In addition, it is important to note that in a period when mortality is declining and fertility remains high, the growth rate of the population is rising and the percentage of young people in the population is also rising. When fertility begins to decline, the percentage of the working-age population increases and continues to rise for more than 5 decades, until fertility decline (Lee, 2011). Strictly speaking, Ahmad and Khan (2018) indicate that the process of demographic transition is completing in four stages: The first stage is with a high mortality rate and a high birth rate; the second stage explains the period of decline in the mortality rate; the characteristics of the third phase are a decline in the birth rate in response to changes in behavior and social networks, and finally, the fourth phase shows the cessation of POPG where there is an replacement level of fertility. In addition, Lee (2011) cites behavioral theories of fertility that has been developed and tested by sociologists and economists, emphasizing that these theories have not proved practical for prediction. Thus, according these theories, fertility in less developed countries is difficult to predict because unlike mortality in a given country, fertility can begin to decline suddenly and rapidly and then equalize, and therefore can be very difficult to predict the initial year of decline, the pace of decline, and the level at which it ceases. Becker's theory was very dominant in understanding the demographic transition, but was most concerned with the fertility transition (Lee, 2015). As is well known, its precise mechanisms and measures were concerned with how economic development could increase children's costs and lead to a decline in fertility despite rising incomes. In the demographic literature, there have been ongoing debates on the causes of fertility decline. In this regard, Willekens (2015) mentions a dominant

school that explains fertility changes as a response to changes in mortality. In addition, some other theories associate the demographic transition with economic and social development.

Furthermore, as a result of the continued work in this area done by the social scientists and epidemiologists, Lee (2011) provides well-ground reasons for decline in mortality during the process of demographic transition as well as for international migration changes. During the demographic transition, the decline in mortality is due to economic progress, improved waste disposal and water supply, public health interventions, and medical treatment. As fertility and mortality declined during the demographic transition, as a result of the globalization process, there was increased international migration as well as growing foreigners born in many countries. Certainly, international migration can affect POPG in more developed countries where low fertility would otherwise lead to population decline. Actually, immigration is often encouraged as a means of reducing the aging population.

Willekens (2015) discusses both consequences of the role of diffusion process in the demographic transition. The first consequence is a divergence followed by a convergence. Because some numbers of people respond before others do, the divergence in a population increases. When more people respond, convergence puts in. The second consequence is the increased response rate among settlers. When the population starts the transition late, that is, when other populations or other countries were already at an advanced stage, then this population has a higher response rate. In the developing countries and less developed countries, mortality and fertility declined more quickly than in Europe, where the start was much earlier. Furthermore, Willekens (2015) points out that people respond to opportunity structures in their close and more far away circumstances (e.g., family, community, country, and at the global level). People also respond to what others do. Thus, when some groups in society change ideas about family and children, birth control, living a healthy life, or about the need to emigrate to improve their living conditions, other people are likely to follow it so these conceptual changes may make diffusion to all groups in a society. These social interactions and the resulting diffusion of ideas show the mechanism of social change.

1.2. Trend and development of the POPG in Türkiye

When speaking about the POPG in Türkiye, it may be openly said that the growth has remained still and has been shaped under the effects of diverse factors. Almost until 1990, the annual POPG rate of the Turkish population remained steadily above 2%, simply slowing down in the 1990s (Kröhnert, 2010). So far, according to the World Bank (2022a) with an annual growth rate of 1.2% in 2008, and a current rate of 1.08 in 2020, Türkiye is above the European average. Regarding population dynamics and transition periods in Türkiye, Doğan (2015) mentions about three different periods. The "first" period takes place between 1927 and 1955. In this "first" period, birth and death rates were at the highest level. There were seven children during this first period on average, and the population doubled in 28 years. The second period of the demographic transition in Türkiye covers the period between 1955 and 1985, when the fertility rate was high and the mortality rate was low (Doğan, 2015). During this period, the yearly POPG rate was 2.8%. The so-called "third period" started in 1985 and still continues. According to Doğan (2015), the most important feature of this period is the considerable decline in the birth rates. It has been observed that the fertility rate in Türkiye has been slowly decreasing since the 1990s (Gönder, 2017). This author emphasizes that the fertility rate has decreased to 2.05 in 2011 compared to 2001 when it was 2.37, and from 1990 as well when it was 3.08. It is well known and accepted that after the 2000s, Türkiye entered the last phase of demographic transition (Yüksel, 2015). The demographic transition of Türkiye is considered an exceptional one. Compared with the averages of the less developed, least developed, and the world, the total fertility rate (TFR) and the life expectancy for Türkiye are the closest to those of more developed countries, especially when observed for the period 2003 – 2010 (Aykut, 2013). Despite this rapid transformation, the aging population in Türkiye is still at a very early stage and Türkiye is one of the slowest aging countries in the world (Aykut, 2013; Gönder, 2017). Türkiye's current demographic structure is still in the final stages of the demographic transition process (Canpolat-Bese, Ucar, and Karakaya-Dogu, 2013). According to these authors, the rapid POPG in Türkiye is now a thing of the past and there is no likelihood of accelerating POPG again, and it can certainly be said that the annual POPG rate will continue to decline thereafter. Doğan (2015) further noted that the "fourth period" will begin after the end of this "third" period. Accordingly, in the "fourth" period, birth and death rates will be expected to be low and equal to each other. As a consequence, the POPG rate would be zero. One of the conditions of the "fourth" period is the reaching of the net reproduction rate to one and this process was expected to be reached in 2014. The stabilization of the population, as a second important condition during this "fourth" period, is expected to be achieved in 2050.

According to the TURKSTAT baseline scenario, the TFR by 2013 is 1.99 (below the 2010 replacement level) and with projections that the rate will drop to 1.85 in 2023 (commonly mentioned in national documents) and to 1.65 in 2050, and then, it is expected that after 2050, the POPG rate will be approximately "zero" and that the total population will begin to

decline after that date (Yüksel, 2015). During that period, the population pyramid of Türkiye will turn to a "pillar" shape and will look like the population pyramids in developed countries (Yüksel, 2015, p.24). According to Kröhnert (2010) and based on the National Institute of Statistics and the UN, the Turkish population will continue to grow until 2050 due to its age structure. Hence, the National Institute for Statistics in Türkiye predicted a total population of 95.0 million for 2050, and the UN predicted as much as 97.3 million. In addition to the above, using the "Address Based Population Registration System" registers and the Central Civil Registration System and cohort-component method in projections, where the components are births, deaths and migration, Canpolat-Bese, Ucar, and Karakaya-Dogu (2013), showed that the POPG rate will decrease by 2023 in Türkiye according to Türkiye's projections as a whole. Based on these projections, the POPG rate in Türkiye would reach very low levels by the next century and could reach zero during that time, and possibly even reach negative values. Given the results of these projections, Canpolat-Bese, Ucar, and Karakaya-Dogu (2013) are pessimistic that the dream of "Turkey of 100 million population size" will ever come true. It is proper here to note also the forecasting by Ergöçmen and Özdemir (2005). They predict that in the next 15 years, the number of children aged 0 – 14 will stabilize, and the size of the working (productive) population, aged 20 – 54, will almost double. Therefore, as a consequence of changes in the fertility rate and mortality, the population age structures will begin the process of rapid ageing. In addition, Ergöçmen and Özdemir (2005) predict that the number of elderly people will increase from 3.6 million in 2005 to 10 million in 2030 and 15 million in 2050. Hence, the "demographic window of opportunities" in Türkiye is expected to lead to significant changes not only in social and economic development trends but also in vital rates and population structure.

What is very interesting to know for Türkiye as noted by Ergöçmen and Özdemir (2005) is that the changes in population trends were not identical, that is, uniform all over the country. Despite the observed convergence in the past, there are still significant differences in demographic trends and population structures between urban and rural communities and in the geographical regions of Türkiye. Internal and international migrations are two other very important demographic issues for Türkiye (Ergöçmen and Özdemir, 2005). With regard to internal migration, Western Türkiye in general and Istanbul in particular are recipient regions, while the Black Sea region and eastern parts of Anatolia are sending regions. In the past, the direction and size of emigration from Türkiye have been linked to foreign labor requirements. For example, during the 1960s, some 810.000 people migrated from Türkiye to European countries, especially Germany, to meet the labor demands of some European countries. That number dropped to 105.000 during 1975 – 1980 as these countries began to restrict their immigration policies. Here, it is worth noting that migration plays an important role in supplementing or counteracting fertility in population replacement in some Turkish regions. In the long run, most regions in Türkiye have a combination of fertility and internal migration that hinders significant population decline. In Istanbul, East Marmara and West Anatolia – despite the relatively low TFR, especially in the first two regions, net migration is so positive that combined reproduction in these regions reaches around 2.5 or even higher (Ediev and Yüceşahin, 2016). Combined reproduction is a composite product of the original TFR in the population of interest and of the migratory fertility. Thus, it enables dynamic POPG in those three regions, by about 25 – 50% every 30 years. Alternatively, in Northeast Anatolia, Central East Anatolia, and Southeast Anatolia, combined reproduction also reaches 2.5 – 3.0; so far in these regions, the combined reproduction continues to be so high due to the high TFR despite the noticeable out migration. These three regions are known as high POPG regions and as stable suppliers of migrants for other regions in Türkiye. The Kurdish community of Türkiye represents at least 18% of the country's overall population and it dominates the southeastern region of the country and has a high birth rate (Gönder, 2017). Due to the unequal economic and socioeconomic development of the country, considerable regional disparities in the population development are present in Türkiye. This generates social disruptions, because the highest POPG and the largest share of the younger population are found precisely in the agrarian, economically underdeveloped provinces in East Türkiye (Kröhnert, 2010).

Accordingly, it may be said that the migration has a capacity as a demographic stabilizer mostly in the western and eastern provinces in Türkiye. Ediev and Yüceşahin (2016) point out that recent estimate of the United Nations High Commissioner for Refugees shows that there are currently more than 2 million Syrian refugees in Türkiye. Assuming the permanent residence of the majority of Syrians in the country, it can be predicted that the population dynamics of the Syrians is likely to have an impact on the population change in Türkiye and its models of reproduction in the near future. Hence, for instance, Gönder (2017) notices that after Türkiye opened its door to Syrian refugees, TFR increased to 2.14 in 2015 compared with 2011 when its level was 2.05. Gönder (2017) notes that the fertility rate has increased in recent years, despite the fact that the Turkish population has not increased. The influx of more than 2 million refugees can have a significant demographic impact both nationally and for the particularly affected regions (Ediev and Yüceşahin, 2016, p.391). Figure 1 shows the POPG rate, TFR, crude mortality rate (CMR), and net migration rate (NMR) in Türkiye for the period 1965 – 2021.

2. Data and Methods

Within our research study, a multivariate regression model of the Turkish POPG rate was applied. Data are provided consisting of 57 annual observations for the period 1965 – 2021 on the POPG rate, CMR, TFR, and net rate of migration (NMR) from the Macrotrends database (https:///www.macrotrends.net/countries/topic-overview), (Macrotrends, 2022). It is worth noting that data sources on key demographic indicators for Türkiye within this Macrotrends web platform are available from the United Nations – World Population Prospects.

There is increasing attention in statistical and econometric research studies devoted to detecting structural breaks in long time series datasets and then to specify the effect from major breaks (Zarei, Ariff, Hook, *et al*., 2015). Structural changes happen if at least one parameter in the model has changed at some period, that is, date (Czech, 2016). This change could include a change in mean or a change in other parameters in the procedure that generates the series. By identifying when the structure of time series changes, the researchers are provided with understanding into the analyzed problem. Furthermore, to determine when and whether there is a significant change in data, structural break tests can be applied. The researchers in demography have obviously paid little attention to this aspect, so this research on POPG is based on this method of identifying and then explaining the periods of the POPG as a result of the impact of the main demographic events embedded in the dataset used. As shown in this research study, this method uses a rigorous pre-analysis filter procedure which will be applied to POPG and other demographic time series. Furthermore, testing for structural change has always been an important matter in econometrics because a multitude of political and economic factors could cause the relationships among studied variables to change over time (Önel, 2005).

The breakpoints may be known *a priori,* that is, from theory or to be estimated using different approaches. For instance, the maximum breaks and maximum levels setting restricts the number of breakpoints permitted through global testing as well as in sequential or mixed versus *l*+1 testing and the user-specified method permits to determine break dates by the user (IHS Global Inc., 2017). Therefore, the breakpoint estimation methods can be in general considered into two categories: Global maximizers for the breakpoints and sequentially determined breakpoints (IHS Global Inc., 2017). In Bai and Perron from 1998, the global optimization techniques are described in order identifying the multiple breaks and connected coefficients which minimize the sums-of-squared residuals of the regression model (IHS Global Inc., 2017). If the preferred number of breakpoints is known, the global break optimizers represent the set of breakpoints and the appropriate coefficient estimates that minimize the sum-of-squares for that regression model. If the preferred number of breakpoints is not known, there may be specification of the maximum number of breakpoints and to apply testing to determine the "optimal" number of breakpoints. A large number of test approaches are available. In Bai from 1997, an intuitional approach for obtaining estimates for more than 1 break has been described (IHS Global Inc., 2017). The procedure includes sequential application of breakpoint tests. If the number of breakpoints is pre-determined, then the estimation of the specified number of breakpoints is used simply with the one-at-a-time method. The sequential evaluation method selects the last significant number of breaks, determined sequentially. In other words, the procedure is employed sequentially, starting with a single break until the null is not rejected.

The Quandt-Andrews framework, as it was known earlier, was extended later by Bai (1997) and also by Bai and Perron in 1998, 2003 to obtain multiple unknown breakpoints. The latest tests developed by Bai and Perron in 1998; 2003 comprise an efficient algorithm that is based on dynamic programming method (Zarei, Ariff, Hook, *et al*., 2015). This method allows global minimizers of the sum of squared residuals in a simple regression test model in a very common framework that permits for pure as well as partial structural changes. With this general structure, the tests can control for different serial correlations, distributions of data, and the errors across divided parts. In 1998, Bai and Perron evaluated the estimation of multiple structural changes in a linear model estimated by least squares. Thus, they proposed a test for structural shift in case without trend regressors and a procedure based on a sequence of tests to estimate consistently the number of break points (Önel, 2005). The adequacy of these methods was assessed through simulation. The size and power of tests for structural change, the coverage rates of the confidence intervals for the break periods, as well as the advantages and disadvantages of model selection procedures were studied by Bai and Perron (2003). Hence, Bai and Perron developed a methodology for finding multiple structural breaks in time series and testing their statistical significance (Antoshin, Berg, and Souto, 2008). In the opinion of Antoshin, Berg, and Souto (2008), the simulation analysis handled in Bai and Perron shows that the size and power of their tests may be significantly distorted by several factors, such as small sample sizes, small break size, breaks clustering and apply of heteroskedasticity, and autocorrelation corrections. The sequential Bai-Perron test is considered a more advanced and compounded way to detect structural breaks. The worth of this test could be seen in identifying more than 1 breakpoint. There are some presumptions that should be made before conducting the sequential Bai-Perron test, like: The maximum number of breaks is 5, trimming percentage to be 15, and the significance level for sequential testing is 0.05 (Czech, 2016). The Trimming percentage, $e = 100(h/T)$ without reserve

determines *h*, the minimum segment length allowed when constructing a test (IHS Global Inc., 2017). Small values of the trimming percentage may lead to estimates of coefficients and variances which are grounded on a very small number of observations. The optimal number of breaks is based on the sequential methodology. In sequential methodology, the methods differ in whether the test is performed for a given *l* breakpoints, for an additional breakpoint in each of the *l*+1 segments (sequential tests all subsets), or whether the single added breakpoint that most reduces the sum-of-squares (sequential L+1 breaks vs. L), (IHS Global Inc., 2017). The structural change, the change of the parameters in the sample period, plays an empirically relevant role in applied time series analysis. In our study, a standard multiple linear regression model with *T* periods and *m* potential breaks (producing *m*+1 regimes) was considered. For the observations T_j, T_j+1., T_{j+1}−1 in regime *j,* the following regression model has been shown:

$$y_t = X_t'\beta + Z_t'\delta + \varepsilon_t \tag{1}$$

for the regimes $j = 0,\ldots, m$. The regressors are divided into two groups. The X variables are those whose parameters do not vary across regimes, while the Z variables have coefficients that are regime specific. ε_t is the error term. Once the number and identity of the breakpoints are determined, the model may be estimated using standard regression techniques. The equation specification above may be rewritten as a standard regression equation:

$$y_t = X_t'\beta + \bar{Z}_t'\bar{\delta} + \varepsilon_t \tag{2}$$

where β and $\bar{\delta}$ are fixed parameters and $\bar{\delta} = (\delta_0', \delta_1', \ldots, \delta_m')$ and $\bar{Z}_t'$ is an expanded set of regressors interacted with the set of dummy variables corresponding to each of the *m*+1 regime segments (IHS Global Inc., 2017). In our research work, the regression model consists of a regime-specific crude death rate (CDR), TFR, NMR regressors, and a C constant regressor. The estimated equation is a multivariable regression model in which some of the variables interact with regime dummy variables. Thus, the equation of the breakpoint model is defined exactly as in the standard least square regression. In other words, the method used was least squares with breaks. Therefore, dichotomous date functions before, during, and after a given period are used to generate regime dummy variables that interact with regressors. To the best of the author's knowledge, there is no such study that applies the Bai and Perron's methodology for demographic time series data. Therefore, this is the motivation for conducting and announcing the results from this research paper.

The Bai-Perron test computes the F statistics without structural change ($p = 0$) on the null hypothesis and $p = r$ when there are structural changes. If M is a standard matrix, such as $(\mathrm{M}\lambda)' = (\lambda'_1 - \lambda'_2, \lambda'_r - \lambda'_{r+1})$, then

$$F_T(\beta_1, \ldots \beta_r; q) = \frac{1}{T}\left(\frac{T-(r+1)q-p}{rq}\right)\hat{\lambda}'\mathrm{M}'(\mathrm{M}'\hat{V}(\hat{\lambda})\mathrm{M}')^{-1}\mathrm{M}\hat{\lambda} \tag{3}$$

where *r* is breaks, and $\hat{V}(\hat{\lambda})$ evaluates the variance-covariance matrix of $\hat{\lambda}$ which is robust to serial correlation and heteroskedasticity (Phoong, Phoong, and Phoong, 2020). The breakpoint F-test is given in Equation (4):

$$F = \frac{[\tilde{u}'\tilde{u} - (u_1u_1 + u_2u_2)/k]}{(u_1u_1 + u_2u_2)/(T-2k)} \tag{4}$$

where $\tilde{u}'\tilde{u}$ is the residual of the limited sum of squares, $u_j'u_j$ is the sum of squared residuals from a sample drawn from a larger sample *j*, the number of parameters is denoted with *k,* and *T* marks the whole number of observations (Phoong, Phoong, and Phoong, 2020).

3. Application of A Breakpoint Model for Türkiye: Key Findings

This study provides an empirical approach by applying the method of Bai and Perron from 1998 and 2003 using POPG rate time series, the CMR, the TFR, and the NMR time series for a sample of Türkiye with data extending over a long period of 57 years of annual observations. Hence, the task is to identify all breaks in this long time series to ensure that the breaks in terms of the POPG are accurately and quantitatively identified. Therefore, a breakpoint model was estimated with POPG regressed on CDR, TFR, NMR, and a constant. The regression output is presented in Table 1.

As can be seen, four statistically significant breaks at 1976, 1984, 2004, and 2013 have been determined using the Bai-Perron tests of sequentially determined breaks, with a maximum of 5 regimes, 15% trimming, and a test size of 0.05. Coefficient covariances for the tests and estimates are computed using white estimator with no d.f. correction. Table 1 shows each regime, as well as the corresponding coefficients estimates, standard errors, and p-values. At the bottom of the table, the standard summary statistics are shown. The results clearly show a significant difference in the mean of CDR,

Table 1. Estimation of breakpoint model for population growth in Türkiye, 1965 – 2021.

Variable	Coefficient	Std. error	t-Statistic	Prob.
1965 – 1975----11 observations				
C	0.1288	0.0835	1.5439	0.1311
CDR	−0.0096	0.0028	−3.4351	0.0015
NMR	−0.2076	0.0305	−6.8126	0.0000
TFR	0.1160	0.0139	8.3255	0.0000
1976 – 1983-----8 observations				
C	0.5681	0.0306	18.557	0.0000
CDR	0.0242	0.0080	3.0408	0.0043
NMR	0.0638	0.0126	5.0669	0.0000
TFR	0.0080	0.0191	0.4237	0.6742
1984 – 2003-----20 observations				
C	−0.2486	0.0361	−6.8855	0.0000
CDR	0.0078	0.0193	0.4029	0.6893
NMR	0.0775	0.0492	1.5753	0.1237
TFR	0.2465	0.0413	5.9706	0.0000
2004 – 2012----9 observations				
C	−3.3897	0.5522	−6.1388	0.0000
CDR	0.4881	0.1298	3.7598	0.0006
NMR	0.1319	0.0106	12.473	0.0000
TFR	0.3136	0.1127	2.7823	0.0084
2013 – 2021-----9 observations				
C	2.0629	3.1275	0.6596	0.5136
CDR	−0.6869	0.2861	−2.4008	0.0215
NMR	0.1077	0.0359	2.9987	0.0048
TFR	0.8271	2.0888	0.3960	0.6944
R-squared	0.9967			
Adjusted R-squared	0.9949			
S.E. of regression	0.0180			
Sum squared resid.	0.0120			
Log likelihood	160.40			
F-statistic	579.45			
Prob (F-statistic)	0.0000			
Mean dependent var	0.5729			
S.D. dependent var	0.2529			
Akaike info criterion	−4.9265			
Schwarz criterion	−4.2096			
Hannah-Quinn crit.	−4.6479			
Durbin-Watson stat	2.0280			

***Dependent variable: Log (population growth). Method: Least squares with breaks. **Break type: Bai-Perron tests of L + 1 versus L sequentially determined breaks. Breaks: 1976, 1984, 2004, and 2013. *Selection: Trimming 0.15, Max breaks 5, Sig. level 0.05. White heteroskedasticity-consistent standard errors and covariances. Source: Author's calculations

TFR, and NMR within all of these regimes, that is, prior and after 1976, 1984, 2004, and 2013. With these results, there is some clear evidence that within the period after 1976, 1984, 2004, and 2013, the POPG is characterized with statistically different trends compared to the period prior 1976, 1984, 2004, and 2013.

The results estimate that the CDR effect is negative and statistically significant at the 5% level in the first regime (1965 – 1975) and fifth regime (2013 – 2021), thus the effect of the CDR was to decrease the POPG rate during these regimes. The effect of CDR during the second regime (1976 – 1983) and during the fourth regime (2004 – 2012) is with positive signs and statistically significant at 5% level. The effect of TFR on POPG was found to be with positive signs in all of the regimes but only statistically significant at 5% level in three regimes: (1965 – 1975), (1984 – 2003), and (2004 – 2012). Thus, the explanation is that higher TFR led to higher POPG. From Table 1, it is revealed that the NMR has a negative statistically significant effect on POPG only during the first regime (1965 – 1975) and with a positive effect for the rest of the regimes, except for the third regime (1984 – 2003) where its effect was positive but not significant at 5% level. In the model, the rate of POPG was greatly influenced by the effect of the change of the constant (intercept), from the second to the fourth regime, that is, from 1976 to 2012. What was interesting is that especially during the third and fourth regimes, that is, during 1984 – 2012, the POPG was under negative influence from the constant (intercept). There are, however, some unique and specific aspects or features of the breakpoint regression in Table 1 that deserves discussion. Thus, in leverage plots, Figure 2 shows graphs which are labeled with the fully dummy variable interactions.

Leverage is a measure of how much each data point influences the regression. Leverage plots are the multivariate equivalent of a simple residual plot in a univariate regression. Like influence statistics, leverage plots can be used as a method for identifying influential observations or outliers. From our Figure 2, it can be observed that there are a lot of observations that have more leverage on, that is, the potential to influence the regression line, either in a positive or negative direction. Moreover, according to that, they tend to be closer to the regression fit with a large influence on the analysis. Thus, the influential points have a large influence on the fit of the model. An especially important influence of the outliers on the regression line is worth mentioning: the data points of NMR during 1984 and 2003, during 2004 and 2013, and after 2013. Also, it is worth to mention the influence of the data points of TFR during 2004 and 2012 and after 2013.

Influence statistics are a method of discovering influential observations or outliers. This method serves to measure the difference that one observation makes on the regression results, or how different one observation is from other observations in a sample equation (IHS Global Inc., 2017). A plot of the influence statistics of R Student test (Figure 3) clearly shows that observations of 2000 – 2001 and 2017 – 2001 years are outliers. The influence statistics of DFFITS plot

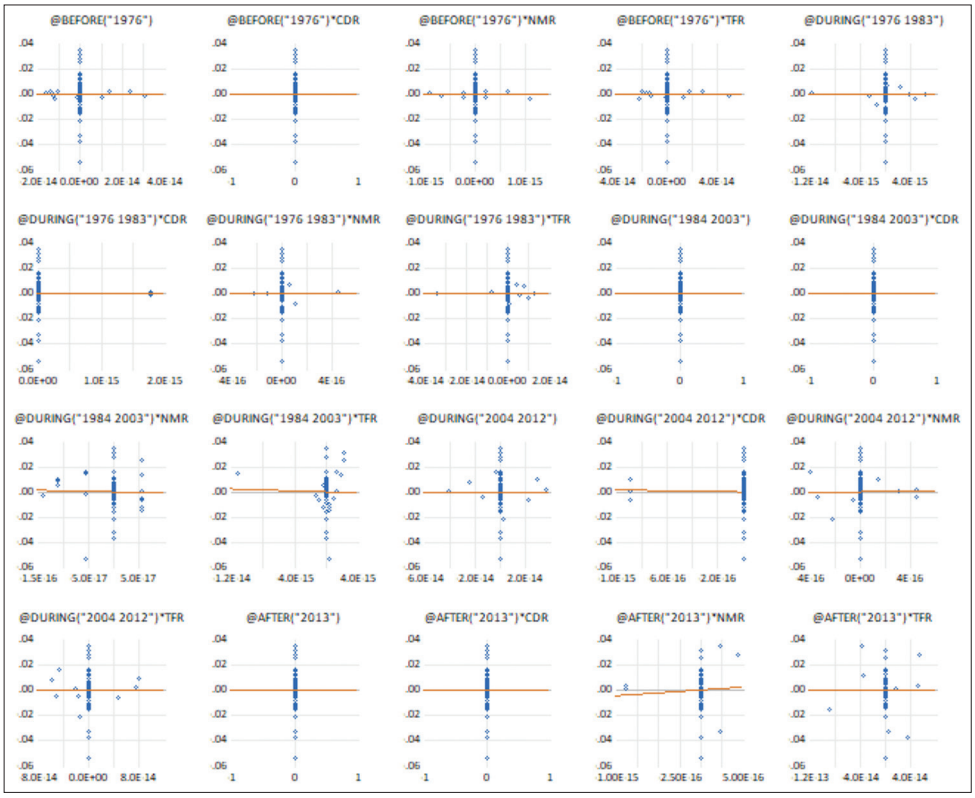

Figure 2. Leverage plots: Log(POPG) versus variables (partial led on regressors). Source: Author's design based on real data.

(Figure 3) are showing that observations of 1979 – 1981, 2000 – 2001, and from 2017 until 2021 are outliers. According to COVRATIO's plot (Figure 3), it can be seen that only the observations of 1979 – 1981 have very huge outliers.

Casual check of the residuals suggests that our model is a very good one and that there is no need to be improved with the additional breakpoints. The corresponding actual, fitted, and residual plot is given in Figure 4:

4. Discussion

Population policies of Türkiye may be analyzed in two periods; the pronatalist period from 1923 – 1960 and antinatalist periods from 1960 to 2000 (Yüksel, 2015; Yüceşahin, Adalı, and Türkyılmaz, 2016). In the middle of 1950s, population policy has been questioned as a result of the fast and not planned urbanization, illegal and harmful to health abortions, as well as lack of public investment for the new cohorts. After the 1960 military takeover, the newly established State Planning Organization and the Turkish Ministry of Health were involved in creating antinatalist policies. Current planning in Türkiye has its origin in the 1961 Constitution, since when planning for social and economic development has been defined as the responsibility of the state (Baran, 1971). The State Planning Organization (SPO) is a government organization having an obligation for drawing up the 5-year plans as well as the annual programs. Since its establishment, the 5-year plans have been drawn up in Türkiye. Furthermore, the duty of the SPO has also to follow up the implementation of the plans and to counsel the government on ongoing economic policy issues (Baran, 1971). The first development plan including antinatalist policies was legalized by the Turkish Parliament in 1965 and the "557 numbered Population Planning Law" was enacted (Yüksel, 2015). Thus, the beginning of the 1960s is accepted as the breaking point for policy change. The 1960s indicate the beginning of the "planned era" in Türkiye, where 5-year development plans have been preparing to assess the current social, economic, and demographic situations and put related goals (Yüceşahin, Adalı, and Türkyılmaz, 2016). Afterward, almost all consequently 5-year development plans between 1965 and 2007 (total eight) are engaged with the population and development relationship and have been indicating the need for controlling the POPG (Yüksel, 2015). As Yüceşahin, Adalı, and Türkyılmaz (2016) emphasize, as from 2008 onward, a new-third pronatalist policy period came into the Turkish scene. A first sign of a new pronatalist policy was given in 2008 by the then-prime minister and current president Recep Tayyip Erdoğan proposing that families should have at least three children (Yüceşahin, Adalı, and Türkyılmaz, 2016). Further signs of the new pro-natalist policy include debates on restrictions on induced abortion and cesarean sections, as well as initiatives for longer maternity leave, early retirement schemes for mothers, and one-time child benefit payments.

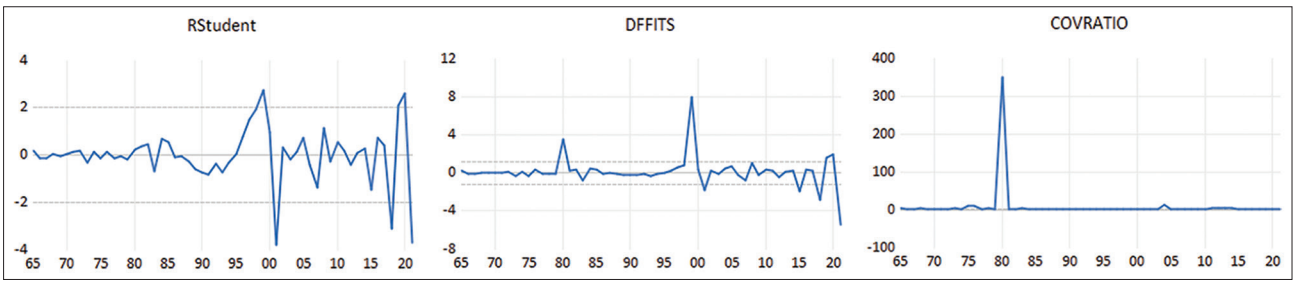

Figure 3. Influence statistics: Breakpoint model for population growth in Türkiye, 1965 – 2021. Source: Author's design based on real data.

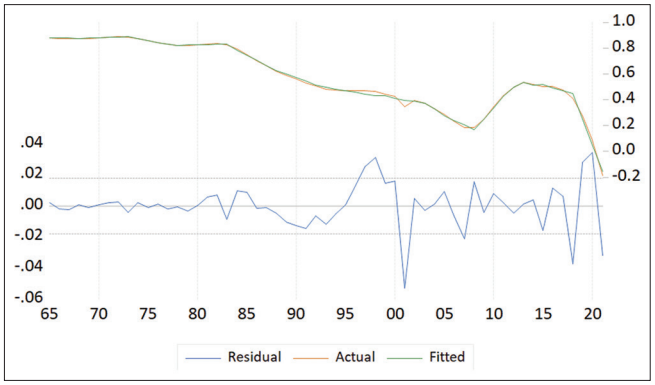

Figure 4. Residual plots: Breakpoint model for population growth in Türkiye, 1965 – 2021. Source: Author's design based on real data.

Our main goal was to convey a deeper understanding by quantifying how much the change in POPG does vary as a result of observations of included parameters of the breakpoint model for Türkiye in the period of 1965 – 2021. The robust least square breakpoint regression using sequential methodology and white standard errors confirms the presence of persistent differences in the impact over POPG in Türkiye during the mentioned period. As mentioned in the previous section, four statistically significant breaks at 1994, 2001, 2010, and 2014 and consequently five regimes have been determined using the Bai-Perron tests of sequentially determined breaks. This indicates that circumstances affecting the mortality, migrations, and fertility in terms of the number of live births and deaths as well as migration trends in the country before and after these indicated years in Türkiye have been largely influenced by the different dynamics of the socioeconomic conditions and different contexts in Turkish society (Lee, 2015; Willekens, 2015; Lesthaeghe, 2014). In this regard, Willekens (2015) states that the processes that are the basis of demographic transitions are interacted with science and technology, the economy, cultural change, and social and political changes. Furthermore, Lesthaeghe (2011) explains more clearly that the theory of the second demographic transition completely recognizes the effects of both structural changes at the macrolevel and economic calculations at the microlevel. The point is that SDT does not consider these explanations as "sufficient," but merely as "necessary" or "non-redundant" (Lesthaeghe, 2011). Moreover, the SDT theory does not consider cultural change as an internal cause of any economic model, but as a necessary additional force with its own external, that is, exogenous effects on demographic outcomes.

It is frequently discussed that the demographic transition in Türkiye is not so advanced (Caarls and de Valk, 2018). However, Türkiye has undergone crucial socioeconomic changes in recent decades and this also has had an impact on the transitions of family life. Herewith, Caarls and de Valk (2018) emphasize that these changes are attributed to the processes of modernization, exposure to Western values, as well as socioeconomic changes. Moreover, as these scholars have mentioned, what also makes Türkiye an interesting illustration is the huge regional variation: There are significant differences between regions both in terms of both economic development and to the extension of more modern values to family life. In view of TFRs, for example, in some regions, these rates are close to those of European countries, while in other regions, the TFR remained very high. In addition, the effects of demographic changes on later POPG can have wider interpretations. Horiuchi (1995) pointed out that demographic changes have an impact on POPG and age distribution in later years, which, in turn, has an impact on future POPG. In any analysis of the current POPG, it is of great importance to take into account the past events of the population. In addition, Horiuchi (1995) showed that not only events that occurred in the recent past but also events that occurred several decades earlier could have significant effects on the current growth rate. These effects are indirect and its impact works through changes in the age structure. The most glaring example is the baby boom generations. These empirical results show clear evidence that in the past 57 years, that is, from 1965 to 2021, the POPG rate in Türkiye is characterized by a different trend and that it has a different effect of the key variables (TFR, CDR, and NMR) on the rate of POPG. From the results in Table 1, it is obvious that the changes in fertility, mortality, and migration trends have notably different impacts on POPG rate in Türkiye. However, it is also argued that life expectancy at birth (e0), TFR, and NMR may be also a good set for modeling since e0 takes age composition into account, while CDR is affected by the age structure of a population of a given year. The conclusion will be likely different if different demographic variables are used in the Bai-Perron approach (Appendix, Table A).

The effect of mortality on POPG gradually increased except for the last regime (2013 – 2021) when fluctuations were noticed. This effect is not the result of an accelerated decline in mortality, as the effect of changes in mortality over the entire period of almost 50 years has remained relatively constant with a steady decline as confirmed by the period data. This effect may be attributed to the accumulation of the reduced mortality. Thus, since 1965, several decades of improved mortality have accumulated. These patterns are consistent with trends in life expectancy in Türkiye which show an acceleration of life expectancy growth in the same period (Bakar, Oymak, and Maral, 2017; World Bank, 2022b; OECD, 2011). The model of the contribution of mortality to POPG has changed during these 57 years and was negative for the first regime (1965 – 1975) and the last regime (2013 – 2021). The impact of mortality on POPG was positive during 1976 – 2012. It is not surprising to claim that a constant infant and child deaths during the first decade or regime of our research study (1965 – 1975) have contributed to reducing the desired number of children, which, as a consequence, had the impact of declining POPG. For a long time, the decreasing infant and child mortality determined the tendency in the death rate (Willekens, 2015). Thus, cumulated improvement in infant and child mortality during the past 57 years as well as the reduction in adult mortality during the whole period contributed the effect of crude death to significantly positive, especially during the second and fourth regimes, that is, (1976 – 1983) and (2004 – 2012), respectively. It is supposed that the mortality effect was positive on POPG during this period mainly as a result of the accumulation of several years of infant and child mortality reduction. It is evident that infant and child mortality decline was very rapid in the remote past compared to the recent past. A lot of literature discusses great improvements of these events in Türkiye during this period (Özen, 2018; Dumont, 2011; Seçkin,

2009). In addition, the decline of the mortality rate in Türkiye from the middle of the 2000s according to Durmus (2022) may be a result of several factors that could explain this phenomenon, such as the reforms in the health system in Türkiye, introducing to a significant improvements in healthcare organization, resource management, and health service delivery to be provided equitable access to quality health services for all since the middle of the 2000s.

The effect of total fertility was positive on POPG in Türkiye throughout the entire period simply because of the high fertility levels. The strongest positive effect of fertility on POPG is considered to be during the third regime (1984 – 2003). Figure 1 indicates a steady and gradually downward trend of the fertility decline during the entire period as well as due to the baby boom. Fertility rates in Türkiye have gradually declined mainly from the early 1970s with about 5.5 births per woman to 2.3 births until early 2000s, that is, the TFR more than halved within these three decades (Ergöçmen and Özdemir, 2005). It is believed that the fertility behavior in Türkiye is mostly affected by social and economic circumstances and that the effects of population policies were quite small (Yüksel, 2015). Thus, Yüksel (2015) mentions that there were some calculations in which the effects of population policies from 1965 to 1980 on fertility were <10 percentages. In addition, Yüceşahin, Adalı, and Türkyılmaz (2016) also stressed out that although Turkish governments implemented antinatalist policies and more liberal regulations toward reproductive health after 1965, it is considered that the fertility decline in Türkiye has followed a course that is much rather independent from these measures. In the study of Bongaarts from 1993 of the impact of policies, it was found that only 31% of fertility decline in Türkiye could be attributed to family planning programs (Yüceşahin, Adalı, and Türkyılmaz, 2016). As stated by these scholars, the fertility transition in Türkiye has mainly carried on as a result of socioeconomic developments and the society's transformation. In addition, education reforms became a national objective for Türkiye, increasing mandatory education from 5 to 8 years in 1997 to improve the levels of educational attainment of the native workforce (Kilic and Biffi, 2021). Furthermore, although Türkiye has gone through major socioeconomic transformation, Yüceşahin, Adalı, and Türkyılmaz (2016) emphasize that Turkish society has still preserved its patriarchal foundation, as it is the case with many developing countries. Since labor force participation among women is low in the country (under 28% within paid employment), therefore, it may be acknowledged that a population policy could at least partially succeed. During the first regime (1965 – 1975), the trajectory of the total effect of fertility on POPG was significantly positive reflecting the fertility increase during the previous period. Horiuchi (1995) calls this "duration-specific effect." The fertility effect on POPG was positively significant also during the third (1984 – 2003) and fourth (2004 – 2012) regime with a duration of <20 years with positive effect probably mainly because of the baby boom. After 2000, fertility rates and the future of Türkiye's population have been discussed at large by scholars, political parties, and policy makers as well from public media. For the 1st time in the history of the Turkish nation in 2005, the age structure of primary school population has been decreased and after 2010 TFR has declined below replacement level (Yüksel, 2015). However, the overall effect remained positive, as the accumulation of previous persistent fertility declines was less pronounced and the compensation for the positive impact of the baby boom.

The results of the effect of NMR on POPG in Türkiye have been explained within this paragraph. Since 1960, international migration has become a global phenomenon. Employers in Europe and in other regions started to recruit immigrant workers, so called – guest workers because of a lack of domestic labor supplies (Willekens, 2015). Thus, labor migration was recruited mainly from South Europe to North and West Europe. The strongest negative effect of the net migration on POPG in Türkiye was noticed during the first regime (1965 – 1975) mostly as a result of migration of a large number of Turks mostly to Germany first as guest workers and later as immigrant workers. During 1963 – 1978, Türkiye was involved in labor recruitment agreements with many European countries (Kilic and Biffi, 2021). Controlled emigration to European countries was officially organized by the Turkish employment agency in collaboration with the public employment agencies of countries with whom Türkiye stipulated into bilateral labor recruitment agreements. The first great and important bilateral labor agreement was with Germany in 1961, and then followed with Austria, the Netherlands, and Belgium in 1964, France 1965, and Sweden and Australia in 1967 (Kilic and Biffi, 2021). In addition, the rapid development of rich countries with oil in the Middle East-North Africa region attracted Türkiye by an agreement with Libya in 1975. At this time, the main characteristics for Türkiye were the lack of political stability and not solved economic, social issues, and a lot of poverty. Türkiye agreed the policy to send unskilled labor for at least two reasons: To lessen unemployment as well as to receive remittances from the migrants and consequently lost more skilled workers in the emigration process than any other Mediterranean countries (Kilic and Biffi, 2021). The positive net migration effect on POPG from 1976 to 1983 onward may be due to the restriction of immigration policies in many European countries that started during 1975 – 1980 (Ergöçmen and Özdemir, 2005). Since 1976, the effect of migration has changed the sign from negative to positive, reflecting the increase in net flow in the country. During the third regime (1984 – 2004), the NMR did not turn to have positive signs but still remained with smaller negative signs, that is, during this whole period emigration to certain extent exceeded immigration. The effect of changes in NMR on POPG during this regime (1984 – 2003) was

slightly positive but statistically insignificant. The intensity of diaspora policies and the positive economic development of Türkiye from the 1980s onward, which was driven by enlarged trade with Europe, foreign investment, and privatization, have increased the process of industrialization of the Turkish economy (Kilic and Biffi, 2021). According to these authors, Türkiye experienced a persistent brain drain during this period not as the result of foreign worker recruitment by the prime European destination countries, but much rather a result of family reunion, but to a certain extent also to the political instability in Türkiye. Political instability has been the most significant factor behind the lack of success of Turkish governments to carry out structural reforms (Murat, 2005). Thus, Murat (2005) has shown that there have been several structural causes of the macroeconomic crises in Türkiye, which also have been strongly connected to the major features of the Turkish political economy. As a result of several factors, the liberal efforts in the Turkish economy underwent sporadic difficulties in 1982, 1988, 1994, 1997, 1998, 2000, and 2001. Hence, the populist policies, the public deficits, inflation, a weak financial system, and increasing public debt were among the leading topics that have been used in explaining economic trends and causal relationships in the Turkish economy for this time (Murat, 2005). The impact of the net migration on POPG during the fourth regime (2004 – 2012) as well as fifth regime (2013 – 2021) remained positive and statistically significant. Thus, during the period of 2001 – 2023, the focus of Turkish migration policy turned to highly skilled immigration. This was an established policy course of many developed as well as developing economies for some time and Türkiye joined this group of countries and implemented numerous policy instruments to attract highly skilled migrants deemed productive for the development of Türkiye (Kilic and Biffi, 2021). Therefore, immigration of high-profile educated people was initiated as a new policy matter. In addition, during this period, the return of skilled Turkish origin diaspora stands on the agenda as well (Kilic and Biffi, 2021). In other words, Türkiye started with the promotion of the policy challenge of return migration of highly skilled Turkish (origin) migrants. As a consequence, and because of successful economic development since the 2000s onward (Mihai, 2009), Türkiye experienced a lowering in population outflows and an increase in population inflows, as migration transition theory would claim. In addition, it is argued that the most important historical development which paved the way of Türkiye for a modernization as well as more enhanced state-society relations in the 2000s can be directly linked with the EU membership process (Burak, 2011). It is well known that the adoption and the implementation of the social, political, and economic policies of the EU are crucial and the basic requirement for the candidate countries to become a full member. As claimed by Burak (2011) during the 2000s, Turkish society went through rapid social-cultural, economic, and political changes.

The last ninth 5-year development plan written for the period 2007 – 2013, highlighted that changes in demographic structure of Türkiye, fertility level, and age structure had started to be similar to those of developed countries (Yüceşahin, Adalı, and Türkyılmaz, 2016). This plan is pointing to the need to re-examine policies on education, health, employment, and social security and setting the stage for a new pronatalist approach. Given the latest values of the death rates and fertility rates for Türkiye, in the near future, the number of deaths is expected to increase, and fertility is expected to remain at a lower level than it is now. TFR in Türkiye reached a replacement level of 2.1 children per woman in 2016 – 2017. The tenth 5-year development plan was prepared in 2013. This plan specified a need to "increase the fertility rate through population policies" and put forward the need for such a policy (Yüceşahin, Adalı, and Türkyılmaz, 2016). To meet this requirement, the Turkish Ministry of Family and Social Policies coordinated an action plan in January 2015 called the "Action Plan to Preserve the Family and the Dynamic Structure of the Population." One of the clearly stated targets of the plan was to remain TFR above the replacement level. Nevertheless, a further steady decreasing trend of POPG will be inevitable for Türkiye. As the population grows, a sudden or steady decline in fertility to replacement level does not mean that there will be an immediate cessation of growth. In general, the growing populations have a tendency to continue to grow because they have large cohorts in the reproductive age and lesser cohorts in the elderly (Schoen, 2018). As mentioned by Horiuchi (1995), the momentum of past demographic events results in steady growth. The experience of actual populations with high fertility usually shows that an increase due to momentum would be of considerable importance. The very interesting question is to what extent POPG may thus depend on the contribution made by immigrants, especially mostly those from Syria and for how long?

Using the Bai-Perron approach, this study has some limitations that future research may address. One such limitation is the lack of exact explanation that could be provided for each of the different regimes of the breakpoint model. However, the author tried as much as he can to cover the regimes with proper socioeconomic policies or population policies specific to Türkiye within the exact period. However, these are different regimes quantified by the breakpoint model and hence the author could not specifically and strictly state a specific policy exactly for each regime of the model but went more to cover partially or completely the period for a given regime from the model. Further studies with this method may be extended to pre-determined breakpoints or to a preferred number of breakpoints that are based on the best knowledge of the author, that is, user specific breakpoints to provide a greater understanding of the breaks in or changes of the time series.

5. Conclusions

The present study aimed to overcome the limitations of the demographic and economic models through the detection of the structural changes in the data series, using the breakpoint test to address the demographic events that led to different regimes of the POPG. The breakpoint model was used because the empirical results provided a large evidence of the major breaks in the POPG series since the sequential procedure selected four breaks. Thus, the breakpoint model was capable of accurately and quantitatively recognizing the key impact of the main demographic events on POPG in Türkiye during six decades now. The results obtained from the breakpoint model are reasonable since the breaks in the POPG somehow coincide with significant economic realities and population dynamics in Türkiye. Consequently, these breaks have fostered to capture the structural changes in Türkiye with regard to its socioeconomic development and population dynamics. Thus, a good exploratory analysis was made based on these breaks and regimes separately from the theoretical knowledge of the four phases of demographic transition process that are specific for Turkish society. In addition, it is observed that within different regimes of the model, the responses in terms of population policies targeting specific demographic aims have lost their popularity and probably, there were replaced by policies focusing on social and economic changes. In today's modern Türkiye, it would be more difficult to implement for instance pronatalist policies that are directly aimed at raising fertility.

The results of this research work provide valuable information on the relationship between migration trends, fertility, and mortality and POPG trends in Türkiye during the period of 57 years, that is, from 1965 to 2021. The empirical results of our research study on Türkiye reflect typical changes in both demographic and epidemiological transitions, such as declining fertility, declining growth rates, declining mortality, and changes in improving longevity. The breakpoint regression analysis confirms the presence of persistent differences in the POPG in Türkiye over the period 1965 – 2021 as a result of the dynamics of key determinants of the POPG. In other words, the relationship between POPG and these determinants is somewhat predictable because POPG is largely directly due to these variables. In addition, for comparison, during the whole period of our research study (1965 – 2021), the POPG rate in Türkiye has more than halved. In other words, from the level of about 2.4% in the late 1960s and the first half of the 1970s in the last years of 2019 – 2020, it reached a level of about 1% and will fall below 1% in 2021. What is interesting is that the Turkish POPG still has positive momentum in comparison to almost all European countries. Furthermore, interesting is the fact that the TFR in Türkiye for the same period (1965 – 2021) has dropped 3-fold. The role ascribed to migration changed from supporting out-migration of mainly low-skilled domestic population in the 1960s to promoting university education abroad from the 1970s until today, and immigration of the highly skilled from 2000 onward. Through this time period of more than 50 years, Türkiye underwent all phases of a migration cycle, beginning as an emigration country and turning into an immigration country. As a result of the complicated process of human migration, it must be pointed out that in Turkish case migration is featured in the context of many policy issues, extending from social and economic policy to demographic, regional, and structural policy, cultural and human resource development, as well as international relations.

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Conflicts of Interest

The author has no conflicts of interest to declare.

Authors' Contributions

Goran Miladinov conceived and designed the paper, analyzed the data, and wrote the paper.

Ethics Statement

Not applicable as this study involves the analysis of secondary data collected by the Macrotrends website.

Availability of Supporting Data

Data utilized to this paper are from secondary sources and available to the public. The data can be freely accessed online from the Macrotrends LLC website: https:////www.macrotrends.net/countries/topic-overview.

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Appendix

Table A. Estimation of breakpoint model for population growth in Türkiye, 1965 – 2021.

Variable	Coefficient	Std. error	t-Statistic	Prob.
1965 – 1977-----13 observations				
C	−0.1613	0.8459	−0.1906	0.8500
Total fertility rate	0.1055	0.0611	1.7278	0.0934
Net migration rate	−0.2531	0.0855	−2.9589	0.0057
Life expectancy at birth	0.0028	0.0105	0.2701	0.7888
1978 – 1985-----8 observations				
C	0.7075	1.7560	0.4029	0.6896
Total fertility rate	0.1900	0.1011	1.8804	0.0689
Net migration rate	0.1591	0.0456	3.4881	0.0014
Life expectancy at birth	−0.0100	0.0224	−0.4478	0.6572
1986 – 1996-----11 observations				
C	−0.0583	1.1753	−0.0496	0.9607
Total fertility rate	0.2457	0.0829	2.9600	0.0057
Net migration rate	0.3998	0.3153	1.2675	0.2138
Life expectancy at birth	1.9905	0.0126	−0.0016	0.9987
1997 – 2004----8 observations				
C	6.5200	2.0890	3.1213	0.0037
Total FERTILITY RATE	−0.6504	0.4931	−1.3184	0.1964
Net migration rate	−0.3558	0.5625	−1.6325	0.5314
Life expectancy at birth	−0.0649	0.0172	−3.7687	0.0006
2005 – 2012-----8 observations				
C	−3.7028	1.7593	−2.1048	0.0430
Total fertility rate	1.2436	0.2983	4.1692	0.0002
Net migration rate	0.1025	0.0052	19.812	0.0000
Life expectancy at birth	0.0156	0.0155	1.0016	0.3238
2013 – 2021-----9 observations				
C	−3.2591	2.0276	−1.6073	0.1175
Total fertility rate	−0.6640	0.6568	−1.0110	0.3194
Net migration rate	0.1588	0.0089	17.875	0.0000
Life expectancy at birth	0.0587	0.0122	4.8285	0.0000
R-squared	0.9979			
Adjusted R-squared	0.9964			
S.E. of regression	0.0152			
Sum squared resid.	0.0077			
Log likelihood	173.19			
F-statistic	669.52			
Prob (F-statistic)	0.0000			
Mean dependent var	0.5729			
S.D. dependent var	0.2529			
Akaike info criterion	−5.2348			
Schwarz criterion	−4.3747			
Hannah-Quinn crit.	−4.9005			
Durbin-Watson stat	2.7321			

***Dependent variable: Log (population growth). Method: Least squares with breaks. **Break type: Bai-Perron tests of L + 1 versus L sequentially determined breaks. Breaks: 1978, 1986, 1997, 2005, and 2013. *Selection: Trimming 0.15, Max breaks 5, Sig. level 0.05. White heteroskedasticity-consistent standard errors and covariances. Source: Author's calculations

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RESEARCH ARTICLE

Social support and food insecurity among older Brazilians in São Paulo

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Abstract: Food insecurity is a growing problem in Brazil, especially among older adults; however, the related sociodemographic factors remain unclear. This study aimed to analyze the relationship between social support dimensions and food insecurity among community-dwelling older adult Brazilians in São Paulo. This cross-sectional study was conducted in three cities in Sao Paulo state, Brazil. The analysis included 598 community-dwelling individuals aged ≥60-years-old, and multiple logistic regression models were used to estimate the associations between the dimensions of social support and food insecurity after adjusting for sociodemographic characteristics. We found that 42.3% of participants were food insecure. In the bivariate analysis, the higher scores in the affective, material, positive social interaction, and informational social support dimensions were statistically associated with the lower odds of food insecurity. In the multiple regression analysis, older adults who had a higher score of positive social interaction were less likely to have food insecurity, whereas the African American ethnicity and those older adults with a total family income ≤2 times of the minimum wage were more likely to have food insecurity. The results indicate that the positive social interaction emerges as an important factor associated with food insecurity among older adults, beyond that of other well-known social factors associated with food insecurity, highlighting the importance of screening for food insecurity and social support in primary care to avoid potential adverse health outcomes among older adults.

Keywords: Older adults; Social determinants of health; Nutrition; Food insecurity; Social support; Brazil

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1. Introduction

Food security and adequate nutrition are basic human rights and are important for health of population. However, the number of people with hunger and food insecurity is growing exponentially due to the coronavirus disease 2019 (COVID-19) pandemic and the current global economic crisis. Data from the latest report by the Food and Agriculture Organization (FAO) show that in 2020, approximately 2.37 billion people worldwide did not have access to adequate food – an increase of 320 million than in 2019 (FAO, IFAD, UNICEF, WFP, and WHO, 2021), and the situation is getting worse since the beginning of 2022 (FAO, IFAD, UNICEF, WFP, and WHO, 2022).

Food insecurity is characterized by the "limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways." (Anderson, 1990, p1588). Data from the 2017 to 2018 Family Budget Surveys (in Portuguese, Pesquisa de Orçamentos Familiares – POF) in Brazil show that, after an upward trend in food security between 2004, 2009, and 2013, there

was a reduction in the prevalence of Brazilian private households that had the ability to feed their residents adequately (quantitatively and qualitatively). In 2017 – 2018, 63.3% of households in the country had consistent access to adequate food, a proportion which was lower than the figures for 2004 (65.1%) and 2013 (18.2%). Conversely, there was a significant increase in food insecurity, which came under the scenario of reduction. The survey also showed that 27.3% of older Brazilians had some degree of food insecurity (IBGE, 2020). Nutritional transition in Brazil is still underway, resulting in a double burden of disease related to nutritional excesses and deficiencies, obesity, and starvation, which are direct causes of poverty and food insecurity (Ghattas, 2014).

In tandem with the worsening food security is the rapid populational aging. It is projected that people aged 60 or older will reach 66 million in 2050, rising from 29 million in 2021; and these numbers equal to 28.8% of the population in 2050 and 13.8% in 2021 (United Nations, 2022). The rapid population aging in Brazil is mainly due to persistent low fertility and improved life expectancy. Data provided by the United Nations (2022) show that total fertility rate has been below the replacement (2.1 births per woman) for two decades and is project to maintain at the current level 1.6 till 2050. The average life expectancy at birth is also projected to be 78.9 years for men and 83.7 years for women in 2050, despite some reduction in 2019 – 2021 due to the COVID-19 pandemic (United Nations, 2022). As older adults are more vulnerable than general adults in the population, food insecurity among older adults will usually exacerbate their disadvantaged health conditions.

Among older adults, food insecurity was associated with negative impacts on mental, physical, and nutritional health, making older adults more susceptible to health problems such as frailty (Pérez-Zepeda, Castrejón-Pérez, Wynne-Bannister, *et al.*, 2016), depression (Jung, Kim, Bishop, *et al*., 2019), cognitive decline (Portela-Parra and Leung, 2019), lower health-related quality of life (Fernandes, Rodrigues, Nunes, *et al.*, 2018), and worsening nutritional status (Grammatikopoulou, Gkiouras, Theodoridis, *et al.*, 2019). Social support has also been identified as an important mediator of food insecurity during aging (Wang and Bishop, 2019).

Although there is no consensus in the literature regarding the definition of social support, it can be understood as the perceived availability of interpersonal resources capable of responding to needs caused by stressful events. Social support can be divided into various dimensions. One common classification is composed of five dimensions: Material (financial or physical assistance), affective (love and affection), emotional (encouragement and empathy), positive social interaction (social companionship), and information (having someone to counsel and help them deal with problems) (Cassel, 1976; Cohen and Wills, 1985). This multiple domain characteristic of social support provides different insights into how social support could be associated with food insecurity. In the literature, it is hypothesized that social support, especially the material and emotional dimensions, could act as a protective factor against hunger and food insecurity, because social support may be decisive in the availability of help when someone has financial difficulties in buying food, for example, (Wang and Bishop, 2019).

Considering that in low- and middle-income countries (LMICs), the prevalence of food insecurity continues to increase, and in most of these countries, the population is rapidly aging, it is important to identify the social factors associated with food insecurity among older adults. Therefore, the aim of this study was to analyze the association between different dimensions of perceived social support and food insecurity among community-dwelling older adults in Brazil, a prime example of such LMICs. The main hypothesis of this study was that older adults with higher scores on all dimensions of social support would have the lowest chance of presenting with food insecurity.

2. Data and Methods

2.1. Data sources

We used data from the cross-sectional study "Evaluation of the prevalence of micronutrient deficiency among community dwelling older adults in the metropolitan area of Campinas – SP," conducted in three cities of São Paulo, Brazil in 2018 and 2019. The sample size for the principal study was based on the estimated total number of inhabitants aged ≥60 years in the municipalities of Campinas, Limeira, and Piracicaba in 2018. The calculation of the sample size considered a prevalence of 60% of older adults with at least one micronutrient deficiency, and a sampling error of 10%, along with a 95% confidence level. Thus, the minimum sample size was set at 600 older adults, with 170 participants being from the city of Limeira, 180 from Piracicaba, and 250 from Campinas.

Six hundred and eleven older adults registered in the Family Health Strategy program between 2018 and 2019 were interviewed. Participants were recruited through an invitation made at the basic health units (UBS) recommended by the respective health departments of each municipality. More details of the data collection have been previously published (Rolizola, Freiria, Silva, *et al*., 2021). The main study eligibility criteria included (1) age of 60 years or older, (2) being a resident of one of the included cities, (3) being registered in the Family Health Strategy program, and (4) presenting the

ability to understand the procedures of the study. Exclusion criteria were: (1) Use of any dietary supplements based on vitamins and/or minerals, (2) being followed up on by a home care program, and (3) undergoing chemotherapy.

Data were collected in the primary healthcare units where older adults were enrolled. Participants with incomplete data on social support and food insecurity were excluded from the analysis (n = 13), thus a total of 598 older adults were included in the study. Signed consent forms were obtained from all participants.

2.2. Measures

2.2.1. Food insecurity

Food insecurity was measured using the abridged version of the Brazilian Food Insecurity Scale, a questionnaire validated for the Brazilian population (Santos, Lindemann, Motta, *et al*., 2014; Sperandio, Morais, and Priore, 2018). The scale is composed of five questions (yes/no): "*Were you worried that the food in your home would be finished before you could buy, receive or produce more food?*", "*Did the food finish before you had money to buy more?*", "*Did you run out of money and could not have a healthy and varied diet?*", "*Did you or an adult in your home reduce the amount of food in your meals, or skip meals, because there was not enough money to buy food?*", "*Did you eat less than you thought you should because there was not enough money to buy food?*", and identified individuals who experienced food insecurity during the previous 3 months. A sixth question that was used in the previous studies on older adults was: "*Have you ever been hungry but did not eat because you were not able to leave the home for food?*" was added to assess the possible mobility difficulties that could influence food access by older adults (Carder, Luhr, and Kohon, 2016; Chung, Gallo, Giunta, *et al*., 2012). Participants who answered "yes" to at least one question were evaluated as food insecure.

2.2.2. Social support

Social support was assessed using the Brazilian adapted and validated version (Griep, Chor, Faerstein, *et al*., 2005) of the Medical Outcomes Study Social Support Survey (Sherbourne and Stewart, 1991). The scale contains 19 questions and evaluates five dimensions of social support: material (four questions), affective (three questions), emotional (four questions), positive social interaction (four questions), and information (four questions). Each question on the scale was answered by indicating the frequency of the support received by the older adult, and each choice had a different score: never (1 point), rare (2 points), sometimes (3 points), almost all the time (4 points), and always (5 points). On each dimension evaluated, the participant obtained a score between 15 points (affective dimension) and 20 points (material, emotional, positive social interaction, and information dimensions). The sum of the points obtained in each dimension was multiplied by 100 and divided by the highest possible score in each dimension, with a higher score indicating a greater perception of social support perceived by older adults.

2.2.3. Sociodemographic covariates

The literature suggests that social, economic, and demographic factors are associated with food insecurity. For example, different studies have shown that higher income is an important factor influencing access to adequate food, along with education. In addition, Causasian older adults have food insecurity rates that are substantially lower than that of other ethnicities (Marín-León, Segal-Corrêa, Panigassi, *et al*., 2005; Fernandes, Rodrigues, Nunes, *et al.*, 2018; Grammatikopoulou, Gkiouras, Theodoridis, *et al.*, 2019; Ziliak and Gundersen, 2022). The following variables were included as covariates that could act as potential confounders in the relationship with social support because they were previously associated with food insecurity: Sex (male or female); family monthly income, classified into two groups: ≤latimes of the minimum wage, >2 times of the minimum wage. The minimum wage was R$954.00 (US$261.10) in 2018 and R$998.00 (US$257.20) in 2019 (we used mean imputation for individuals with missing data (n = 52) in this variable); schooling (0 – 8 years, 9 years or more, not informed); marital status (married, widowed, and single/divorced); ethnicity (Caucasians, African Americans – African Americans and Mixed Race, and Others – South native American and Asian); whether they were the head of the household (yes and no); working for pay (yes, no, and not informed); and age group (60 – 69-years-old, 70 – 79-years-old, and 80 years and older).

2.3. Analytical strategies

All analyses were conducted using Stata® version 12.0. In the descriptive analysis, frequencies and percentages were used for categorical variables, and means with standard deviations were estimated for the continuous variables. To examine the differences in the prevalence of food insecurity, we used Chi-square test for categorical variables and Mann–Whitney U test for social support dimensions as continuous variables (because they did not adhere to a normal distribution according to the Shapiro-Wilk test).

Logistic regression models were used to estimate crude and adjusted odds ratios (OR) and respective 95% confidence intervals (CI). Sociodemographic covariates that presented $P < 0.20$ in the unadjusted analysis were incorporated into the adjusted analysis. In the final model, all the social support dimensions and the sociodemographic covariates with $P < 0.05$ were maintained. Statistical significance was set at $P < 0.05$.

3. Results

Among the 598 participants, 42.3% were classified as having food insecurity and 76.8% had a family income equivalent to more than two minimum wages. Food insecurity was more prevalent among women (45.0%), those of African American ethnicity (49.0%), and among those with a family income equal to or less than two minimum wages (56.1%). No significant differences were observed in the first analysis with respect to age, marital status, whether the older adults worked, and whether they were the head of their household.

The characteristics of the sample, as well as the prevalence of food insecurity according to sociodemographic variables, are shown in Table 1.

Table 1. Sociodemographic characteristics of the sample and by food insecurity status.

	Total 100% (598)	**Food secure 57.7% (345)**	**Food insecure 42.3% (253)**	***P***
Sex				0.040
Male	30.6% (183)	63.9% (117)	36.1% (66)	
Female	69.4% (415)	55.0% (228)	45.0% (187)	
Age group (years)				0.147
60–69	52.2% (312)	55.5% (173)	44.5% (139)	
70–79	39.0% (233)	57.9% (135)	42.1% (98)	
80 and older	8.8% (53)	69.8% (37)	30.2% (16)	
Family monthly income				<0.001
≤2 times of minimum wage	23.2% (139)	43.9% (61)	56.1% (78)	
>2 times of minimum wage	76.8% (459)	61.9% (284)	38.1% (175)	
Ethnicity				0.007
Caucasians	55.5% (332)	61.1% (203)	38.9% (129)	
African Americans	40.6% (243)	51.0% (124)	49.0% (119)	
Others	3.9% (23)	78.3% (18)	21.7% (5)	
Head of Household				0.226
Yes	77.4% (463)	56.4% (261)	43.6% (202)	
No	22.6% (135)	62.2% (84)	37.8% (51)	
Schooling (years)				0.020
0–8	72.6% (434)	55.3% (240)	44.7% (194)	
9 and more	26.6% (159)	65.4% (104)	34.6% (55)	
Not informed	0.8% (5)	20.0% (1)	80.0% (4)	
Marital Status				0.064
Married	59.9% (358)	61.4% (220)	38.6% (138)	
Widowed/Single	28.2% (169)	53.2% (90)	46.8% (79)	
Divorced/Other	11.9% (71)	49.3% (35)	50.7% (36)	
Working for pay				0.488
Yes	19.6% (117)	62.4% (73)	37.6% (44)	
No	79.1% (473)	56.5% (267)	43.5% (206)	
Not informed	1.3% (8)	62.5% (5)	37.5% (3)	

Minimum Wage: Considered the minimum monthly income received at the time of interview 2018 = R$954.00 ($261.1)/2019 = R$998.00 (U$257.2). Chi-square test

Regarding the dimensions of social support (Table 2), it was observed that among all participants, the lowest mean score was obtained on the informational dimension (79.7 points) and the highest was observed on the affective dimension (92.1 points). Significant differences were observed in all dimensions considering the food insecurity status, except for the emotional dimension. Participants with food insecurity had the lowest score on the positive social interaction dimension (75.9 points) and those with food security had their lowest score on the informational dimension (81.5 points). Both groups obtained their highest scores on the affective dimension (93.8 and 89.7 points, respectively).

Table 3 presents the results of the regression models. In the univariate analyses, we observed an inverse association of all social support dimensions with food insecurity: the higher the score obtained, the lower the chances of the

Table 2. Social support characteristics of the sample stratified by food insecurity status.

	Total 100% (598)	**Food secure 57.7% (345)**	**Food insecure 42.3% (253)**	***P***
SS – Affective	92.1 (14.9)	93.8 (12.9)	89.7 (17.0)	0.002
SS – Emotional	82.4 (21.7)	84.1 (20.4)	80.0 (23.0)	0.051
SS – Material	84.6 (20.5)	86.8 (18.7)	81.6 (22.4)	0.003
SS – Positive social interaction	81.0 (23.1)	84.6 (19.8)	75.9 (26.1)	<0.001
SS – Informational	79.7 (23.2)	81.5 (22.1)	77.2 (24.4)	0.034

SS: Social support. Values are presented as mean (points) ± standard deviation. Mann–Whitney U test.

Table 3. Odds ratios for presence of food insecurity considering social support and sociodemographic factors.

	Crude OR[a]	**CI**	***P***	**Final adjusted model**		
				OR[b]	**CI**	***P***
SS – Positive social interaction	0.98	0.97 – 0.99	<0.001	0.98	0.97 – 0.99	0.002
SS – Material	0.98	0.97 – 0.99	0.002	0.99	0.98 – 1.00	0.140
SS – Emotional	0.99	0.98 – 0.99	0.022	1.00	0.99 – 1.02	0.326
SS – Affective	0.98	0.97 – 0.99	0.001	0.99	0.97 – 1.00	0.418
SS – Informational	0.99	0.98 – 0.99	0.025	1.00	0.99 – 1.01	0.523
Sex [ref. male]						
Female	1.45	1.01 – 2.08	0.041	-	-	-
Family monthly income [ref. >2 times of minimum wage]						
≤2 times of minimum wage	2.07	1.41 – 3.04	<0.001	2.01	1.35 – 2.98	0.001
Ethnicity [ref. Caucasians]						
African Americans	1.51	1.08 – 2.11	0.016	1.48	1.04 – 2.09	0.026
Others	0.43	0.15 – 1.20	0.110	0.39	0.13 – 1.13	0.084
Head of Household [ref. no]						
Yes	1.27	0.86 – 1.88	0.227	-	-	-
Schooling [ref. ≥9 years]						
0 – 8 years	1.52	1.04 – 2.22	0.022	-	-	-
Marital Status [ref. married]						
Widowed/single	1.39	0.96 – 2.02	0.075	-	-	-
Divorced/Other	1.63	0.98 – 2.73	0.058	-	-	-
Age group [ref. 60 – 69 years]						
70 – 79 years	0.90	0.64 – 1.27	0.562	-	-	-
80 and older	0.53	0.28 – 1.00	0.053	-	-	-
Working for pay [ref. no]						
Yes	0.78	0.51 – 1.18	0.245	-	-	-

SS: Social support; Minimum Wage: Considered the minimum monthly income received at the time of interview = 2018: R$954.00 ($261.1)/2019: R$998.00 (U$257.2). CI: Confidence interval. [a]crude OR derived from univariate logistic regression, [b]Derived from multiple logistic regression adjusting for all other variables in Table 1. For schooling and working for pay, the "not informed" category was suppressed from the model

individual presenting with food insecurity. Concerning sociodemographic covariates, older adults with <9 years of schooling ($P = 0.022$), women ($P = 0.041$), the African American ethnicity ($P = 0.016$), and individuals with low income ($P < 0.001$) were more likely to have food insecurity. In the adjusted model, only the positive social interaction dimension was significantly associated with the outcome ($P = 0.002$). Regarding sociodemographic covariates, only low-income (OR: 2.01; $P = 0.001$) and African American ethnicity (OR: 1.48; $P = 0.026$) were associated with food insecurity.

4. Discussion

In this study, we partially confirmed our initial hypothesis, showing that food insecurity was significantly associated with the positive social interaction domain of social support, and that this effect was independent of important indicators of social inequality, such as income and ethnicity.

The prevalence of food insecurity was different from that reported in the previous studies conducted among older adults in Brazil. Marín-León *et al*. (2005), for example, found a prevalence of 52% of food insecurity in families with older adults. Souza and Marin-Leon (2013),;however, found a prevalence of 21.8% in their study among older adults who attended popular restaurants. More recent data from a nationwide survey (2018/2019) showed that 27.3% of older Brazilians had some degree of food insecurity (IBGE, 2020). At the international level, the prevalence found in our study was much higher than that found in a study of older adults in the United States (7.8%) (Holben and Marshall, 2017) and Portugal (23%) (Fernandes, Rodrigues, Nunes, *et al.*, 2018) but similar to that found in China (45%) (Cheng, Rosenberg, Yu, *et al*., 2015).

These differences observed between our study and national and international counterparts show that both the period and the region in which the research was conducted have great importance in determining the prevalence of food insecurity, along with the type of questionnaire used in the research. Our study was conducted more recently than other Brazilian studies, and our instrument included an additional question that assessed mobility difficulties that could also influence food access, which could explain the higher prevalence in relation to national data. Only a few recent studies have analyzed the association between social support and food insecurity among older adults, especially considering all social support dimensions. Burris *et al*. (2019) in a study with older adults who utilized primary care services, found that lack of social support was strongly associated with food insecurity. Similarly, Wang and Bishop (2019) found that low emotional social support was associated with food insecurity among older adults.

Although almost all dimensions of social support were significantly associated with food insecurity in our study, only the positive social interaction sustained this association in our adjusted model. This association can be understood when we consider food as beyond merely something that nourishes the body, but also as complex, with a social impact and connection with issues such as cultural belonging, family relationships, pleasure when eating, and behavioral aspects (Oliveira and Santos, 2020). In this context, less positive social interaction may decrease the desire to eat, which can lead to food insecurity among older adults. This phenomenon was also observed by Interlenghi and Salles-Costa (2015) in a study conducted in Rio de Janeiro that evaluated the association between food insecurity and social support among adults between 18 and 60-years-old. The study showed that individuals with high scores in the positive social interaction dimension had lower chances of experiencing food insecurity. Another qualitative study that analyzed food choices and food access among low-income older adults pointed out that social interactions, especially with family and friends, can positively affect the eating behavior of older adults, increasing the consumption of healthier meals and decreasing the intake of quick meals, such as toasts and cereals (Oemichen and Smith, 2016).

The importance of social interactions for healthy aging among older adults has been highlighted by the Brazilian Ministry of Health. The Brazilian Dietary Guidelines encourage making meals in the company of family members or friends to make this moment more pleasurable, which gives a sense of belonging and integrity to older adults, stimulating food intake and reducing their food vulnerability (Brazil, 2021). Positive social interaction with others can also help older adults not only maintain adequate nutrition but also improve their subjective well-being, providing an emotional resource to deal with adverse situations, such as food insecurity (Farriol-Baroni, González-García, Luque-García, *et al*., 2021; Na, Miller, Ballard, *et al*., 2018; Sharifian and Grühn, 2019).

Another factor significant in our results is income, which is considered to be one of the main determinants related to access and availability of food. In our study, those with a family income equal to or less than two minimum wages were more likely to experience food insecurity. This finding is expected and is accordance with plenty of previous studies. Grammatikopoulou *et al.* (2019) observed similar results in older adults from communities in Greece. In their study, older adults without food insecurity had a medium income of 700 euros per month, which was higher than that of the group with food insecurity, which had a medium monthly income of 560 euros. Fernandes *et al.* (2018), in a study of older adults in Portugal, found that having a monthly income of 500 euros or less, reporting having financial difficulties, or reporting that it was very difficult to live with their current income, were associated with increased odds of living in a food-insecure

household. In the United States, data from the report *The State of Senior Hunger in 2020* showed that among the older adults who fell below the poverty line, 38.2% had food insecurity (Ziliak and Gundersen, 2022).

It is important to highlight that in Brazil, 70.6% of older adults contribute to the family income, of which 62.5% help the family through their retirement income, a fact of great relevance nowadays, since the premature death of older adults by COVID-19 would have a high impact on the income of several Brazilian families, increasing the number of families falling below the poverty line (Camarano, 2020).

In Brazil, to attenuate the situation of food insecurity, the government provides some social security programs such as cash transfer programs, family agriculture food acquisition programs, and popular restaurants (places that offer lunch and dinner at a low cost, but only in specific regions). However, despite benefiting older adults, none of these programs were designed considering their specific needs. As mentioned by Lima-Costa *et al.* (2022), Brazil has undergone a period of important cuts in social security and health program investments in the past 4 years, including the extinction of the National Council for Food and Nutrition Security (in Portuguese, Conselho Nacional de Segurança Alimentar e Nutricional – CONSEA), an important institution that fought against food insecurity in Brazil. The extinction of the council reduced the articulation of society within the federal, state, and municipal government spheres, diminishing actions and programs that help food insecure individuals and may have a greatly negative impact in the short-term (Ribeiro-Silva, Pereira, Campello, *et al*., 2020).

Another factor that presented a high association with food insecurity in our study was self-reported ethnicity, showing that African American individuals had a 48% higher chance of having food insecurity compared to Caucasian. The same was observed in another study in the United States, in which African American older adults have a food insecurity rate close to 4 times that of Caucasian individuals (Ziliak and Gundersen, 2022) and in Canada, in which older adults who declared themselves non-white had a higher chance of having food insecurity (OR: 2.49; $P < 0.001$) (Leroux, Morrison, and Rosenberg, 2018).

In our study, some other factors shown in the literature as being associated with food insecurity, such as level of education, marital status, sex, current work, marital status, and being the head of the household, did not maintain a significant association in the final regression model. This demonstrates the importance of performing this type of research in different locations and analyzing other aspects (e.g., social support) in addition to those already described to better understand the sociodemographic factors associated with food insecurity in aging.

Although our study presents great potential for analyzing a sample of community-dwelling older adults who attend primary health care units, and, to the best of our knowledge, it is the first study to analyze the association between social support and food insecurity among older adults in Brazil, we must consider some limitations. The cross-sectional design did not allow inferences of cause and effect between the study variables. In addition, this study was limited to only community-dwelling older adults, making it difficult to generalize the results to other populations. Another important limitation is that we included only individuals registered in the Family Health Strategy program, so caution should be taken when generalizing the results to all older adults.

5. Conclusions

Our results highlight the important association between food insecurity and markers of social inequality as well as social determinants in health, especially social support. Considering these, our study presents important contributions to the practice in primary health-care units because stimulating social interaction and support may be a low-cost intervention capable of reducing the chances of food insecurity among older adults. Finally, our results highlight the importance of screening for food insecurity among older adults to prevent potential health problems related to this parameter.

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Conflict of Interest

The authors declare that they have no conflict of interest.

Author's Contributions

C.N.F: Conceptualization, Investigation, Data Curation, Formal Analysis, Writing – Original Draft and Funding Acquisition. G.M.S and L.M.H: Investigation and Writing – Review and editing. F.S.A.B and T.R.P.B: Formal Analysis, Methodology and Writing – Review and editing. L.P.C: Conceptualization, Investigation, Methodology, Supervision, Funding Acquisition and, Writing – Review and editing. All authors read and approved the final manuscript.

Ethics Statement

This study was approved by the Research Ethics Committee of the Faculty of Medical Sciences – University of Campinas, under the protocol 95607018.8.0000.5404 following the Declaration of Helsinki.

Availability of Supporting Data

The datasets on which the conclusions of this manuscript rely on are not available publicly. The datasets used and/or analyzed during the current study are available from corresponding author, on reasonable request.

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RESEARCH ARTICLE

Family size preferences among women in a union in Nigeria and associated factors

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Abstract: Nigeria's population is currently estimated at 216million and the country will be the third most populous in the world in 2050. A major driver of the high population growth is persistent high fertility. This study examined women's fertility preferences, which was measured with ideal family size (IFS) and the associated factors. Data were obtained from the 2018 Nigeria Demographic and Health Survey. The analysis consisted of a weighted sample of 13, 673 women in union, aged 15–49 years whose first marriage took place within 10 years before the survey. Descriptive and multinomial logistic regression analyses were conducted. The proportion of respondents whose IFS was 5+ was 65%. Slightly above one-quarter had IFS of four children, and 11% had IFS of 0 – 3. IFS of 5+ was significantly associated with women resident in the Northern and Southeast regions, rural residents, Muslims, women who had no education, women working in agriculture, sales/service jobs, those who participated in one or two out of four household decisions, justified wife beating, have 5+ siblings, experienced child death, and married before age 20. Efforts to achieve the target reduction in total fertility rate in Nigeria should be multi-sectoral targeting these subpopulations of women.

Keywords: Fertility preferences; Ideal family size; Fertility; Women; Family size preferences

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1. Introduction

Globally, sub-Saharan Africa has the highest total fertility rate (TFR) of 4.6 in 2021(United Nations, Department of Economic and Social Affairs, Population Division, 2022). The decline in TFR in many sub-Saharan African countries has been either slow or stalled (United Nations, Department of Economic and Social Affairs, Population Division, 2022). For instance, the decline in Nigeria's TFR has been slow for many years. The country's TFR declined by 13.7% within 10 years from 7.3 in 1972 to 6.3 in 1982. The ensuing decade witnessed a decline of just 6%, from 6.3 in 1982 to 5.9 in 1992. During the following decade, the pace of decline reduced to 3% from 5.9 in 1992 to 5.7 in 2003 and slightly decreased by 4% from 5.7 in 2003 to 5.5 in 2013, and 5.3 in 2018 (National Population Commission (NPC) [Nigeria] and ICF, 2019; NPC and ICF International, 2014; NPC and ICF Macro, 2009; United Nations, Department of Economic and Social Affairs, Population Division, 2022). Of note also is that the decline in Nigeria's TFR continues to fall short of the numeric target of at least 0.6 reduction every 5 years as stipulated in the country's 1988 population policy, and the revised versions of 2004 (Federal Republic of Nigeria, 1988; 2004) and 2021 (Federal Government of Nigeria, 2021; Federal Republic of Nigeria, 1988; 2004). The rate of decline has consistently fallen short of the target with a decline of only 0.2 over 10 years from 2003 to 2013 and between 2013 and 2018. The failure to achieve this target and the targets of the other components of the policy has been attributed to structural issues, inadequate funding, and lack of political will, among others (National Population Commission of Nigeria and Health Policy Project, 2015).

Similarly, individual and couples' ideal family size (IFS) in Nigeria show no consistent pattern of decline and exceeds TFR consistently. Ideal number of children for all currently married women aged 15–49 years was 6.2 in 1990, 7.3 in 2003, 6.7 in 2008, 7.1 in 2013, and 6.6 in 2018 (National Population Commission (NPC) [Nigeria] and ICF, 2019; NPC and ICF International, 2014; and NPC, and ICF Macro, 2009). In contrast to the Nigerian situation, some sub-Saharan African countries, such as Ghana and Rwanda, have made better albeit slow progress in fertility decline. In Ghana, the mean ideal number of children among currently married women declined from 5.5 in 1988 to 4.7 in 2014, and TFR declined by 34.4% from 6.4 in 1988 to 4.2 in 2014, and 3.8 in 2019, 40.6% in slightly over three decades (ICF International, 2021). In Rwanda, IFS declined from 4.4 in 1992 to 3.7 in 2019, and TFR declined from 6.2 in 1992 to 4.1 in 2019, a 33.9% decline in nearly three decades, whereas Nigeria's TFR only declined by 11.7% within the same period (ICF International, 2021). The high IFS and TFR in Nigeria are indicative of a persistent pronatalist norm and highlight a demographic future that is of concern, given the slow pace of socioeconomic development in the country.

Nigeria's population is estimated at 216 million on January 1, 2022, and the country will be the fourth most populous in the world in 2050, next to India, China, and the United States (United Nations, Department of Economic and Social Affairs, Population Division, 2022). Although the country's gross domestic product (US$432.3 billion) is the largest in Africa (The World Bank, 2021), 82.9 million of her population are considered poor by national standards (National Bureau of Statistics (NBS), 2020) Among other factors, the high level of poverty is partly attributed to large and growing population, due to persistent high fertility (Adebowale, Fagbamigbe, Akinyemi, *et al*., 2020; Bongaarts, 2001; United Nations, Department of Economic and Social Affairs, Population Division, 2022).

Past studies attributed the slow and stalled trend in fertility in Nigeria to diverse factors, such as cultural and religious beliefs, high values about marriage and children, early marriage, low contraceptive prevalence rate, and high fertility desires (Alaba, Olubusoye, and Olaomi, 2017; Caldwell, Orubuloye, and Caldwell, 1992; Feyisetan and Bankole, 2009; Isiugo-Abanihe, 1994; Izugbara and Ezeh, 2010; Olaseinde, Owagbemi, Aruna, *et al*., 2022; Smith, 2005). However, there have been limited scholarly attempts to identify the drivers of women's IFS desire. IFS is indicative of actual fertility behavior. Studies conducted in sub-Saharan African countries indicate that women's reproductive preferences and decisions are constrained by culture (Dodoo, Horne, and Biney, 2014) and that men prefer more children than women (Bankole and Audam, 2011; Isiugo-Abanihe, 1994). However, women's fertility preferences in many situations are more predictive of actual fertility than men's desired family size.

In a recent systematic review of longitudinal studies in 28 low- and middle-income countries in Asia and Africa, women's desire to stop childbearing was a strong predictor of subsequent fertility compared to the modest influence of the man's desire (Cleland, Machiyama, and Casterline, 2020). Women are likely to use contraceptives when there is a disagreement between their desired number of children and their partners'. Evidence from Bankole and Audam's (2011) study showed that in seven of nine sub-Saharan African countries higher fertility preference by wives was inversely associated with the use of contraceptives, relative to husbands' higher preference. In Bangladesh, the risk of having another pregnancy for women who wanted additional children when their husbands did not want them was 2.20 times higher than when it was the husband alone who wanted a child, compared to the group where neither couple wanted another child (Gipson and Hindin, 2009). In an Australian study, Fan and Maitra (2011) found that wife's fertility preference was more predictive of subsequent births than the husband's. A similar finding in Nigeria showed that where wives desired more children than husbands, fertility preference implementation is higher (Ibisomi, 2011). These findings underscore the crucial importance of women's family size preferences in predicting actual fertility. Scholars have argued that although family size desire is not always achieved, it is predictive of actual fertility (Bongaarts, 2001; Kodzi, Jonsone, and Casterline, 2010). In a study by Mberu and Reed (2014) in Nigeria, the ideal number of children was positively associated with fertility behaviour. Declining reproductive preferences indicate changing values about childbearing and fertility transition (Bongaarts, 2001; Feyisetan and Bankole, 2009; Mberu and Reed, 2014). Therefore, family size preference is vital for projections of fertility behaviour, planning, implementation and assessment of family planning programmes, and for population policies. As Nigeria renews her commitment to pursue a 0.6 reduction every 5 years until 2030 with a target TRF of 4.7 by 2025, it is important to provide some information on the population groups to target.

There have been studies on fertility preferences in Nigeria, but most of them had a focus on couple's fertility preferences or desire for more children (Odusina, Ayotunde, Kunnuji, *et al*., 2020; Oyediran, 2006; Oyediran and Isiugo-Abanihe, 2002), men's fertility preferences (Isiugo-Abanihe, 1994), the influence of fertility preference on achieved fertility, fertility preference implementation, (Bankole, 1995; Ibisomi, 2011), IFS without segregating by sex (Amusa and Yahya, 2019), and IFS among all women who currently had children aged 0–60 months (Akeju, Owoeye, Ayeni, *et al*., 2021). The studies that also examined women's fertility preferences, such as Bankole (1995) and Umoh, Abah and Ekanem (2012) were either focused on couple's preferences or situated within a state in Nigeria. Furthermore, many of these studies

measured fertility preferences with a desire to have an additional child. Although the desire for an additional child is indicative of fertility preference, it is more of reproductive intention than family size preference (Bongaarts, 1992). The current research examined the family size preferences of women in a union, indicated by IFS and factors associated with their preferences. The results of this study contribute to the global discourse on sub-Saharan African fertility by examining factors influencing women's IFS. Furthermore, the study highlights changing values about childbearing and fertility preference transition in Nigeria. Bongaarts (2011) argues that persistent high fertility preference in sub-Saharan Africa is a strong factor that will keep TFR at a high level for some years to come even when the unmet need for contraceptives in the region is largely met.

IFS as an indicator of family size preference has two potential sources of bias – ex-post rationalization and non-response, but because its interpretation is straightforward it is still widely used as a standard indicator of lifetime fertility goal (Bongaarts and Casterline, 2015). Following Bongaarts and Casterline (2015), to overcome the bias that may arise from ex-post rationalization, the present study was limited to women whose first marriage took place within 10 years before the survey. Women whose marriages are of longer duration (more than 10 years) are likely to have completed childbearing or have had four or more children. To justify their number of living children, the reported IFS of such women is likely to be influenced by their current family size.

2. Data and Methods

2.1. Setting

This study was conducted in Nigeria. Administratively, Nigeria is made of up 36 States and the Federal Capital Territory, Abuja. The 37 States are further grouped into six geopolitical zones also called regions – Northcentral, Northeast, Northwest, Southeast, South-South, and Southwest. The Northern regions are predominantly Islam, whereas the South is predominantly Christian. The regions are culturally heterogeneous, with over 250 ethnic groups, and many Nigerian societies are largely patriarchal (Izugbara, 2004; Ntoimo and Isiugo-Abanihe, 2014). Men, and in some cases, the husband's extended family had the final say on family size (Isiugo-Abanihe, 1994; Izugbara, 2004). However, there has been improvement in factors that enhance women's control of their fertility behaviour. For instance, women's access to education and paid employment has continued to increase. The percentage of women who have no education declined from 42% in 2003 to 35% in 2018, and the proportion who are employed increased to 65% in 2018 from 59% in 2008 (National Population Commission (NPC) [Nigeria] and ICF, 2019).

2.2. Data source

Cross-sectional micro-level data were obtained from the 2018 Nigeria Demographic and Health Survey (NDHS). The DHS makes use of standardized questionnaires to obtain data on socioeconomic, demographic, and health characteristics from a nationally representative sample of women and men selected in households. The respondents were selected through a stratified multi-stage sampling technique. Data collection for the 2018 NDHS took place from August to December 2018 in 40,427 occupied households out of the 42,000 households in the sample. All women aged 15–49 who were either permanent residents or visitors who slept over the night before the survey in these households were eligible for interview. Men aged 15–59 in one-third of the 42,000 households were eligible to be included in the study. With a response rate of 99%, a total of 41,821 out of 42,121 eligible women, and 13,311 out of 13,422 men were successfully interviewed in the 40,427 occupied households (National Population Commission (NPC) [Nigeria] and ICF, 2019). The present study draws on data from the women's individual recode of the household survey. A weighted sample of 13,674 women aged 15–49 years who were in union (married or living together/cohabiting) at the time of the survey and whose first marriage took place within 10 years before the survey were selected for this study.

2.3. Dependent variable

The dependent variable was IFS, which was indicated by the ideal number of children in the DHS. Respondents who had living children were asked: "if you could go back to the time you did not have any children and could choose exactly the number of children to have in your whole life, how many would that be?" Those who had no living children were asked the number of children that they would have in their whole life-time if they could choose. The responses to these questions were both numeric and non-numeric. For descriptive and multivariable analyses, this variable was categorized into three: 0 – 3, 4, and 5+. The categorization into three was intended to highlight transitions in the desired number of children toward a lower fertility preference regime, preferences around Nigeria's recommended four children per woman (Federal

Government of Nigeria, 2021), and persistence of high fertility preference of five or more children. Non-numeric response (2.39%) was assigned the median value of 5 (IQR 4) as the IFS variable was not normally distributed. The median value after assigning it to the non-numeric response was similar to the median without the non-numeric response. Although Bongaarts (1992) argued that non-numeric responses are likely to be more than the population mean, it is anticipated that assigning the median value to such responses will not distort the result of this analysis given that the non-numeric responses were below 3%. Furthermore, in Dodoo and Seal (1994), non-numeric response in fertility preference was more likely among wives who are younger than their husbands by over 10 years, junior wives in a polygynous union, and those who have no or low levels of spousal communication on contraceptive use.

2.4. Independent variables

Drawing on past studies, socioeconomic and demographic characteristics of individual women were included as explanatory variables. Age was categorized in 5-year groups except age 35 – 49 which was recategorized into one group due to the few cases. A measure of place of residence was rural or urban. Region was measured based on the six regions in Nigeria: North-central, Northeast, Northwest, Southeast, South-south, and Southwest. The number of respondents' siblings was a measure of parents' family size, an indication of intergenerational transmission of family size preference. Other variables included in the analysis were age at first marriage, the number of co-wives, highest attained education, year of first cohabitation/marriage, occupation, participation in household decisions, religion, and experience of child death. Age at first marriage may indicate an inclination to a large or small family size (Mencarini and Tanturri, 2006). Furthermore, women who entered marriage late may be affected by their declining fecundity if they prefer fewer children or a desire to "catch up" if they prefer a large number of children (Mencarini and Tanturri, 2006; Upadhyay and Karasek, 2010). The number of co-wives (categorized into monogamy if one cowife, and polygyny for more than one co-wife) is associated with the desired number of children, due to co-wife competition for the number of children (Feyisetan and Bankole, 2009). The influence of education at all stages of fertility preference transition is shown in previous studies (Bongaarts, 2003; 2020), year of first cohabitation/marriage was included, because exposure to similar situations influences demographic and health behavior (Doctor, 2011). Women are likely to adopt the IFS prevailing among their peers and in their immediate communities at the time of marriage. The occupation of the respondents was categorised into five: not working, white-collar (those who worked in offices), sales/services, those engaged in agriculture as employers or employees, skilled and unskilled manual workers, and others.

Participation in the household decision and attitude to wife beating was included in the analysis as indications of gender ideology and norms. Participation in household decisions was derived from responses to four questions on the final say in household decisions on respondent's health, making large purchases, visits to respondent's family and relatives, and how to spend husband's income. In each question, lone decision by the respondent, a joint decision with the husband or partner, a sole decision by the husband, and a decision by others were the responses. The four questions were recoded. Participation alone or joint participation with a partner was regarded as participation in household decision and coded 1, whereas decision by the husband alone or others was regarded as participation in none and coded 0. The dummy recodes were used to generate an index of participation in household decisions categorized as participation in none, participation in 1 – 2, and participation in 3 – 4. Missing values in the participation in the household decision variable (0.24%) were dropped. Attitude to wife beating was measured with five questions on whether beating a wife is justified when she goes out without telling her husband/partner, neglects the children, argues with her husband/partner, refuses to have sex with her husband/partner, and burns the food. The response options were yes (justified), no (not justified), and do not know. The response to the five questions was recoded to generate a composite index of attitude toward wife beating. A response of no in all the five questions was categorized as not justified, a response of yes and do not know in 1 – 4 questions was categorized as somewhat justified, and yes in all the five was justified.

Religious affiliation was measured as Catholic, other Christian, and Islam; traditionalist and others were dropped, because they were few (0.46%). Experience of child death was a dummy variable; experience of child death was coded 1 and no child death 0. Child death influences reproductive preference (Upadhyay and Karasek, 2010). Added as controls were partner or husband's family size desire; past studies show that a partner's desired number of children influences women's IFS (DeRose, Dodoo, and Patil, 2002; Izugbara and Ezeh, 2010). Other controls were the partner's education and age and the number of living children which are related to fertility preference (Westoff, Bietsch, and Hong, 2013).

2.5. Analytic approach

All the variables were checked for multicollinearity, none of the variables had a variance inflation factor (VIF) of five and above, indicating that the multocollinearity is not a concern (Pallant, 2020). Description of the study population

was presented in weighted frequency and percentage. The distribution of the outcome variables by the independent variables was done using cross-tabulations, and a Chi-square test was conducted to establish an association. Given that the dependent variable was categorized into three, multinomial logistic regression was used for the multivariable analysis. The weighting factor provided in the DHS was used for the descriptive and multivariable analyses to adjust for representativeness. The svy command in Stata was used in both the cross-tabulation and regression analysis to adjust for the complex survey design of the DHS. All the analyses were two-tailed, the level of statistical significance was $P < 0.05$, and statistical analysis was conducted in Stata 13.0 for windows.

3. Results

3.1. Description of the study population

A description of the study population is presented in Table 1. The median ideal number of children in the study population was 6 (IQR 4). For over 65% of the respondents, five or more children was their ideal number of children. This is a 5.7% decline from 69.41% in 2008. The number of respondents whose IFS was 0 – 3 and four increased by 28.2% and 4.97%, respectively, from 2008 (Figure 1). The median age of the respondents was 25 (IQR 9), with the majority aged 20–29. Most of the women were in a legal monogamous union, married before age 20, and had an average of 2 living children. The majority (61.5%) had five or more siblings. The distribution of the respondents by their places of residence showed that 57% resided in rural areas, and over 50% of respondents were Muslims. A larger percentage of respondents (67%) were working, particularly in sales and services jobs, and slightly above 65% attained any level of education. Many respondents (35%) participated in no household decision, and about 71% did not see wife beating as justified for any reason.

3.2. Findings from bivariable analysis

The distribution of the three categories of ideal number of children by the potential explanatory variables is presented in Table 2. All the explanatory variables were significantly associated with IFS. The ideal number of children by birth cohort (age) showed that a larger proportion of younger women aged 15–29 desired 5+ children compared to their older counterparts aged 30–49. The ideal number of children for women who were living together with a partner was lower than for those in a legal union. There was a variation by region, 0 – 3 ideal number of children was more in the Southwest and South-south regions than other regions; IFS that corresponds with the country's recommended 4 is more in the southern regions than in the Northern regions. IFS for close to half of women in the urban area was <5 unlike those in the rural area. By religious affiliation, a larger percentage of Catholics and other Christians had IFS 0 – 3 and 4 in contrast with Muslims.

IFS declined with a higher household wealth index. Over 70% of women who were not working and those who had agricultural occupations had IFS of five and over. The majority of women in white-collar occupations had IFS of <5. Similar to the pattern in the household wealth index, IFS declined with a higher level of education. The majority of women who attained no education had IFS of five and over, whereas most of those who attained higher education had IFS <5. Close to 80% of women who participated in no household decisions had IFS of five and over in contrast with 47% for those who participated in 3–4 decisions. The majority of the respondents who justified wife beating for any reason also had large IFS of 5+. Respondents who have 7+ siblings were in the majority among those whose IFS was 5+. About 81% of women in the polygynous union had IFS 5+ compared to 61% of those in a monogamous union. Most of those who have experienced child death had IFS 5+. A larger proportion of the respondents who married before age 20 had IFS 5+ compared to 46% for those who married later. IFS seems to be decreasing with the younger marriage cohorts. Those who married between 2014 and 2018 had fewer IFS than their counterparts who married between 2008 and 2013.

3.3. Results from multivariable analysis

The results of the multinomial logit model predicting the relative risk ratio (RRR) of IFS by the potential independent variables are presented in Table 3. An IFS of five or more children was the base outcome. Hence, the estimated RRR reflects the effect of an independent variable on the likelihood of preferring 0–3 or 4 relative to 5 or more children, given other variables in the model are held constant. Compared to the North-central which was the reference category, the risk of preferring 0 – 3 instead of 5 was significantly lower in the Northeast and Northwest, but 1.49 and 4.22 times higher in the South-south and Southwest regions. The relative risk of IFS of 4 was also significantly lower in the Northeast and Northwest, and the Southeast regions, but higher in the Southwest (RRR 2.35 CI:1.88-2.94). Compared to urban residents, the relative risk of IFS of 0 – 3 and 4 children instead of 5 or more was significantly lower for rural residents.

Table 1. Percentage distribution of the study population by selected demographic and socioeconomic characteristics

Characteristic	Frequency (N=13,674)	Percent (%)
Ideal number of children		
0 – 3	1,551	11.34
4	3,171	23.19
5+	8,951	65.46
Median 6 (IQR 4)		
Age		
15 – 19	1,927	14.09
20 – 24	4,282	31.32
25 – 29	4,228	30.92
30 – 34	1,980	14.48
35 – 49	1,256	9.19
Median 25 (IQR 9)		
Marital status		
Married	13,070	95.58
Living together	604	4.42
Region		
North-central	2,038	14.90
Northeast	2,137	15.63
Northwest	4,155	30.39
Southeast	1,499	10.97
South-south	1,408	10.30
Southwest	2,436	17.81
Place of residence		
Urban	5,814	42.52
Rural	7,860	57.48
Religious affiliation (N=13,611)		
Catholic	1,339	9.84
Other Christian	4,616	33.91
Islam	7,656	56.25
Household wealth index		
Poorest	2,394	17.51
Poorer	2,786	20.37
Middle	2,634	19.26
Richer	2,763	20.21
Richest	3,097	22.65
Occupation		
Not working	4,508	32.97
White-collar	1,133	8.28
Sales/services	5,639	41.24
Agriculture	1,761	12.88
Skilled/unskilled manual/other	633	4.63
Highest education		
No education	4,894	35.79
Primary	1,696	12.40
Secondary	5,321	38.91
Higher	1,763	12.89
Participation in household decisions (N=13, 641)		
None	4,794	35.14
1 – 2 decisions	3,918	28.72
3 – 4 decisions	4,929	36.14
Wife beating justified		
Not justified	9,693	70.88
Somewhat justified	2,298	16.81
Justified	1,683	12.31

(Contd...)

Table 1. *(Continued)*

Characteristic	Frequency (N=13,674)	Percent (%)
Number of respondent's sibling		
0 – 2	1,714	12.54
3 – 4	3,537	25.87
5 – 6	4,145	30.31
7+	4,278	31.28
Number of co-wives		
Monogamous	10,838	79.26
Polygynous	2,836	20.74
Experience of child death		
No	11,480	83.96
Yes	2,194	16.04
Age at first marriage		
<20	7,693	56.26
20+	5,981	43.74
Year of marriage		
2008 – 2013	7,902	57.79
2014 – 2018	5,772	42.21
The frequency may not equal the N due to rounding		

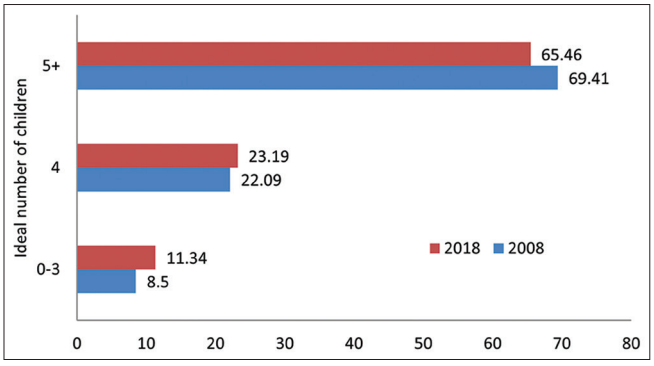

Figure 1. Percentage of women in union by ideal number of children 2008/2018 NDHS.

The respondents who were affiliated with Islam were less likely to have IFS of 0 – 3 (RRR 0.47 CI: 0.33 – 0.66) and 4 (RRR 0.45 CI: 0.34 – 0.59) relative to Catholics. Occupation only predicted the relative risk for IFS 0 – 3 with women in sales/services and agriculture significantly less likely to have IFS 0 – 3. The relative risk for 0 – 3 and 4 IFS was significantly more for women who had attained any level of education compared to those who had no education. IFS of 0 – 3 was significantly higher among women who had attained secondary and higher education; whereas IFS of 4 was 40% higher among women who attained primary education, 93% higher for those who had secondary education, and 130% higher for women who attained higher education. Participation in 1 – 2 decisions predicted a lower risk of 0 – 3 IFS (RRR 0.58 CI: 0.47 – 0.72), whereas participation in 3–4 decisions increased the risk of 4 IFS compared to 5 by 51%. Relative to the respondents who did not justify wife beating, the respondents who somewhat justified or justified wife beating were significantly less likely to have IFS of 4 compared to 5. Respondents who have 5 – 6 siblings were less likely to have IFS of 0 – 3 children. Experiencing child death significantly lowers the relative risk of IFS 0 – 3 and 4 compared to 5. The relative risk of IFS of 4 was 25% higher among respondents who married at age 20 and above compared to those who married before age 20. Respondents who married between 2014 and 2018 were 19% more likely to have IFS of 4 instead of 5 compared to those who married between 2008 and 2013.

4. Discussion

The objective of this study was to examine the family size preferences of women in a union, indicated by IFS and factors associated with their preferences. The proportion of respondents whose IFS was 5+ decreased by 5.7%, and IFS of 0 – 3

Table 2. Percent distribution of the outcome variable by the independent variables

Characteristic	Ideal number of children N (%)			Chi-square *P*-value
	0-3	4	5+	
Age				
15 – 19	120 (6.25)	224 (11.63)	1,582 (82.12)	<0.001
20 – 24	377 (8.79)	709 (16.55)	3,197 (74.65)	
25 – 29	468 (11.07)	1,088 (25.73)	2,672 (63.20)	
30 – 34	372 (18.79)	692 (34.96)	916 (46.25)	
35 – 49	214 (17.04)	458 (36.48)	584 (46.48)	
Marital status				
Married	1,412 (10.81)	2,965 (22.69)	8,692 (66.51)	<0.001
Living together	139 (22.96)	206 (34.18)	259 (42.86)	
Region				
North-central	168 (8.25)	547 (26.82)	1,323 (64.93)	<0.001
Northeast	104 (4.88)	128 (5.99)	1,905 (89.14)	
Northwest	222 (5.34)	274 (6.59)	3,660 (88.07)	
Southeast	106 (7.05)	557 (37.12)	837 (55.83)	
South-south	249 (17.67)	575 (40.86)	584 (41.47)	
Southwest	702 (28.83)	1,091 (44.8)	642 (26.37)	
Place of residence				<0.001
Urban	1,026 (17.64)	1,934 (33.27)	2,854 (49.08)	
Rural	525 (6.68)	1,237 (15.74)	6,098 (77.58)	
Religious affiliation				<0.001
Catholic	135 (10.05)	526 (39.32)	678 (50.63)	
Other Christian	850 (18.41)	1,747 (37.85)	2,019 (43.74)	
Islam	560 (7.31)	878 (11.46)	6,219 (81.23)	
Household wealth index				<0.001
Poorest	96 (4.01)	196 (8.18)	2,102 (87.80)	
Poorer	149 (5.34)	335 (12.03)	2,302 (82.64)	
Middle	206 (7.80)	541 (20.53)	1,888 (71.66)	
Richer	403 (14.59)	832 (30.10)	1,528 (55.31)	
Richest	698 (22.53)	1,268 (40.94)	1,131 (36.52)	
Occupation				<0.001
Not working	416 (9.22)	632 (14.01)	3,460 (76.76)	
White-collar	271 (23.90)	441 (38.97)	421 (37.13)	
Sales/services	673 (11.93)	1,510 (26.78)	3,456 (61.29	
Agriculture	74 (4.22)	396 (22.51)	1,290 (73.27)	
Skilled/unskilled manual/other	117 (18.52)	192 (30.34)	324 (51.13)	
Highest education				<0.001
No education	214 (4.37)	317 (6.48)	4,363 (89.15)	
Primary	132 (7.80)	338 (19.91)	1,226 (72.30)	
Secondary	748 (14.05)	1,803 (33.89)	2,770 (52.06)	
Higher	457 (25.95)	713 (40.47)	592 (33.59)	
Participation in household decisions				<0.001
None	425 (8.86)	539 (11.24)	3,830 (79.91)	
1 – 2 decisions	327 (8.33)	816 (20.83)	2,776 (70.84)	
3 – 4 decisions	794 (16.11)	1,806 (36.64)	2,329 (47.24)	
Wife beating justified				<0.001
Not justified	1,262 (13.02)	2,729 (28.15)	5,702 (58.82)	
Somewhat justified	187 (8.12)	311 (13.55)	1,800 (78.33)	
Justified	102 (6.06)	132 (7.82)	1,449 (86.12)	
Number of respondent's sibling				<0.001
0 – 2	280 (16.35)	473 (27.59)	961 (56.06)	
3 – 4	571 (16.14)	997 (28.18)	1,969 (55.68)	
5 – 6	445 (10.75)	1,052 (25.38)	2,647 (63.87)	
7+	254 (5.95)	650 (15.19)	3,373 (78.86)	

(Contd...)

Table 2. *(Continued)*

Characteristic	Ideal number of children N (%)			Chi-square *P*-value
	0-3	4	5+	
Number of co-wives				<0.001
Monogamous	1,329 (12.26)	2,851 (26.31)	6,657 (61.43)	
Polygynous	222 (7.83)	320 (11.29)	2,294 (80.89)	
Number of living children				<0.001
4 – 10	96 (6.59)	220 (15.03)	1,146 (78.39)	
0	246 (11.86)	392 (18.88)	1,437 (69.26)	
1	562 (14.43)	987 (25.32)	2,348 (60.26)	
2	433 (11.28)	1,057 (27.56)	2,346 (61.16)	
3	214 (8.90)	517 (21.48)	1,675 (69.62)	
Experience of child death				<0.001
No	1,398 (12.17)	2,843 (24.77)	7,239 (63.06)	
Yes	154 (7.00)	328 (14.96)	1,712 (78.04)	
Age at first marriage				<0.001
<20	506 (6.58)	1,013 (13.17)	6,173 (80.25)	
20+	1,045 (17.47)	2,158 (36.09)	2,778 (46.44)	
Year of marriage				<0.001
2008 – 2013	769 (9.73)	1,664 (21.06)	5,469 (69.21)	
2013 – 2018	782 (13.55)	1,507 (26.12)	3,482 (60.33)	

Table 3. Multinomial logistic regression of ideal number of children and selected characteristics of the study population

Variable	RRR (95% Confidence Interval)	
	0 – 3 versus 5	4 versus 5
Age		
15 – 19 (Ref)		
20 – 24	1.07 (0.78 – 1.48)	0.81 (0.65 – 1.00)
25 – 29	0.99 (0.67 – 1.47)	0.83 (0.63 – 1.08)
30 – 34	1.16 (0.73 – 1.83)	0.81 (0.59 – 1.13)
35 – 49	0.91 (0.54 – 1.51)	0.75 (0.51 – 1.12)
Marital status		
Married (Ref)		
Living together	1.28 (0.93 – 1.76)	0.94 (0.72 – 1.23)
Region		
North-central (Ref)		
Northeast	0.64 (0.45 – 0.90)*	0.28 (0.22 – 0.37)***
Northwest	0.71 (0.52 – 0.96)*	0.34 (0.26 – 0.45)***
Southeast	0.38 (0.26 – 0.54)***	0.65 (0.53 – 0.80)***
South-south	1.49 (1.09 – 2.03)*	1.15 (0.94 – 1.41)
Southwest	4.22 (3.24 – 5.48)***	2.35 (1.88 – 2.94)***
Place of residence		
Urban (Ref)		
Rural	0.70 (0.57 – 0.87)**	0.81 (0.70 – 0.95)*
Religious affiliation		
Catholic (Ref)		
Other Christian	0.97 (0.73 – 1.30)	0.83 (0.68 – 1.00)
Islam	0.47 (0.33 – 0.66)***	0.45 (0.34 – 0.59)***
Household wealth index		
Poorest (Ref)		
Poorer	1.04 (0.72 – 1.50)	0.98 (0.77 – 1.25)
Middle	1.04 (0.73 – 1.48)	1.04 (0.80 – 1.35)
Richer	1.24 (0.87 – 1.78)	1.07 (0.80 – 1.42)
Richest	1.45 (0.98 – 2.14)	1.26 (0.95 – 1.69)

(Contd...)

Table 3. *(Continued)*

Variable	RRR (95% Confidence Interval)	
	0 – 3 versus 5	**4 versus 5**
Occupation		
Not working (Ref)		
White-collar	0.86 (0.65 – 1.15)	0.91 (0.71 – 1.17)
Sales/services	0.75 (0.61 – 0.93)**	0.93 (0.80 – 1.09)
Agriculture	0.37 (0.26 – 0.51)***	0.87 (0.72 – 1.06)
Skilled/unskilled manual/other	1.17 (0.80 – 1.71)	1.01 (0.76 – 1.34)
Highest Education		
No education (Ref)		
Primary	1.15 (0.79 – 1.66)	1.40 (1.12 – 1.75)**
Secondary	1.64 (1.18 – 2.26)**	1.93 (1.53 – 2.45)***
Higher	2.86 (1.99 – 4.13)***	2.30 (1.66 – 3.19)***
Participation in household decisions		
None (Ref)		
1 – 2 decisions	0.58 (0.47 – 0.72)***	1.15 (0.98 – 1.36)
3 – 4 decisions	0.90 (0.73 – 1.12)	1.51 (1.24 – 1.84)***
Wife beating justified		
Not justified (Ref)		
Somewhat justified	1.14 (0.87 – 1.48)	0.68 (0.58 – 0.80)***
Justified	1.36 (0.95 – 1.93)	0.76 (0.59 – 0.98)*
Number of respondent's sibling		
0 – 2 (Ref)		
3 – 4	0.97 (0.77 – 1.22)	0.97 (0.79 – 1.18)
5 – 6	0.69 (0.52 – 0.92)*	0.88 (0.70 – 1.12)
7+	0.45 (0.34 – 0.60)***	0.69 (0.55 – 0.85)**
Number of co-wives		
Monogamous (Ref)		
Polygynous	1.11 (0.87 – 1.41)	0.87 (0.72 – 1.06)
Experience of child death		
No (Ref)		
Yes	0.74 (0.58 – 0.95)*	0.80 (0.67 – 0.95)*
Age at first marriage		
<20 (Ref)		
20+	1.18 (0.93 – 1.50)	1.25 (1.05 – 1.48)**
Year of marriage		
2008 – 2013 (Ref)		
2013 – 2018	1.17 (0.91 – 1.51)	1.19 (1.01 – 1.40)*

Base outcome 5 + children, RC: Reference category; RRR: Relative risk ratio. *$P < 0.05$, **$P < 0.01$, ***$P < 0.001$

increased by 28% between 2008 and 2018, indicating some transition in preferred family size. There was evidence of IFS lower than 5 among some sub-groups such as women in the South-south and Southwest regions, women who had attained any level of education, women who participated in decisions in the household, those who married at age 20 and above, and between 2014 and 2018.

The above findings point to issues that would require close programmatic and policy attention if Nigeria would achieve her population policy target for fertility. For instance, attainment of any level of education increased the likelihood of lower IFS. Women who have attained some education, particularly secondary education or more would be more likely to understand the health and economic value of small households and have life aspirations beyond the dual roles of wife and motherhood (Akeju, Owoeye, Ayeni, *et al*., 2021; Mohanty, Fink, Chauhan, *et al*., 2016; Testa, 2014). Educated women are also more likely than their illiterate counterparts to participate in household decisions, another predictor of lower IFS (Upadhyay, Gipson, Withers, *et al*., 2014; Upadhyay and Karasek, 2010). Although female enrolment in primary, secondary, and tertiary education in Nigeria has continued to improve relative to male enrolment (UNDP, 2014; 2020), there is the need to encourage women to attain at least secondary education to increase the proportion of women who desire smaller family size. Education, particularly university education, is inversely related to high fertility (Kumar,

Bordone, and Muttarak, 2016; Mencarini and Tanturri, 2006). Significant variation in IFS by region was observed in a similar study in Nigeria (Akeju, Owoeye, Ayeni, *et al*., 2021). The lower IFS in the South-south and Southwest regions could be associated with the higher number of women in the southern regions compared to the Northern regions who are educated and participate in household decisions (National Population Commission (NPC) [Nigeria] and ICF, 2019). However, of note is that the Southeast has more pervasive norms of son preference, and pockets of localities, where large family size was traditionally celebrated, this culture has continued to wane, but the TFR in Southeast region remains the highest (4.7) compared to 4.0 in the South-south and 3.9 in the Southwest (Isiugo-Abanihe and Nwokocha, 2008; National Population Commission (NPC) [Nigeria] and ICF, 2019; Nwokocha, 2007).

Women whose occupations were in sales/services and agriculture were significantly less likely to have IFS 0 – 3 versus 5 compared to women in other occupations. This is expected considering that 95% of Nigerian women work in the informal sector, where they dominate in sales and services (International Labour Organization, 2018; National Population Commission (NPC) [Nigeria] and ICF, 2019). Small-scale agriculture, sales, and services constitute a large part of the informal economy in Nigeria. Women who work in these occupations are more likely to have attained no formal education or primary education, which have low income, and perceive children as old age security. These factors have been shown to predicts high fertility preferences in Nigeria and other countries (Akeju, Owoeye, Ayeni, *et al*., 2021; Hilgeman and Butts, 2009; Mberu and Reed, 2014; Muhoza, Broekhuis, and Hooimeijer, 2014).

Being a Muslim was a strong predictor of IFS of five and above. Preference for larger family size among Muslim than Christian women in Nigeria is consistent with past studies in Nigeria and India (Murthi, 2002; Isiugo-Abanihe, 1994). However, the large family size preference among Muslim women may be more of a function of other factors, not the Islamic religion. Many Islamic countries have achieved sustained transition in fertility, and being a Muslim did not significantly predict larger family size in Ghana holding the husband's religion constant (Gyimah, Takyi, and Tenkorang, 2008). Polygyny and early marriage in the predominantly Muslim Northeast and Northwest regions in Nigeria may be the drivers of large family size desire among Muslim women. Early marriage was significantly associated with IFS of 5 and over in this study, and in many previous studies, polygyny and early marriage were strongly associated with large family size desire and lifetime fertility (Ariho and Kabagenyi, 2020; Izugbara and Ezeh, 2010; Yaya, Odusina, and Bishwajit, 2019). The Nigerian population policy for sustainable development also stipulates the age of 18 for marriage. There is a need to enforce this policy as well as discourage polygyny and serial remarriage by women in these regions.

Women who lost a child were more likely to report IFS five or more than women who never lost a child. This result demonstrates the strong link between child death and fertility and confirms the replacement fertility hypothesis (Westoff, Bietsch, and Hong, 2013). Given that women are likely to achieve their IFS (Fan and Maitra, 2011), where there is no supply constraint, the Nigerian Government needs to intensify its effort to implement strategies stipulated in the country's national population policy to lower under-5 mortality to achieve the target reduction in TFR. As mortality declines, particularly under-five mortality, one of the responses is a decline in fertility as people are now sure their children would survive to old age (Mohanty, Fink, and Chauhan, *et al*., 2016; Pullu, Shoumaker, and Becker, *et al*., 2013).

Another interesting finding in this study is the strong evidence of an intergenerational effect. The respondents who have five or more siblings also are more likely to have IFS of 5 and above. The previous studies have documented intergeneration transfer of fertility behavior (Booth and Kee, 2009; Kumar, Bordone, and Muttarak, 2016; Morosow and Trappe, 2018; Silalahi and Setyonaluri, 2018; Isiugo-Abanihe, 1994; Mencarini and Tanturri, 2006). This speaks to the impact of family-level socialization in shaping behavior, and the need to engage behavior change models in the country's programs to achieve a lower fertility preference regime.

Gender norms and ideology as indicated by participation in four household decisions and attitude to wife beating were predictive of IFS. Women who participated in no household decisions and justified wife beating for any reason were more likely to have IFS of five and above. This affirms the critical role of gender in fertility choices and health outcomes (Rossi and Rouanet, 2015; World Health Organization, 2021). A multi-sectoral approach to addressing norms that reinforce male dominance and superiority are recommended, and the existing policies in Nigeria on gender equality and equity should be enforced to facilitate lower IFS among women.

Marital status, household wealth index, and type of marriage were not statistically significant predictors of IFS among women aged 15–29. Given the close relationship between household wealth and education (although there was no multicollinearity problem between them in this study VIF <5), the result was not unexpected in a model that has the two variables. That women in a cohabiting union desired fewer children was expected. Although it was not statistically significant, previous studies link consensual/cohabiting unions with fewer children and low fertility desire than formalized marital unions (Hiekel and Castro-Martín, 2014; Laplante, Castro-Martin, and Cortina, *et al*., 2016). In a previous Nigerian study, women in polygynous unions in Northern Nigeria had many children to avert divorce and retain their husband's

favour (Izugbara and Ezeh, 2010). Thus, it was expected that women in a polygynous union would be significantly more likely to have IFS five and above, but the present study proved otherwise, confirming that the high fertility among them is contrary to their desired family size. We welcome more research to shed light on this theme.

This study has limitations. One, the data are cross-sectional, thus, the estimates are for a particular time, and causal inference cannot be made. A study that is based on a follow-up on the same respondents over time will provide more precise insight into IFS as it changes over time, and mitigate bias arising from post rationalization. Furthermore, a qualitative study will be useful to uncover some of the sociocultural and other reasons for large family size preferences in Nigeria. However, this study contributes to the existing body of literature on fertility preferences, many of the findings support past scientific research on family size preference. Furthermore, the findings elicited new insights on fertility preference among sub-populations of women in Nigeria, areas for further research, and useful information for policy and program.

5. Conclusions

The results of this study show that there are signs of transition to four children as recommended in Nigeria's population policy and to lower family size regime of 0 – 3 children among women of higher socioeconomic status, women with more positive gender ideology, residents in urban areas, and the South-south and Southwest regions. Given that women's IFS predicts realised fertility, there is a need to strengthen the factors that are associated with lower IFS and intervene in the population groups that have high IFS for Nigeria to achieve her fertility reduction target.

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Conflicts of Interest

The author declares no conflicts of interest.

Authors' Contributions

There is only one author for this work.

Ethics Statement

The secondary data used for this study were accessed with the permission of ICF Macro International. All identifiers were removed and ethical approval for the conduct of the surveys was granted by the National Ethics Committee in the Federal Ministry of Health, Abuja, Nigeria, and the Ethics Committee of the Opinion Research Corporation of Macro International Inc. Calverton, MB, USA.

Availability of Supporting Data

The supporting data for this manuscript is available on DHSprogram.com

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RESEARCH ARTICLE

Risk factors for cesarean section in women of urban Puducherry, India: A matched case–control study

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Abstract: Cesarean section (CS) is generally performed either to ensure maternal and child safety when vaginal delivery is not possible. The WHO has indicated that CS rates of more than 10% are considered overutilization. Increased CS rates can cause an increase in postpartum antibiotic treatment and longer hospital stay. In this research, we conducted a matched case–control study, including all women who gave birth through CS and resided in the study area over a 3-year period before the survey as cases and similar age- and year-matched women who had normal vaginal delivery during the same period as controls. The data were collected using a semi-structured pro forma through personal interviews and verified with discharge cards. We obtained a sample of 140 women (70 matched cases and controls) as study participants. Our results show that unadjusted analysis revealed socioeconomic status, history of gestational diabetes mellitus, previous lower segment CS (LSCS), and malpresentation emerged as risk factors, whereas in the adjusted analysis, we observed that previous LSCS (aOR 45.4 [4.3 – 483.6]), malpresentation (aOR 11.0 [1.6 – 73.8]), and belonging to middle (aOR 3.3 [1.0 – 10.8]) and upper class (aOR 23.55 [CI: 1.2 – 463.8]) remained as independent risk factors. Our study identified independent risk factors for CS that needs to be tackled for bringing down the CS rates.

Keywords: Antenatal care; Cesarean section; India; Matched case–control design; National Family Health Survey; Risk factors

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1. Introduction

Cesarean section (CS or C-section) is a surgical procedure performed either to ensure maternal and child safety when vaginal delivery is not possible (emergency CS) or as an elective procedure (planned CS). With advancement in anesthetic procedures and improved surgical techniques, the morbidity and mortality of CSs have reduced. The WHO considers the proportion of CS to the total births as one of the vital indicators of emergency obstetric care (Arjun, 2008). A CS rate higher than 10% is regarded as over utilization, that is, for other than life-saving reasons (Wehberg *et al*., 2018). Both developed and developing countries have reported about 27% CS in 2013 (Betran *et al*., 2021). Many developing countries such as China and Bangladesh have reported a tremendous increase in CS birth rates in the past two decades (Ahmmed *et al*., 2021; Li *et al*., 2020), thereby making it a serious public health issue (Lauer *et al*., 2010). Several studies conducted in different parts of the world have shouldered the above statement (Betran *et al*., 2007; Betran *et al*., 2016; Betran *et al*., 2021).

A WHO global survey has revealed that CS is associated with an increase in postpartum antibiotic treatment, greater complications in subsequent pregnancies, longer hospital

stay, and severe maternal-neonatal morbidity and mortality (Villar *et al*., 2006). Especially in neonates, this has led to increased risk of neonatal complications such as pulmonary hypertension, respiratory distress syndrome, and iatrogenic prematurity (Betran *et al*., 2021; Wehberg *et al*., 2018).

In India, there is no national guideline for decision-making among the clinicians in choosing CS. National Family Health Survey-4 states that the proportion of births delivered by CS in India is 17.2%, which is higher than the WHO recommendations (Panda *et al*., 2018). It is disquieting to note that these rates have doubled in the past decade (Srivastava *et al*., 2020). A study done among 30 teaching hospitals/medical colleges in South India, comparing the rates between 1993 – 1994 and 1998 – 1999, has shown that the overall CS rates have increased from 21.8% in 1993 – 1994 to 25.4% during 1998 – 1999. Alarmingly among them, primigravida constituted around 42.4%, and 31% were hailing from rural areas, which has right now reached 21% at the national level, with a considerable increase specifically in the private sectors (Kambo *et al*., 2002; Roy *et al*., 2021). One such important reason for peaking of these CS rates is the rise in primary CS followed by proportionate rise in repeat CS as well. Studies done in South India have also shown similar findings (Bhasker, 1994; Roy *et al*., 2021).

A cesarean without any indications could result in more harm than good, in fact a low-risk uncomplicated CS has an 8 times higher risk of mortality and 8 – 12-fold more risk of morbidity than spontaneous vaginal delivery (Boehm & Graves, 1994). Studies have proven that non-medical indications make up about 1/3rd of the global total 18.5 million CS cases performed annually (Begum *et al*., 2017; Festin *et al*., 2009).

Unnecessary cesareans may also result in catastrophic health expenditure at the family level and overburden the existing health finances at the national level (Lauer *et al*., 2010). Dismally, taking India's economic and human resource constraints into consideration, our health system is hardly equipped to handle such an unprecedented increase in CSs.

This drastic escalation of CS rates has warranted further research to monitor the indications and evaluate the factors influencing them. There is a paucity of research on clinical indications and factors influencing cesarean deliveries in India, which is essential for deeper understanding of various strategies to halt this epidemic of CSs. Prior attempts to determine the risk factors for CS were mostly cross-sectional in nature and were widely done across western settings. Thus, our study aimed to determine the various sociodemographic risk factors and antenatal complications that influenced cesarean deliveries among the mothers who delivered during the past 3 years in the selected wards of urban Puducherry, India.

2. Data and methods

2.1. Study design and study setting

Our study was conducted as a matched case control study in Jipmer Institute Urban Health Centre (JIUHC) service area, health center of a tertiary care institute in Puducherry, India. We adopted this novel study design as matched case–control studies, as this study design helps us not only to eliminate confounding but also to gain potential benefit in gaining efficiency when compared to conventional case–control studies. The health center caters a population of about 8000 comprising four wards, namely, Kurusukkupam, Vazhaikullam, Chinnayapuram, and Vaithikuppam, with around 2000 population each. The JIUHC (nearest health facility to all four wards ~ 1.2 km) provides comprehensive primary care services to the people, apart from being an urban health center for undergraduate and postgraduate teaching under JIPMER (Rajaa *et al*., 2019). All four wards share similar sociodemographic and cultural factors. The study was conducted during January and February 2018. A preliminary record review showed that on an average, around 80 – 90 deliveries are registered in the service area every year. For our study, we included all women who gave birth through CS and reside in our service area, during the past 3 years (January 2015 – December 2017) as cases and for controls, we enrolled age- and year-matched (for risk factor comparability) women who had normal vaginal delivery during January 2015 – December 2017.

2.2. Sample size

Sample size was calculated to be 45 matched pairs based on a study done by Wehberg *et al*. (2018) in Denmark taking the percentage of exposed (previous lower segment CS (LSCS) in cases as 36% and controls as 8% (normal delivery), power of 80%, alpha error of 5%, and 95% CI using nMaster 2.0 software). However, we included 70 matched pairs (140 in total, i.e., 70 women who delivered through CS and another 70 who delivered vaginally) as we considered all women who delivered through CS during the past 3 years of the study.

2.3. Data collection procedure

Three trained doctors were assigned to collect list of mothers who delivered in the past 3 years from the birth register (giving a total of 241 deliveries) and the total CS deliveries were jotted down. After a preliminarily data analysis, we could

get a total of 83 CS deliveries. We tried approaching all 83 women who delivered through CS, out of which we could reach 70 mothers. Out of the 83 women who had CS, three of them moved out of the service area and 10 were not reachable even through mobile. Thus, finally, we finally arrived at 70 cases, and we went on choosing eligible age- and year-matched controls in the ratio of 1:1. Thus, the study progressed with 70 matched pairs (cases and controls). The controls were then age matched for the cases by selecting them with a within an age difference range of ±2 years. The controls were also month-matched by choosing them of the same month of delivery as that of the cases.

After obtaining the list of cases and eligible controls, four trained doctors were chosen to do data collection. The data collectors were enrolled after familiarizing them regarding the questionnaire and objectives of the study. Data collection was done through regular house to house visits on a daily basis, data collection process was supervised and reviewed by the principal investigator posted in health center to ensure completion of data and to address the issues faced by the data collectors. If the households remained closed even after making two home visits, we tried contacting them through phone and if they were: Not traceable through phone, moved out of service area, and houses remaining locked after two visits were excluded from the study. The same excluding criteria were applicable for the controls too.

The importance of the study was explained to the women before administration of the questionnaire. They were enrolled only after obtaining informed consent and assured confidentiality. Interview had three sections: Sociodemographic characteristics; indications for cesarean; and last section had delivery details. Since delivery being a significant life event, the recall period of 3 years was chosen as the chances of remembering the details are highly possible. The indications for CS were asked from the mother and cross-verified with the discharge slip for all cases. The delivery details were obtained from the delivery card.

2.4. Data analysis

Data were entered into Microsoft Excel 2013 and analyzed using STATA 14 (Stata Corp., 2012). Continuous variables were summarized as mean (SD) or median (IQR) depending on their distribution. The sociodemographic risk factors were summarized as proportions. Association between CS and various risk factors and sociodemographic factors was analyzed using Chi-square test with 95% confidence intervals. $P < 0.05$ was taken to be statistically significant. Bivariable logistic regression was carried out for each variable and those variables whose odds ratios (OR) were significant at $P < 0.2$ were taken into the model for calculating adjusted odds ratio.

2.5. Ethical statement

The study was done as a component of MCH care services delivered in the urban health center toward obstetric care. Any queries arising from the participants were clarified after obtaining written consent. The study was reviewed and approved by the department review committee.

3. Results

There were totally 140 mothers included into the study (70 case and 70 age and period matched controls). Table 1 shows the sociodemographic characteristics of the study participants. The mean age ± standard deviation (SD) of the cases and controls were 29.4 ± 4.9 and 29.2 ± 4.5 years, respectively. Among 140 mothers interviewed, almost 50% of the cases and controls had education up to 10th standard. Majority 61 (87.1%) and 62 (88.5%) of the cases and controls were Hindu by religion. About 56 (80%) of the cases and controls 60 (85%) were housewives by occupation. More than 2/3rd of the study population in each group belonged to middle or upper class according to Modified BG Prasad classification (cases 78% and controls 66%) (Majhi & Bhatnagar, 2021). Both the groups had almost equal proportion of low birth weight (cases 48% and controls 52%). A higher proportion of the cases (31.4%; $n = 22$) had delivered in a private institution compared with controls (18.5%; $n = 13$).

Among sociodemographic factors, only socioeconomic status ($P = 0.04$) emerged as a significant risk factor for CS. Other factors such as education, occupation, and religion and birth weight of the baby of the baby did not show significant association.

The association of cases and controls with the various antenatal complications assessed in the study is represented in Table 2. In unadjusted analysis [Table 2], history of gestational diabetes (OR = 3.7; CI: 1.1 – 14.2), previous LSCS (OR = 29.5; CI: 3.8 – 227.4), and malpresentation during delivery (OR = 5; CI: 10 – 24.1) emerged as the three significant risk factors for CS in this study.

Table 3 shows the final multivariable analysis which includes variables whose OR had a significance level $P < 0.2$ in unadjusted bivariable analysis. In multivariable analysis, previous LSCS (aOR of 45.4, CI: 4.3 – 483.6), malpresentation

Table 1. Sociodemographic characteristics of cases and controls among selected wards in urban Puducherry, ***n***=140.

Study characteristic	Cases frequency, *n* (%)	Controls frequency, *n* (%)	*P*-value*
Years of education (in years)			
<10	36 (51.4)	35 (50)	0.97
11–12	11 (15.7)	12 (17.1)	
>12	23 (32.8)	23 (32.9)	
Religion			
Hindu	61 (87.1)	62 (88.5)	0.79
Others	9 (12.9)	8 (11.4)	
Occupation of mother			
Housewife	56 (80.0)	60 (85.7)	0.37
Working	14 (20.0)	10 (14.3)	
Occupation of father			
Unskilled	9 (12.9)	4 (5.7)	0.33
Semiskilled	42 (60.0)	47 (67.1)	
Skilled	19 (27.1)	19 (27.1)	
Socioeconomic status (Modified BG Prasad Scale) (Majhi *et al.*, 2021)			
Lower class	1 (1.4)	5 (7.1)	0.04†
Lower-middle class	14 (20.0)	19 (27.1)	
Middle class	15 (21.4)	21 (30.0)	
Upper-middle class	15 (21.4)	14 (20.0)	
Upper class	25 (35.7)	11 (15.7)	
Parity			
1	32 (45.7)	28 (40.0)	0.37
2	35 (50.0)	37 (52.9)	
3	3 (4.3)	5 (7.1)	
Institution of delivery			
Private	22 (31.4)	13 (18.5)	0.07
Government	48 (68.6)	57 (81.4)	
Birth weight			
Low birth weight (<2.5 kg)	10 (47.6)	11 (52.4)	0.81
Normal birth weight (>2.5 kg)	60 (50.4)	59 (49.6)	

*Chi-square test, †statistically significant

during delivery with (aOR of 11.02, CI: 1.6 – 73.8), and belonging to middle and upper class emerged as independent risk predictors with an aOR of 3.3 (CI: 1.0 – 10.8) and 23.55 (CI: 1.2 – 463.8), respectively, even after adjusting for all other factors which turned significant during unadjusted analysis.

4. Discussion

This was a community-based matched case–control study conducted among selected urban wards of Puducherry to assess the risk factors for CS and compared to vaginal delivery. The proportion of CS deliveries among all deliveries during the past 3 years was found to be 34.4%. This found to be in accordance with the CS rates in Puducherry according to NFHS-4 but almost twice that of the national average (Matkar, 2017; Srivastava *et al*., 2020). In our study, four factors, namely, middle and upper socioeconomic class, antenatal complications such as previous history of LSCS, and malpresentation during delivery were found to be the independent predictors of CS.

Table 2. Antenatal complications and its association with cases and controls among selected wards in urban Puducherry, ***n***=140.

Complications	Total, *n* (%)	Cases, *n* (%)	Controls, *n* (%)	Unadjusted odds ratio (95% CI)	*P*-value*
Gestational diabetes mellitus					
Yes	13 (9.3)	10 (14.3)	3 (4.3)	3.7 (1.1–14.2)	0.04†
No	127 (90.7)	60 (85.7)	67 (95.7)	1	
Gestational hypertension					
Yes	13 (9.3)	9 (12.9)	4 (5.7)	2.4 (0.7–8.3)	0.14
No	127 (90.7)	61 (87.1)	66 (94.3)	1	
Cardiovascular diseases					
Yes	3 (2.1)	2 (2.9)	1 (1.4)	2 (0.2–22.9)	1
No	137 (97.9)	68 (97.1)	69 (98.6)	1	
Previous LSCS‡					
Yes	22 (15.7)	21 (30)	1 (1.4)	29.5 (3.8–227.2)	<0.001†
No	118 (84.3)	49 (70)	69 (98.6)	1	
Elderly gravida					
Yes	6 (4.3)	5 (7.1)	1 (1.4)	5.3 (0.6–46.6)	0.2
No	134 (95.7)	65 (92.9)	69 (98.6)	1	
Anemia					
Yes	24 (17.1)	13 (18.6)	11 (5.7)	1.2 (0.5–2.9)	0.8
No	116 (82.1)	57 (81.4)	59 (84.3)	1	
Malpresentation					
Yes	11 (7.9)	9 (12.9)	2 (2.9)	5 (1.0–24.1)	0.02†
No	129 (92.1)	61 (87.1)	68 (97.1)	1	

*Binary logistic regression, †statistically significant, ‡lower segment cesarean section

Table 3. Multivariable logistic regression analysis for factors associated with the cases and controls among selected wards in urban Puducherry, ***n***=140.

Characteristics	Adjusted odds ratio (95% CI)	*P*-value
Gestational diabetes mellitus	3.3 (0.7–15.3)	0.16
Gestational hypertension	1.98 (0.4–9.3)	0.38
Previous LSCS	45.42 (4.3–483.6)	0.002*
Malpresentation	11.02 (1.6–73.8)	0.01*
Elderly gravida	6.3 (0.5–75.7)	0.15
Lower-middle class	1.36 (0.4–4.3)	0.59
Middle class	3.3 (1.0–10.8)	0.05*
Upper-middle class	2.2 (0.7–7.1)	0.18
Upper class	23.55 (1.2–463.8)	0.03*
Delivery in private hospital	1.81 (0.7–4.7)	0.22

*Statistically significant, †lower segment cesarean section

Our study showed that the socioeconomic status and delivery in a private institution had higher proportions of CS. A wide range of literature from different parts of the world has well established the relationship between the place of delivery and the risk of CS (Gibbons *et al*., 2010; Witt *et al*., 2015). The proportion of CS in a private sector was found to be almost 1.5 times more than the rate of vaginal deliveries (18.5% and 31.4%, respectively), though not statistically significant. This proportion was lesser than Puducherry data according to NFHS but quite similar to the national level figures (Matkar, 2017; Srivastava *et al*., 2020). We also found that higher socioeconomic status was a risk factor. Various studies done in Latin America,

China, and South India have also emphasized the above findings (Ming *et al*., 2019; Mohan *et al*., 2019). This reinforces the hypothesis that CS rates are highly influenced by income and health-seeking behavior of the wealthy people.

Our study described that gestational diabetes mellitus was a significant risk factor for CS, in unadjusted analysis. Similar study done in Indian context to understand the risk factors for CS have also established the same (Poobalan *et al*., 2009). Our study established that mothers who delivered through CS had 5 times more odds of having Malpresentation (breech/transverse lie, etc.,) as a risk factor. We also found that among the mothers who underwent CS had 30 times, more odds of having undergone a LSCS in their previous pregnancy. Similar findings were reported in a cohort study conducted in Denmark which reported serious and explosive risk associated with these risk factors and the type of delivery (Wehberg *et al*., 2018). These figures question the practice of trial of labor after CS (TOLAC) or vaginal birth after cesarean (VBAC) after previous LSCS. There is enough evidence around the world supporting trial of labor as a safe option for women following previous LSCS. Studies have showed that the success rates of TOLAC to be around 60-80% provided the candidates are appropriately selected (favorable bishop score and spontaneous onset of labor) (Soni *et al*., 2015). Thus, encouraging VBAC or TOLAC among women with favorable factors would enable the health systems to combat this epidemic of rising CS rates. However, an individualized approach is necessary assessing every woman taking the existing circumstances and facilities into consideration.

Our study in multivariable logistic regression analysis showed that previous LSCS, malpresentation, and belonging to middle and upper socioeconomic class emerged as independent risk factors for CS even after adjusting for all other variables in the model. This shows the importance of clinician's decision-making in determining the indication of CS among the pregnant women. It is very difficult to follow a protocol with a set of indications in determining CS as mostly these decisions are taken in an individualized approach, inside the labor room based on the intrapartum condition of the mother and the fetus.

Our study had several strengths. We employed a case–control design to find the risk factors associated with increased CS in an urban setting. We age and period matched the cases and controls to match the characteristics and risk factor profile of the study participants. Although we picked only 70 matched pairs, matching for age and period increased the power of the study. We collected the information through personal interviews from the mothers themselves. We verified the information obtained, through the discharge slips available with the mothers. Our study also adds to the existing literature for evidence-based decision-making in choosing CS as a mode of delivery. We used the same reference period for both cases and controls to reduce misclassification bias. To reduce interviewer bias, identical probes were used and effort was made to ensure approximately similar interview time for both cases and controls.

Our study also had certain limitations. Although we had a recall period of 3 years to reduce the recall bias, it was unavoidable. The assessment of risk factors could have been subjected to recall bias when the discharge slips were not available with the participants. Furthermore, we got a limited sample size of 70 matched cases and controls, the results are less likely robust, especially for some very large odds ratios, making our study lacked sufficient power to detect an association for known risk factors such as gestational hypertension, cardiovascular diseases, and elderly gravida. In addition, we have only utilized the variables that were readily available in the ANC cards, thus, we could have missed other significant associates of CS. Studies with larger sample size are clearly warranted to establish more reliable findings.

5. Conclusions

Our study showed that socioeconomic class, previous LSCS, and malpresentation were found to be independent risk factors for CS in urban Puducherry. We recommend a further review of the health-care delivery system, to halt the rise in CS rates in the nation. We also call for policymakers to formulate and set up national guidelines reviewing various indications for CS, thereby minimizing the rates of unnecessary CS.

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Conflict of interest

None declared.

Author contributions

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Ethics approval and consent to participate

The study was done as a component of MCH care services delivered in the urban health center toward obstetric care. Any queries arising from the participants were clarified after obtaining written consent. The study was reviewed and approved by the department research and ethics committee (approved ID batch: JIP/2018).

Consent for publication

Not applicable.

Availability of data

The authors confirm that the data supporting the findings of this study are available within the article, and if necessary, will be shared on reasonable request.

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RESEARCH ARTICLE

Factors associated with contraception and induced abortion among young women in Nepal

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Abstract: This study analyzed data from the 2016 Nepal Demographic and Health Survey (NDHS) supplemented by key indicators from several previous waves of NDHS to identify the sociodemographic profiles of women aged 15 – 24 who were using contraceptive methods and sought an abortion within 5 years before surveys. To augment the abortion analysis, field monitoring data of the Gorkha Safe Abortion (GSA) project were also used. Results from multivariable analyses show that women who ever gave a birth, who were from Province 1, who were economically well-off, and who knew the legal status of abortion, were more likely to practice contraception than their respective counterparts. Results, further, reveal that women practicing traditional methods of family planning were more likely to have an abortion than their counterparts not using any contraception. Women with two or more children ever born were more likely to have an abortion. Women from Karnali Province were most likely to have an abortion. Rich women were most likely to have an abortion than poor women. Regarding safe abortion, it is found that women living in the *Tarai* area were most likely to have a safe abortion than other geographic areas, due perhaps to family health services being more accessible in the *Tarai* area. Although the analyses found no relationship between age and abortions, perhaps due to small sample, the GSA project data clearly indicate that women under age 20, and those from Dalit community in particular, were more likely to seek an abortion than women aged 20 – 24. One lesson learned from the GSA project is that the pay-off for increasing access to safe abortion for hard-to-reach populations is high. To understand the complexity of sexual behaviors, contraceptive uses, and abortions among young women, more research using both qualitative and quantitative approaches are needed.

Keywords: Youth; Adolescent; Contraception; Abortion; Safe abortion; Reproductive health; COVID-19 pandemic; Nepal

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1. Introduction

Youth aged 15 – 24 make up 20% of Nepal's population (United Nations, 2022a). Youth have a high unmet need for contraception, and this has declined very little in the past 20 years in Nepal from 40% in 1996 (Pradhan *et al.*, 1997) to 33% in 2016 (MOH *et al.*, 2017). Globally, young women are more likely to access unsafe abortion due to stigma (Yokoe *et al.*, 2019). In developing countries, about 40% unsafe abortions occur among women under age 25 and about one in seven women who have unsafe abortions is under 20 (PRB, 2005; Shah & Ahman, 2012). Nepal is among the top countries with highest abortion rate (Singh *et al.*, 2018).

High and persistent unmet need for contraception among youth has important implications for reproductive health programming and planning. Youth who have unmet needs for modern contraception are likely to take recourse to traditional methods of contraception such as period or withdrawal methods and their effectiveness is very low. At the same time, as unsafe abortion is common among the youth, it is likely that if unmet

need for contraception is not addressed, increasing number of youths will end up in taking recourse to unsafe abortion. Unsafe abortion is a pressing public health concern and is a major contributing factor to high maternal mortality in Nepal (Thapa & Padhye, 2001). The government's aim of reducing maternal mortality ratio (MMR) to <70/100,000 live births by 2030 (NPC, 2017) will not be achieved when unsafe abortion persists among the youth population. As per the past 2016 survey, women aged 15 – 24 contribute 55% to age specific fertility (MOH *et al.*, 2017), and therefore, it is important to pay special attention to unmet need for contraception among the youth so that the maximum number of youths are prevented from practicing unsafe abortion. This motivates the present research.

Below in the remaining of this introduction section, some background information about contraceptive use and abortion in Nepal is briefed, followed by reviews on factors associated with contraceptive use and abortion, an introduction of the Gorkha Safe Abortion (GSA) project aiming to help young Nepali women to get safe abortion services, and the objectives of the present research. Subsequently, data sources and methods used for fulfilling the research goals in the data and method section are described, followed by the results, discussion, and conclusion sections.

1.1. Brief background on contraceptive use and abortion in Nepal

In Nepal, contraceptive use has increased markedly since 1996. The prevalence rate of using any contraceptive method among currently married women was 32% in 1996 (Pradhan *et al.*, 1997) and increased to 39% in 2001 (MOHP *et al.*, 2002), 50% in 2006 (MOHP *et al.*, 2007), and 53% in 2016 (MOH *et al.*, 2017). Along with the increase in the use of modern contraceptive methods, increase in the use of traditional methods is also seen in Nepal. In 2006, the proportion of currently married women using traditional methods comprising mainly withdrawal and rhythm methods was 4% (MOHP *et al.*, 2007), which increased to 7% in 2011 (MOHP *et al.*, 2012) and further to 10% by 2016 (MOH *et al.*, 2017).

However, any method can fail, and some are more dependable than others. Research has shown that the chance of an unexpected pregnancy is almost non-existent for couples who rely on sterilization and very low for users of IUD, injectables, or implants. It is moderate for pill and condom users and very high if couples rely on periodic abstinence, withdrawal, or spermicides (The Alan Guttmacher Institute, 1999). This means that increasingly more couples might end up with unwanted pregnancies and thus demand more abortion services. However, despite a steady increase in contraceptive use, the unmet need for family planning is still high in Nepal. For all women aged 15 – 49, the total unmet need for family planning was estimated at 18% for 2016, higher for limiting methods (12%) than for spacing methods (6%) (MOH *et al.*, 2017).

Abortion was legalized in Nepal in 2002 (MOH, 2004), and Safe Abortion Policy 2002 and Procedural Process developed and implemented since 2004 (MOH, 2005). The policy called for an expansion of quality comprehensive abortion care services in the country with appropriate numbers of trained and skilled service providers, adequate equipment, and essential drugs. Under this policy, safe abortion services were charged at Nepalese Rupees 1,000/- or US$10, which was out of reach for many women, especially in rural areas, but these services were made free of charge nationwide in 2016 (MOH, 2016).

Before 2002, abortions were totally illegal in Nepal. The Legal Code 1963 (*Muluki Ain*) of Nepal did not permit the termination of pregnancies even if they were the result of rape or incest or threatened the woman's life. In effect, it equated abortion with infanticide (Ministry of Law and Justice, 1963). Physicians and other medical practitioners were prohibited from recommending abortion or performing abortion without exceptions (Thapa, 2004). In this context, both women sought abortions and providers provided necessary abortion services clandestinely. Most of the abortions that took place were unsafe; only a very small proportion of women, mostly those living in urban or semi-urban areas and able to afford the cost, had access to trained medical practitioners and safe procedures (Thapa & Padhye, 2001).

As a result of the illegal and criminal status of abortion in Nepal before 2002, the conditions under which poor women obtained abortion services were often extremely unsafe. High unintended pregnancy makes women look for means to terminate it and in the absence of readily available safe abortion facility women who are likely to seek unsafe methods of abortion. This situation is likely to contribute to high maternal morbidity and mortality. Many are still dying during or shortly after pregnancy due to unsafe abortion (The Kathmandu Post, March 31, 2022). MMR in Nepal was estimated at 790 deaths/100,000 live births in 1990 (WHO, 2014). In a hospital-based study of abortion in Nepal pre-legalization, deaths from abortion-related complications accounted for over half of all maternal deaths (Thapa *et al.*, 1992). The recognition that illegal abortions were unsafe and contributed to Nepal's high maternal mortality was instrumental in the advocacy efforts to legalize abortion (Shakya *et al.*, 2004). Indeed, MMR had improved and gone down to 239 deaths/100,000 live births for several years before the 2016 survey (MOH *et al.*, 2017). However, MMR of 186/10000 live births still remains among the highest worldwide (WHO, 2022), and unintended pregnancy was around 19% in 2016 (MOH *et al.*, 2017).

Under the current law, pregnancy can be terminated up to 12 weeks for any reason and up to 18 weeks for pregnancy resulting from rape or incest with the pregnant woman's consent. Recently, a provision has also been made to allow pregnancy termination as late as 28 weeks (The Kathmandu Post, 03 July, 2019), but this has not been operationalized (The Kathmandu Post, 27 August, 2019). However, the legalization of abortion does not seem to have much impact; the proportion of women aged 15 – 49 who are aware that abortion is legal in Nepal increased by only 3% points from 38% in 2011 (MOHP, 2012) to 41% in 2016 (MOH, *et al.*, 2017). According to the Nepal Demographic and Health Survey (NDHS) 2016, this knowledge is lower among older women aged 40 – 49 (34%), women living in rural areas (36%), women with primary (33%) or no education (28%), and poor (38%) and very poor (30%) women (MOH, *et al.*, 2017). By caste/ethnic groups, this knowledge is highest among the highest ranked group, namely, *Chhetri/Bahun* (48%), followed by the second highest ranked group, that is, *Janajati* ethnic group (40%) and the lowest ranked group – the *Dalit* (34%). After Nepal became a federal state in 2015, health care has been devolved to each province. Although safe abortion is free and legal, 50% of abortions accessed by young women in 2016 were "unsafe," that is, performed at unauthorized facilities (MOH *et al.*, 2017). The worrisome situation is that unsafe abortion is reported to be on the rise in the country due to lockdowns during the COVID-19 pandemic (Gorkhapatra, October 07, 2020).

Gender-biased sex selection (GBSS) in favor of boys is a symptom of pervasive social, cultural, political, and economic injustices against girls and women. GBSS can be measured using sex ratio at birth (SRB), a comparison of the number of boys born versus the number of girls born in a given period. According to the WHO, 2011, when many more boys are born than girls, it is a sign that sex selection is taking place (WHO, 2011). In Nepal, high son preference (Brunson, 2010) and prevailing discrimination against girls are factors contributable to sex selection (Nanda *et al.*, 2012). Although sex selective abortion is strictly prohibited by law and punishable, it is also possible that people may take advantage of liberal abortion to fulfill their wishes. In addition, the situation of stagnant contraceptive prevalence but declining fertility in the past 10 years may indicate that women are using abortion as a family planning method (Gorkhapatra, August 3, 2019).

Despite the legalization of abortion and the expansion of maternal health services, such as increased access to safe motherhood services including abortion services, it appears that the sexual and reproductive health needs of women are not being met. Furthermore, the existing accredited health facilities are not functioning well due to the lack of sufficient quantity of drugs and equipment, the frequent transfer of trained abortion service providers, and weak abortion related infrastructure development stand as a serious barrier to women seeking abortion services (Wan-Ju *et al.*, 2017). Nevertheless, Nepal is committed to Sustainable Development Goal 3 of achieving an MMR of 70 by 2030 (NPC, 2017), which calls for more focus on reproductive health and rights including safe abortion.

1.2. Factors associated with contraception and abortion

Numerous studies have examined factors associated with the prevalence of contraceptive use and the prevalence of abortion among young women (Bayer *et al.*, 2011; Munakampe *et al.*, 2018). Studies have revealed that lack of or limited knowledge, lack of sexuality education and limited access to services, high risk of misperceptions, and harmful social norms surrounding premarital sexual activity and pregnancy could be major barriers to use contraception and abortion services (Campbell *et al.* 2006; Siziya *et al.* 2008). These obstacles apply equally to adolescents and young people of Nepal (Thapa *et al.*, 2001). While several efforts have been made to understand young people's knowledge, attitudes and practices regarding contraception and safe abortion, systematic research on this matter, and related contexts remain limited. Increase in couple's knowledge that they can plan their family size leads them to search for contraceptive methods.

The relationship between contraceptive use and induced abortion is complex due to interactions of several interrelated factors that range from social, cultural, and economic, from how ideal family size is determined, and from the demand for contraception and abortion, to another set of variables related to the quality of reproductive health services (Phiri *et al*., 2022; Senlet *et al.*, 2001). Modern contraceptives are considered the safest methods to help couples realize better family planning. Despite the availability of various contraceptive methods, communities in both the developed and developing countries continue to register high rates of unintended and unwanted pregnancies which contribute to a higher prevalence of abortions (Haub & Kaneda, 2014).

An analysis of data of women aged 15 – 49 from 2011 Nepal Demographic and Health Survey found that women of older ages (35 years and above) were less likely to undergo both abortion and unsafe abortion. Educated women were more likely to undergo an abortion along with those who had no knowledge of legal abortion. Being rich was protective against unsafe abortion. Child spacing was the most common reason for abortion (Yogi *et al.*, 2018).

The above brief review of contraceptive use and abortion among women aged 15 – 49 shows that, although increases in contraceptive use ultimately led to decreases in induced abortion rates, trends have been following different paths

in individual country settings. Abortion rates and contraceptive practice often rise simultaneously because they are affected by the same underlying social and demographic factors (Noble & Potts, 1996). Similarly, women who practice contraception are often those who are more likely than others to undergo abortions, again due to bidirectional causality. In these situations, increases in contraceptive use may reduce reliance on abortion by keeping abortion rates stable or by preventing an even more rapid increase in abortion rates.

1.3. Objectives of the present study

Research studies on abortion in Nepal are very limited. NDHS is carried out every 5 years and the survey started including abortion section since 2011 which provide basic quantitative indicators. Data on abortion incidence in Nepal are hardly available except for one study by Puri *et al.* (2016) that show 42/1000 women of reproductive ages 15 – 49 in 2014 based on Nepal's National Health Facilities Survey and Health Professionals Survey. Another important limitation in the existing literature is the paucity of research on how women accessed family planning services during the crisis. This is extremely important and closely relevant given the current situation of the ongoing COVID-19 pandemic. A recent estimate shows the contraceptive prevalence rate in Nepal among currently married women declined from 53% in 2016 (MOH *et al.*, 2017) to 33% in 2020 due to disturbance in supply of contraceptives (Global Financing Facility-GFF: https://www.globalfinancingfacility.org/CoVid19/).

Although no studies on the theme were available by far, it is fortunate that Nepal implemented the GSA project during mid-2018 to June 2020 (including the first period of the COVID-19 pandemic, April-June 2020) in three *palika* (subdistrict) in Gorkha district that aims to empower women to access safe abortion services (see Map of Gorkha in Figure A1). The data collected in this GSA project enable researchers to investigate how family planning services were delivered to the most vulnerable populations in the area. Research using such data would have added value to the existing literature and have important policy implications on how to improve family planning services on the general as well as in crises, such as in this ongoing pandemic.

Based on the above reviews and consideration, this paper is written with three objectives in mind to fill the research gap. First, using national data from NDHS of different years, it attempts to show different family planning practices by sociodemographic characteristics of adolescents and youth. Second, it examines factors associated with abortion and safe abortion, and third, using the *Gorkha* project monitoring data on abortion, it investigates how increasing access to functioning safe abortion services could pay off even in difficult times such as in the COVID-19 pandemic lockdown periods.

2. Data and methods

2.1. Data sources

For national level data analysis on family planning and abortion, nationally representative sample survey data from the Nepal Demographic and Health Survey (NDHS) 2016 (MOH *et al.*, 2017) were the main source, but for comparison purposes, NDHS data from 1996 (Pradhan *et al.*, 1997), 2001 (MOHP *et al.*, 2002), 2006 (MOHP *et al.*, 2007), and 2011 (MOHP *et al.*, 2012) were also used. In all, 12,862 women of reproductive age 15 – 49 were interviewed in 2016 and the corresponding figures were 12,674 in 2011 and 10,793 in 2006. Interviews were conducted with only ever-married women in 2001 and 1996 and the numbers of women interviewed were 8,429 in 2001 and 8,726 in 1996, respectively. However, only the NDHS 2016 collected information about the residence of province because when the earlier surveys were conducted that the country was not divided into federal provinces. There are seven provinces in Nepal (Province No.1, *Madhesh* Province, *Bagmati* Province, *Gandaki* Province, *Lumbini* Province, *Karnali* Province, and *Sudurpashchim* Province; see Appendix). Therefore, for analyses of relationships between contraception, abortion, and sociodemographic variables, only the NDHS 2016 data were used with 4,568 women aged 15 – 24.

NDHSs deal with a number of topics, including but not limited to fertility, family planning, infant and child health and mortality, maternal health, and HIV/AIDS-related knowledge and behaviors and mass media exposure. Only NDHS reports of 2011 and 2016 contain separate section on abortion although induced abortion rate as a component of pregnancy outcomes is reported in all NDHS reports. Some details about sampling designs, field work, and data quality of NDHSs can be found at https://dhsprogram.com

In addition to five national NDHS datasets, regularly collected abortion monitoring data from the project *Empowering women to access safe abortion services in Gorkha* implemented in three *palika* (subdistrict) in Gorkha district of Nepal (see Map in Figure A1) during mid-2018 to June 2020 (including the first few months of the COVID-19 pandemic, April-June 2020) are also used to augment the analysis.

The Gorkha project was funded by the Safe Abortion Action Fund (SAAF) and the International Planned Parenthood Federation (IPPF) (London) and was implemented by the Population, Health, and Development Group (PHD Group – a local NGO). The objectives of the project were to empower women and girls to realize their rights to sexual and reproductive health and for them to be informed and able to access contraception and safe abortion when needed.

Gorkha District was the epicenter of the 2015 devastating earthquake (NPC, 2015); nearly every house was hit by the tremor. People suffered and women and girls were impacted the most as a large number of women and girls who engaged in income-generating activities from their homes, incurred additional losses of home-based economic resources, and assets essential for their livelihood and well-being (NPC, 2015). The 21,000 women of reproductive age (WRA) in the three *palika* of Gorkha District were the project's main target group. In addition, about 2,000 boys of average age 16.2 years and 2,100 girls of average age 16 years in grades 9 to 12 in the project areas also benefited from basic sexuality education. This paper examines the association between sociodemographic characteristics (including caste/ethnicity) and access to safe abortion in young women aged 15 – 24, both nationwide and in the project area.

2.2. Measurements

2.2.1. Dependent variables

This study has three dependent variables that are all dichotomous variables. One dependent variable is whether a participant was using any of contraception at the time of survey; the second is whether a participant had an abortion within 5 years preceding the survey, and the third whether such an abortion is a safe abortion. Any respondent using any of the birth control methods, such as Pill, Intra Uterine Device (IUD), injections (popularly known as Depo Provera), male condom, female sterilization, male sterilization, periodic abstinence or rhythm method, withdrawal, and implants/Norplant, is categorized as currently using a contraceptive method. A respondent was classified as having had an abortion if she obtained such abortion at a government accredited medical facility or at any other health facility, although as a rule, only government accredited health facilities can provide abortion services. In principle, a government facility that has not been accredited for safe abortion service by the Ministry of Health and Population cannot perform any abortion service. Any health facility that is private or non-governmental that has been accredited by the government can provide safe abortion services. In practice, however, NGO or private health facilities not accredited by the government also provide abortion services, but such abortions are regarded as "unsafe." Women performing abortion at home using modern drugs such as Mifepristone and Misoprostol bought from a pharmacy and abortions performed using crude methods are all regraded as "unsafe."

2.2.2. Explanatory variables

Having reviewed the literature earlier on reproductive health including contraception and abortion in the context of Nepal and elsewhere, a number of factors have been identified that are associated with women's access to contraception and abortion. These variables are grouped within three categories: demographic characteristics (age, marital status, caste/ethnic groups, and number of children ever born), socioeconomic characteristics (residence, ecological region, province, wealth index, and education), and knowledge (knowledge of legal status of abortion). For abortion models, the type of contraception (modern methods or traditional methods) currently used is also included as an independent variable. The traditional methods used by young women in 2016 included rhythm and withdrawal methods (MOH *et al.*, 2017). Therefore, ten independent variables were used for contraception models and 11 independent variables for abortion models.

Education is referred to as responsible for turning knowledge into practice (Martin & Juarez, 1995). The household wealth index is a composite measure of the cumulative living standard of a household (including assets such as the type of material used for flooring, water, and sanitation facilities and the possession of televisions). The methodology for construction of the index, based on the principal component analysis, is described in detail elsewhere (Rutstein & Johnson, 2004). The variable was classified into five categories using quintile (poorest, poor, middle, rich, and richest).

Demographic variables included respondent's age (15 – 19 years and 20 – 24 years), marital status, and caste/ethnic groups categorized as *Chhetri/Bahun*, *Janajati*, *Tarai*, and *Dalit*. In the 2011 census about 81% of the Nepalese reported their religion as Hindu and thus locating themselves within the caste system (CBS, 2012). In caste hierarchy, *Chhetri/Bahun* are ranked the highest followed by *Tarai* (those aboriginally living in the *Tarai* area excluding *Dalit*), *Janajati*, and *Dalit* – the lowest ranked group (Bennet *et al.*, 2008). Socioeconomic variables included urban-rural residence (urban vs. rural), ecological region (Mountain, Hill, and *Tarai* area), residence of province (seven provinces), wealth index (poorest,

poorer, middle, richer, and richest), and educational attainment (no education, primary school, secondary school, and school leaving certificate or higher).

2.3. Analytical strategies

To obtain the profile of young women who were practicing contraception and those who obtained an abortion service in the past 5 years preceding the survey of 2016, basic statistical techniques such as frequencies, cross tabulations, and Chi-squire tests were conducted. In this paper, multivariable logistic regression analyses were employed using SPSS v.21 to cross-check the results regarding who practiced contraception who obtained abortion and examined who opted for safe abortion. In addition, bivariate analyses and Chi-square tests were also conducted using project monitoring data on women 15 – 24 only. These young women obtained safe abortion services during the stringent lockdown of COVID-19 pandemic period January – June 2020 and during the 1-year period just before the lockdown.

3. Results

3.1. Sample description and odds ratios of use of contraception

Nationwide, contraceptive prevalence rate among married young women steadily increased from a mere 10% in 1996 to 17% in 2001 and further to 23% in 2011 (Figure 1). However, the proportion of young women using contraception stagnated at 21% between 2011 and 2016. Among the adolescents aged 15 – 19, the contraceptive use was much lower than their youth counterparts, exhibiting an increasing gap of about 10% points since 2001 between the two groups.

Table 1 presents the descriptive analysis of the young women aged 15 – 24 who were currently using contraceptive methods at the time of the survey in 2016 and also presents chi-squire tests of the significance of the association between the various background characteristics and the use of contraception. In 2016, the sample of young women aged 15 – 24 was 568 (Muslim women not included in the analysis). Of these 4,568 women, 15.1% were currently using any method of contraception, while the corresponding figure for all women aged 15 – 49 was 40.8% (MOH *et al.*, 2017).

Among the demographic variables, as shown in Table 1, age was significantly associated with the use of contraception, with more older women (24.9%) practicing contraception compared to their younger counterparts (6.4%). The prevalence of contraceptive use among married young women was 30% and it was virtually non-existent among currently not married. Among the four broad caste/ethnic groups of women, the highest proportion of women practicing contraception was seen among *Janajati* women (17.7%) in comparison with the lowest proportion among *Dalit* women (12.8%). Equal proportions (13.6% each) of women of the *Tarai* caste and the *Chhetri/Bahun* caste practiced contraception. Contraceptive use significantly increased with increasing number of children ever born: only 3.9% women practiced contraception without having any children ever born in comparison with the corresponding figures 34.8% for women with one child and 40.8% for women with two or more children.

The association between contraceptive use and socioeconomic variables was found significant for provinces and education. Among the seven provinces, the highest proportion (19.3%) of young women in Province 1 practiced contraception followed by *Gandaki* (15.9%), *Karnali* (15.7%) provinces, and so on while the contraceptive use was the lowest in *Madhesh* province (11.9%). Urban-rural residence, ecological region, and the wealth index were not significantly associated with contraceptive use (Table 1). Knowledge of the legal status of abortion was not significantly associated

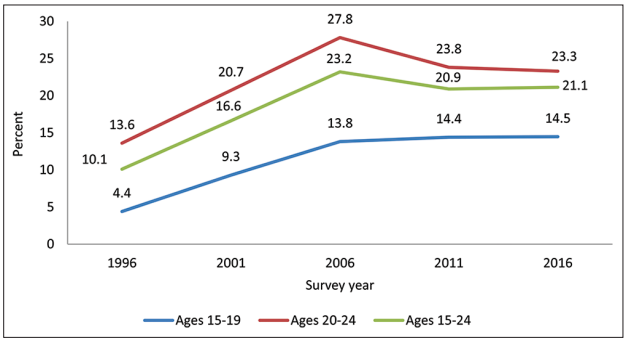

Figure 1. Prevalence of modern contraceptive use among currently married adolescents and young women by age, Nepal DHS 1996-2016. Source: MOH *et al.* (2017), MOHP *et al.* (2002); MOHP *et al.* (2007); MOHP *et al.* (2012), and Pradhan *et al.* (1997)

Table 1. Percentage distribution of women aged 15 – 24 by contraceptive method currently used by study variable, Nepal, 2016

Characteristics	N	Not using contraception	Using contraception	Chi square test "*P*"
Total	4,568	84.9	15.1	
Demographic characteristics				
Age				***
15 – 19	2,429	93.6	6.4	
20 – 24	2,139	75.1	24.9	
Marital status				***
Currently married	2,237	69.4	30.6	
Currently not married[a]	2,331	99.9	0.1	
Caste/ethnic group				***
Chhetri/Bahun	1,350	86.4	13.6	
Janajati	1,755	82.3	17.7	
Tarai	823	86.4	13.6	
Dalit	641	87.2	12.8	
Number of children ever born				***
None	3,012	96.1	3.9	
One child	1,027	65.2	34.8	
Two or more	530	59.2	40.8	
Socioeconomic characteristics				
Residence				
Rural	1,722	84.4	15.6	
Urban	2,846	85.2	14.8	
Ecological region				
Mountain	306	83.7	16.3	
Hill	2,041	84.3	15.7	
Tarai area	2,221	85.7	14.3	
Province				**
Province 1	748	80.7	19.3	
Madhesh	855	88.1	11.9	
Bagmati	953	86.1	13.9	
Gandaki	458	84.1	15.9	
Lumbini	823	84.7	15.3	
Karnali	293	84.3	15.7	
Sudurpaschim	438	85.2	14.8	
Wealth index				
Poorest	843	85.8	14.2	
Poor	969	83.9	16.1	
Middle	907	85.0	15.0	
Rich	1,015	85.0	15.0	
Richest	835	85.1	14.9	
Education				***
No education	378	79.4	20.6	
Primary	595	80.0	20.0	
Some secondary	1,907	84.9	15.1	
SLC or Higher	1,688	88.0	12.0	
Knowledge				
Knowledge of legal status of abortion				
Yes	2,574	85.0	15.0	
No	1,994	84.9	15.1	

All estimates were weighted. Per cents may not sum to 100 due to rounding. *$P \leq 0.05$; **$P \leq 0.01$; ***$P \leq 0.001$. [a]Currently not married also includes 6 women aged 15 – 19 and 14 women aged 20 – 24 formerly in union. SLC: School leaving certificate.

with contraceptive use either. Table 1 shows that higher contraceptive use among less educated women compared to their educated counterparts, although it was not statistically significant.

Table 2 presents the odds ratios of practicing contraception among young women from multivariable logistic regression models. The results regarding the demographic characteristics of women who practiced contraception were supported in the multivariable analyses. Among all the samples, women aged 15 – 19 was less likely to use contraception, which is mostly because they were not married and were involved in sexual activity less frequently. NDHS 2016 shows that 72% of women aged 15 – 19 never had sex in the last 1 year and among those who were sexually active only 15% had sexual intercourse in the past 1 month compared to 40% among their counterparts aged 20 – 24 (MOH *et al.*, 2017). The results among married women verified the no differences for use of contraception between these two age groups.

The number of children ever born stood out prominently: young women with two or more children ever born were about as much as 25 times of and women with one child were about 15 times of the odds of practicing contraception among the entire sample, compared with women who had no children (the higher odds ratios were reduced to 6 times and 3 times among the married sample). Women of the *Janajati* ethnic group were more likely to use family planning methods than adolescents and women from other caste/ethnic groups. Young women from *Madhesh* province were significantly less likely (65%) (OR = 0.35) (it was 69% in the married sample) than those from Province 1 to practice contraception. Young women from Gandaki and Lumbini provinces were also less likely than those young women from Province 1 to practice contraception. The odds of using contraception were the highest in Province 1 compared to all other provinces. This is also supported by simple contraceptive use prevalence among adolescents and youth by provinces, as shown in Table 1 above.

The multivariable analysis shows that the economic status of respondents was positively related to the practice of contraception. Compared to women from the poorest wealth quintile, women belonging to the rich quintile were significantly 1.7 times more likely to use contraception (it was the same in the married sample) and it is even higher (2.7 times) for women from the richest wealth quintile (it was 3.4 times among the married sample). The multivariable logistic analyses largely confirm the results for the socioeconomic characteristics except for the association between educations. Knowing about the legal status of abortion was associated with higher odds of contraceptive use among married women, although such higher odds were not significant among the entire sample.

3.2. Descriptive profile of women having an abortion

Table 3 presents descriptive profiles of young women aged 15 – 24 who obtained an abortion in the past 5 years preceding the survey of 2016. It also presents the results of Chi-square tests of the significance of the association between the various background characteristics and having obtained an abortion. Overall, among all young women aged 15 – 24, about 1.8% had an abortion during the 5 years preceding the survey. There was a significant distributional difference in the prevalence of abortion over age, marital status, children ever born, contraceptive use, and wealth index.

The results in Table 4 show that women who ever gave one birth were nearly 6 times (OR=5.72) more than to have an abortion than women without any birth. The odds ratio was even higher among women who ever gave two or more births (OR= 7.14). The higher ratios for these two subgroups were reduced to 2 times and about 3 times in the married sample. Women who were using modern traditional contraceptive methods were 6 times (OR = 6.17) (4.4 times in the married sample) more likely to have an abortion than their counterparts using no contraception, implicating either a low effectiveness of traditional methods of family planning or lower sexual activities among those who were not using any methods. No difference in prevalence of abortion was found between women who were not using any contraceptive method and women who were using modern contraceptive method. The richer a woman, the greater the odds they had an abortion. Women from *Karnali* Province had nearly 6 times higher odds of having an abortion compared to women from Province 1, but there was no provincial difference for other provinces compared to Province 1. The results are very similar among the married sample with some reduced odds ratios for few factors as we also noted above.

3.3. Descriptive profile of women obtaining safe abortion services

In NDHS 2016, a total of 492 women aged 15 – 49 reported having had an abortion 5 years preceding the survey (MOH *et al.*, 2017), and 51% of them were performed at government authorized health facilities. Among the youth aged 15 – 24, the total number of recent abortions in the past 5 years was 83 with 42 abortions that were “safe” or performed at government authorized health facilities and the remaining 41 abortions were “unsafe” (see Table 5). Caste/ethnic group and the number of children ever born were the only demographic variables associated with abortion safety. It was only ecological region that was significantly associated with abortion safety among the five socioeconomic variables. Knowledge of the legal status of abortion was also associated with abortion safety.

Table 2. Odds ratios of a woman practicing contraception by study variables, Nepal, 2016

Characteristics	All women	Currently married women
	Odds ratio	Odds ratio
Demographic characteristics		
Age		
15 – 19 (r)	1.00	1.00
20 – 24	1.30*	0.80
Caste/ethnic group		
Chhetri/Bahun (r)	1.00	1.00
Janajati	1.58***	1.69***
Tarai	1.23	1.20
Dalit	1.05	0.98
Children ever born		
None	1.00	1.00
One	15.17***	3.17***
Two or more	24.75***	6.04***
Socioeconomic characteristics		
Residence		
Rural	1.00	1.00
Urban	1.12	1.18
Ecological region		
Mountain (r)	1.00	1.00
Hill	0.99	1.02
Tarai area	0.82	0.87
Province		
Province 1 (r)	1.00	1.00
Madhesh	0.35***	0.31***
Bagmati	0.75	0.79
Gandaki	0.68*	0.66*
Lumbini	0.72*	0.71*
Karnali	0.79	0.70
Sudurpaschim	0.90	0.86
Wealth index		
Poorest (r)	1.00	1.00
Poor	1.33	1.30
Middle	1.36	1.32
Rich	1.71**	1.65**
Richest	2.69***	3.43***
Education		
No education (r)	1.00	1.00
Primary	1.07	0.98
Some secondary	1.16	1.08
SLC or Higher	1.10	1.24

(Cont'd...)

Table 2. *(Continued)*

Characteristics	All women	Currently married women
	Odds ratio	Odds ratio
Knowledge		
Knowledge of legal status of abortion		
Yes (r)	1.00	1.00
No	1.17	1.24*
Model summary		
−2 log likelihood	2,885.2	2,467.2
Cox and Snell R2	0.194	0.121
Nagelkerke R Square	0.340	0.171
(Weighted N)	4,568	2,237

Odds ratios were weighted. SLC: School leaving certificate. *$P \leq 0.05$; **$P \leq 0.01$; ***$P \leq 0.001$.

Table 3. Percentage distribution of young women aged 15 – 24 by abortion status in the 5 years preceding the survey, according to selected characteristics, Nepal, 2016

Characteristics	N	No abortion	Had abortion (s)	Chi square test "*P*"
Total	4,568	98.2	1.8	
Demographic characteristics				
Age				***
15 – 19	2,429	99.3	0.7	
20 – 24	2,139	96.9	3.1	
Marital status				***
Currently married	2,237	96.3	3.7	
Currently not married[a]	2,331	100.0	0.0	
Caste/ethnic group				
Chhetri/Bahun	1,350	97.9	2.1	
Janajati	1,755	98.3	1.7	
Tarai castes	823	97.9	2.1	
Dalit	641	98.6	1.4	
Children ever born				***
None	3,012	99.5	0.5	
One	1,027	95.7	4.3	
Two or more	530	95.3	4.7	
Use of family planning method				***
None	3,880	99.0	1.0	
Modern method	495	95.4	4.6	
Traditional method	193	88.1	11.9	
Socioeconomic characteristics				
Residence				
Rural	1,722	98.4	1.6	
Urban	2,846	98.0	2.0	
Ecological region				
Mountain	306	98.7	1.3	

(Cont'd...)

Table 3. *(Continued)*

Characteristics	N	No abortion	Had abortion (s)	Chi square test "*P*"
Hill	2,041	98.0	2.0	
Tarai	2,221	98.2	1.8	
Province				
Province 1	748	98.8	1.2	
Madhesh	855	98.5	1.5	
Bagmati	953	98.4	1.6	
Gandaki	458	97.8	2.2	
Lumbini	823	97.9	2.1	
Karnali	293	96.2	3.8	
Sudurpaschim	438	97.9	2.1	
Wealth index				
Poorest	843	99.2	0.8	**
Poor	969	98.2	1.8	
Middle	907	98.3	1.7	
Rich	1,015	98.1	1.9	
Richest	835	96.9	3.1	
Education				
No education	378	97.4	2.6	
Primary	595	97.3	2.7	
Some secondary	1,907	98.5	1.5	
SLC or Higher	1,688	98.3	1.7	
Knowledge				
Knowledge of legal status of abortion abortion				
Yes	2,574	98.3	1.7	
No	1,994	97.9	2.1	
(Weighted n)	4,568	4,485	83	

All estimates are weighted. Per cents may not sum to 100 due to rounding. *$P \leq 0.05$; **$P \leq 0.01$; ***$P \leq 0.001$. [a]Among women currently not in union there was one woman reporting abortion but due to rounding it is reported as "zero;" SLC: School leaving certificate.

Table 4. Odds ratios of women of having an abortion within 5 years preceding the survey by study variables, Nepal, 2016

Characteristics	All women	Currently married women
	Odds ratio	Odds ratio
Demographic characteristics		
Age		
15 – 19 (r)	1.00	1.00
20 – 24	1.44	1.00
Caste/ethnic group		
Chhetri/Bahun (r)	1.00	1.00
Janajati	0.91	0.90
Tarai castes	1.23	1.28
Dalit	0.75	0.71

(Cont'd...)

Table 4. *(Continued)*

Characteristics	All women	Currently married women
	Odds ratio	Odds ratio
Children ever born		
None	1.00	1.00
One	5.72***	2.01*
Two or more	7.14***	2.77**
Use of family planning method		
Not using	1.00	1.00
Using modern methods	1.77	1.44
Using traditional methods	6.17***	4.36***
Socioeconomic characteristics		
Residence		
Rural	1.00	1.00
Urban	1.17	1.21
Ecological region		
Mountain (r)	1.00	1.00
Hill	1.26	1.26
Tarai	1.00	0.99
Province		
Province 1 (r)	1.00	1.00
Madhesh	0.78	0.68
Bagmati	1.12	1.19
Gandaki	1.56	1.55
Lumbini	1.70	1.52
Karnali	5.96***	5.15***
Sudurpaschim	2.50	2.42
Wealth index		
Poorest (r)	1.00	1.00
Poorer	3.01*	2.9*
Middle	3.48*	3.35
Richer	4.35**	4.31**
Richest	9.83***	10.28***
Education		
No education (r)	1.00	1.00
Primary	1.25	1.23
Some secondary	0.68	0.66
SLC or Higher	0.59	0.66
Knowledge		
Knowledge of legal status of abortion obo		
Yes (r)	1.00	1.00
No	1.44	1.45

(Cont'd...)

Table 4. *(Continued)*

Characteristics	All women	Currently married women
	Odds ratio	Odds ratio
Model summary		
−2 log likelihood	663.631	621.849
Cox and Snell R^2	0.036	0.037
Nagelkerke R^2	0.218	0.136
(Weighted N)	4,568	2237

(r): Reference category. SLC: School leaving certificate. Significant at *$P \leq 0.05$; **$P \leq 0.01$; ***$P \leq 0.001$.

Table 5. Percentage distribution of young women who terminated a pregnancy in the 5 years preceding the survey by selected characteristics, according to abortion safety, Nepal, 2016

Characteristics	N	Unsafe abortion	Safe abortion	Chi square test p
Total	83	49.4	50.6	
Demographic characteristics				
Age				
15 – 19	16	56.3	43.8	
20 – 24	67	47.8	52.2	
Marital status				**
Currently married	82	49.4	50.6	
Currently not married	1	100.0	0.0	
Caste/ethnic group				**
Chhetri/Bahun	29	62.1	37.9	
Janajati	28	57.1	42.9	
Tarai castes	17	11.8	88.2	
Dalit	9	55.6	44.4	
Children ever born				*
None	15	73.3	26.7	
One	43	51.2	48.8	
Two or more	25	32.0	68.0	
Use of family planning method				
None	37	43.2	56.8	
Modern method	23	56.5	43.5	
Traditional method	23	52.2	47.8	
Socioeconomic characteristics				
Residence				
Rural	28	46.4	53.6	
Urban	55	50.9	49.1	
Ecological region				**
Mountain	5	80.0	20.0	
Hill	40	65.0	35.0	
Tarai	38	28.9	71.1	

(Cont'd...)

Table 5. *(Continued)*

Characteristics	N	Unsafe abortion	Safe abortion	Chi square test p
Province				
Province 1	10	60.0	40.0	
Madhesh	13	15.4	84.6	
Bagmati	14	71.4	28.6	
Gandaki	10	50.0	50.0	
Lumbini	16	50.0	50.0	
Karnali	11	54.5	45.5	
Sudurpaschim	9	44.4	55.6	
Wealth index				
Poorest	7	42.9	57.1	
Poor	16	31.3	68.8	
Middle	15	53.3	46.7	
Rich	20	60.0	40.0	
Richest	25	52.0	48.0	
Education				
No education	10	20.0	80.0	
Primary	16	37.5	62.5	
Some secondary	29	58.6	41.4	
SLC or Higher	28	57.1	42.9	
Knowledge				
Knowledge of legal status of abortion				*
No	42	40.5	59.5	
Yes	41	58.5	41.5	

Percentages were weighted. Percent may not sum to 100 due to rounding. SLC: School leaving certificate. The statistical tests were based on the Chi-square tests. *$P \leq 0.05$; **$P \leq 0.01$

Of the total recent 17 abortions reported by young women in the *Tarai* area in the past 5 years, 88% were performed at "safe" facilities, while the corresponding figures for other caste/ethnic groups were 38% for *Chhetri/Bahun* high castes, 41% for *Janajati* or indigenous ethnic groups, and 44% for *Dalit* castes (Table 5). The number of children ever born was also significantly associated with abortion safety. A large proportion (73%) of young women without having live birth were putting them at risk of going to "unsafe" health facilities for an abortion. More young women (51%) with one child ever born also took recourse to "unsafe" health facilities for abortion, while nearly one-third (65%) young women with two or more children ever born visited "safe" abortion health facilities for abortion (Table 5).

Proportionately, more women not currently using contraception were accessing safe abortion service than those who were using any contraception, although the relationship is not statistically significant. Women not using contraception were accessing "unsafe" abortion service; perhaps, the pregnancy was unplanned or was due to forced sex. For wealth quintiles and education, it appears that accessing safe abortion services decrease with rising economic status and education, although the association is not statistically significant. Higher proportion (60%) of women having no knowledge of the legal status of abortion were reporting accessing safe abortion service compared to their counterparts (42%) aware of the legal status of abortion (Table 5).

3.4. Safe abortion in Gorkha project area

The implementation of the PHD Group women empowerment and the safe abortion project in Gorkha has some good experience to share. The project was supplementing the government's efforts of expanding safe abortion services in the country. The PHD Group does not have its own service infrastructure rather it uses the government infrastructure, health sector in this case, for project implementation. It is a Public-Private Partnership model in that NGOs or private sectors

collaborate with the government entity to implement development activities. Provision of safe abortion services calls for, among other things, training of health personnel, supply of drugs, and equipment, record keeping of clients receiving service and follow-up of abortion clients for 2 weeks and taking care of post abortion complications (PAC). From January 2019 to end of June 2021, 348 women received safe abortion service in the project areas. Of them only four women had PAC and they were well taken care of following the procedure.

Monitoring data from PHD Group's project in the Gorkha district indicate that despite difficult times due to COVID-19 lockdown which caused cancellation/postponement of several proposed project activities a large number of women and girls utilized safe abortion service. During the first 3 months of this period, the number of women and girls accessing safe abortion service was 67 (23 among women aged 15 – 24 and 44 among women aged 25+), while the corresponding figure increased to 106 (28 among women aged 15 – 24 and 78 among women aged 25+) in the following 3 months, representing a growth of 58.2% during the lockdown (Figure 2).

A number of reasons have been put forward for the increase in client flow during the pandemic. First, due to mothers' group meetings which are organized by Female Community Health Volunteers (FCHVs) attended by women of reproductive age (WRA), more girls and women in villages are now aware that abortion is legal. Second, project employed Female Field Facilitators (FFFs) and FCHVs do compassionate counseling to local women and girls about abortion and sometimes help them visit safe abortion facility. Third, free and quality safe abortion service is available. Fourth, local safe abortion facilities are never stock out with necessary drugs and the service is available 24 hours and 7 days a week. Fifth, service facility is readily accessible and nearby. Sixth, due to lockdown, women and girls are unable to visit health facility for contraception, and in several cases, the facilities are facing shortage of contraceptives resulting in more girls and women getting pregnant. Seventh, due to lockdown, frequency of meetings of family members increased giving rise to more unplanned pregnancies compared to other normal times making girls and women to opt for abortion. Eighth, due to introduction of sexuality education in schools by the project, adolescent girls and boys are aware of consequences of unwanted pregnancies and what to do about them. Finally, due to project and other development activities, women and girls are more empowered, have learned about reproductive health and rights, and make their own decision about sex and sexuality.

The monitoring data of the GSA project indicate that adolescents and youth aged 15 – 24 from Dalit community were significantly more likely to utilize safe abortion service before the COVID-19 pandemic. For instance, during January 2019 – June 2020, among the 15 – 19 and 20 – 24-year olds combined, the proportion of Dalit youth utilizing safe abortion service in the project areas was 38.5%, while among their high caste or non-Dalit counterparts, the corresponding proportion was 26.8% (Table 6A). During lockdown period from March 24, 2020, to July 21, 2020 too, the proportion of Dalit youth utilizing safe abortion service stood at 41.8% which was significantly higher than the proportion of 23.7% utilizing safe abortion service among the non-Dalit or *Chhetri/Bahun* and *Janajati* youth (Table 6B). Although as the national data show proportionately that fewer Dalit women were aware that abortion is legal in Nepal than their *non-Dalit* counterparts, they utilized safe abortion service more in PHD Group project catchment areas. Field enquiry revealed that over two-thirds of the under 20 women and girls were unmarried, although marital codes were not included in the data set due to sensitivity.

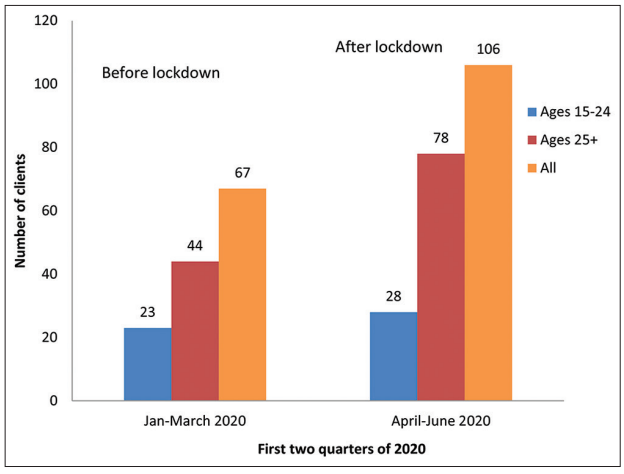

Figure 2. Safe abortion client flow before and during COVID-19 lockdown, Jan-June 2020

Table 6. Distribution of abortion cases before and during COVID-19 lockdown period

Caste/ethnic group	Age group			Total	
	15 – 19[1]	20 – 24	25+	%	N
(A) Abortion cases from in 2019- June 2020 including COVID-19 lockdown period*					
Dalit	11.0	27.5	61.5	100.0	109
Non-Dalit	8.4	18.4	73.2	100.0	239
Total	9.2	21.3	69.5	100.0	348
(B) Abortion cases during COVID-19 lockdown period in January – June 2020**					
Dalit	10.9	30.9	58.2	100.0	55
Non-Dalit	9.3	14.4	76.3	100.0	118
Total	9.8	19.7	70.5	100.0	173

[1]One girl aged 14 is added. Pearson Chi-square test significant at *$P < 0.10$; **$P < 0.05$.

4. Discussion

Using both the Nepal national DHS and some project specific monitoring data, this paper reviewed the trend of proportion of contraceptive use over time from 1996 to 2016 from several DHSs, and the prevalence of abortion among young women aged 15 – 24 from the 2016 DHS. The study also investigated the factors associated with the prevalence of contraceptive use and the prevalence of abortion based on multivariable regression models and examined the distributional difference in abortion safety for some major sociodemographic characteristics.

This study revealed several findings worthy of reporting. Contraceptive use data of various years reveal that since 2006 among the currently married adolescents use of modern contraceptive methods has remained nearly constant at 14% and among all adolescents, it declined from 4.5% in 2006 to 4.2% in 2011 and further to 4.0% in 2016. The use of traditional methods among all adolescents has increased from 0.7% in 2006 to 0.9% in 2011 and shot up to 2.3% in 2016. Among the women aged 20 – 24, the use of contraceptive methods declined from 22.4% in 2006 to 17.9% in 2016 and the corresponding figures for the use of traditional methods increased from 2.3% to 6.1%. These findings indicate that either the modern methods of contraception were increasingly becoming unpopular among both the adolescent and young women, or there was increased inaccessibility over the period. These imply that family planning programs in Nepal need to be strengthened and the young women need education and information on the usefulness of modern contraceptive methods instead of relying on traditional methods. Perhaps, there are misconceptions about modern contraceptives methods which need to be removed.

Regression analyses show that women who were aged 20 – 24, from *Janajati* ethnic group, and in rich/richest wealth index groups, and ever gave a birth, were more like to practice contraception than their counterparts who are adolescents, have fewer children ever born, poorer wealth index groups, and from *Chhetri/Bahun* or *Dalit* castes. The finding that women in their 20s are more likely to obtain an abortion than adolescents could be because the women in the former group are sexually more active (40% sexually active within the past 4 weeks) than adolescents (15% sexually active within the past 4 weeks) (MOH *et al.*, 2017) and have higher chance of becoming pregnant and, therefore, have a higher rate of unplanned pregnancies. Among the seven provinces contraceptive use was the lowest among young women from *Madhesh* Province and the highest in Province 1, which calls for special focus of family planning programs in *Madhesh*.

Despite limitation of sample size, our regression analyses of abortion among young women aged 15 – 24 also provide a glimpse of young women who are likely to take recourse to abortion in case that the pregnancy was unwanted. The results showed that while women who ever gave a birth were more likely to seek an abortion compared to women who did not give a birth, they were more likely to seek unsafe abortions. Results, further, show that women who were well-off were more likely to seek an abortion, and that if they sought abortions, they were more likely to seek safe abortions. Women who were using the family planning services, especially those who were using traditional methods, were likely to seek an abortion service and obtain the abortion services at "unsafe" facilities. By contrast, those who were not using any contraceptive methods were less likely to seek abortion services and if they obtained services, they were more likely to obtain it from authorized facilities. Women in *Madhesh* Province were least likely to seek an abortion, while women in Karnali were likely to seek abortion services. Among young women seeking an abortion, it was found that women from the *Tarai* caste or the *Tarai* region were likely to have a safe abortion.

The likelihood of seeking an abortion among women who had been practicing traditional methods of family planning may reflect their mistrust for modern contraceptive methods or because they are unable to obtain modern methods that they wished. Increasing use of traditional methods indicates not just unavailability of contraceptives but it also implies the entrenched belief that contraceptives have side effects and may even make woman infecund. As fecundity is highly valued, it is challenging for family planning program to persuade young women to practice modern contraceptive methods. Women with greater wealth were more likely to obtain abortions services simply, because they have better access to financial resource and to better health care. Women who gave one or more births were more likely to seek abortion may be because they did not wish to have more children and wish to have space for more personal development (Kirkman *et al.*, 2009; World Bank, 1993). Total fertility rate in Nepal was substantially decreased down to 2.0 in 2021 from 3.9 in 2000 and 2.5 in 2010 (United Nations, 2022a). Apparently, factors other than contraceptive use and abortion, such as socioeconomic developmental, are attributable to such fertility decline (Anderson & Kohler 2015; Caldwell *et al.*, 1992; and Jain & Ross, 2012). Women in *Madhesh* province were least likely to seek an abortion reflecting lowest human development in the province (NPC & UNDP, 2020).

In the context of Nepal, these results may imply improvement and empowerment of women which enables them to decide when to seek an abortion. The finding that women with one or more children ever born are likely to obtain an abortion could be because the women who have been giving births to increasing number of children ever born are more likely ever to have been pregnant than women who have had no birth. In the abortion model, women who had one or more children ever born were more likely to have an abortion than those who did not give any birth. Furthermore, it could be because women's desired family size has become 2 or less, many women opt for permanent method of family planning and if accessing such service is difficult, they choose to go for medical abortion which is free and relatively easy to access. Indeed, according to the Ministry of Health of Nepal, of the total abortions in the 5 years preceding the 2016 survey, 72% were medical abortions (MOH *et al.*, 2017).

Nevertheless, the NDHS 2016 data show nearly half of all abortions among women aged 15 – 24 were taken place in unauthorized facilities such as at home, which is likely higher than the world average (Shah & Ahman, 2012). This is because Nepalese women buy medical abortion drugs from private pharmacies and use them at home and some women get abortion service at private pharmacies not authorized by government to perform abortion (Gorkhapatra, September 5, 2019; The Himalayan Times, March 7, 2022). This proportion is alarmingly high. With the prime objective of reducing maternal mortality, the government of Nepal legalized abortion in 2002. In 2004, the government announced a policy of providing safe abortion services through the extensive health infrastructure existing in the country. In principle, such private facilities are not legally allowed to sell abortion drugs, but still this takes place. Journalists report about illegal sale of abortion drugs and as per the government law illegal sellers can be subject to 3 years imprisonment and/or charged with fines but the situation has not improved (Gorkhapatra, October 9, 2020). However, until mid-2020, only about 1,500 health facilities in the country had provided safe abortion service out of about 4,400 facilities (Gorkhapatra, October 7, 2020). It is also argued that distance to a health facility is a major problem of accessing health care including abortion service in Nepal (MOH *et al.*, 2017). Besides, the facilities that are authorized to perform safe abortion service are not functional all the time, because they frequently face the absence of service providers and/or the shortage of supply of necessary drugs, and it is common that post-abortion contraceptives and equipment are interrupted. In addition, there are a number of social, normative, economic, and distance barriers for women to access safe abortion services. Nepalese is a patriarchal society and the NDHS 2016 data show that only 23% currently married women make decisions on their own about their own health care (MOH *et al.*, 2017). Last, but not least, due to cultural values and norms of son preference prevailing in Nepal (Karki, 1988), there is also evidence that sex selective abortion is on the rise after it was legalized (Frost *et al.*, 2013), although there are strict laws that prohibit such a practice (MoH, 2016). All these factors could make women to go to private unauthorized health-care facilities which are usually close by. The situation was likely worsened due to the COVID-19 lockdown. Relatively more Nepalese women ended up with unwanted pregnancies during the lockdown, because contraceptives were in short supply, and many service centers were closed during the lockdown period, because abortion service providers were overwhelmed by COVID-19 pandemic, compelling women to seek abortion service from unauthorized private facilities (The Himalayan Times, 15 July 2021).

Fortunately, the analysis of the project data shows that access to safe abortion services has been improved even during the COVID-19 pandemic and lockdown. This is because no woman in the project was prevented from accessing safe abortion service, while, in other parts of the country, more women were utilizing unsafe abortion and putting their life at high risk. In the Gorkha project catchment area, there are 18 health facilities that provide safe medical abortion service. This indicates one facility per about 1,000 women of reproductive age, which is advantageous compared to the national rate of about 5,000 women per facility (MOH, 2021). The beauty of the project is that women in highly disadvantaged

Dalit, in relative terms, were utilizing the safe abortion service made available in close-by facilities more than their advantaged counterparts. Furthermore, post-abortion family planning is much higher (87%) in the Gorkha project area than the national rate of 25% (MOH *et al.*, 2017). Admittedly, the findings in the Gorkha field monitoring data, and those from Dalit community in particular, were not sufficiently captured in the NDHS of 2016. To understand the complexity of sexual behavior and abortion among the young age population, more research aiming to capture large sample using both qualitative and quantitative approaches are needed. Furthermore, more investment is needed in that as evidenced from the data that even during difficult times of COVID-19 pandemic many women could access the safe abortion service available nearby.

In sum, findings of this study indicate that the sexual and reproductive health and rights (SRHR) programs including family planning and safe abortion programs in Nepal have not been satisfactory. For this, not only the family planning and safe abortion programs need to be strengthened but also the local Female Community Health Volunteers (FCHVs) have to be encouraged to do their jobs in communities better. The FCHVs should also be asked to hold community meetings with local women and young girls to spread the knowledge about effective use of modern contraceptive methods, unreliability of traditional contraceptive methods, legal status of abortion, and availability of free abortion service. The health infrastructure such as Health Posts, Primary Health Care Centers, local, district, and other hospitals must ensure that the contraceptives and medical abortion drugs are never in short supply. Family planning program was introduced in the country more than 50 years ago, and yet, it appears that the program needs an overhaul to increase its efficacy. Furthermore, abortion was legalized and safe abortion service was introduced for over 12 years, and yet, it is still far from providing extensive safe and quality abortion service for common women and girls to access it.

4.1. Limitations

This study has several limitations. The NDHS data that have been used here are cross-sectional in nature which does not permit to establish causal relationships between contraceptive use and abortions. The NDHS data that are regularly collected in Nepal since 1996 are meant for monitoring progress made in health and demographic dynamics in every 5 years. The issues explored in the surveys do not probe for in-depth understanding of such a causal relationship, although they are good for program managers and policy makers. For instance, we have learned from the data that a certain proportion of women had abortion in the recent past, but we do not have information with respect to what made her to go for abortion nor we know how she felt about the service or how she felt herself after the service.

The monitoring data used in this analysis have limitations too. Because the government categorizes abortion facility data as highly sensitive and only a few characteristics of abortion clients are collected, it is not possible to understand deeply about the way a woman decides to opt for abortion service at a facility. Nevertheless, project monitoring data contain a few basic background characteristics in numerical forms which are helpful to make quantitative analysis.

In addition, the number of young women who had an abortion in the 5 years preceding the survey in this study was only 83 and when they were further divided into two groups the analyzed sample number became even smaller. It is thus important that the interpretations presented here must therefore be taken cautiously. Abortion is highly stigmatized in Nepalese society and people still believe that abortion is a sin (Karki & Magar, 2018). In such a society, collecting information on abortion from a face-to-face interview in a questionnaire survey is subject to underreporting. There is evidence that many women just do not report that they have had an abortion. On the basis of the total sample of 12,862 women aged 15 – 49 in 2016 (MOH *et al.*, 2017) and annual abortion rate of 42/1000 women of reproductive age 15 – 49 in 2014 (Puri *et al.*, 2016) of other data sources, approximately 2,700 abortion cases should be captured for the 5-year period preceding the 2016 NDHS survey. This suggests that only about 20% of abortions were reported in NDHS. As adolescents face severe social sanctions against premarital pregnancy (Thapa *et al.*, 2001), it is likely that many premarital pregnancies that ended in abortions were not captured in the survey. The analysis is based on cross-sectional data – abortions that took place in the past 5 years preceding the survey, which is subject to several limitations. In the absence of some important variables such as education, residence, and socioeconomic status at the time of abortion, the analysis was based on data collected at the time of the survey. As education and economic status change over time, they can impact the results that are presented here.

5. Conclusions

The 2016 Nepal Demographic and Health Survey (NDHS) supplemented by key indicators from several previous waves of NDHS shows that the prevalence of contraceptive use among women aged 15 – 24 has been stagnant, and their prevalence of unsafe abortion is high in the last two decades in Nepal. The study also investigated the factors associated

with the prevalence of contraceptive use and the prevalence of abortion based on multivariable regression models for some major sociodemographic characteristics. It, furthers, analyzes the distributional difference in unsafe abortion by major factors, which shows that different sociodemographic factors played varied roles in affecting Nepalese young women's choice of contraceptive use and abortion behaviors. Overall, the sexual and reproductive health and rights (SRHR) programs including family planning and safe abortion programs in Nepal have not been very effective in the past two decades. Family planning and safe abortion programs need to be strengthened to achieve sustainable development goals. The Gorkha project demonstrated provided a good example that access to contraceptive and abortion services among disadvantaged populations could be largely improved when available services are provided to them. Post-abortion family planning services could also increase safe abortion. To understand the complexity of sexual behavior and abortion among the young age women and to achieve the sustainable development goals for reduction in maternal mortality risk in Nepal, more research aiming to capture large sample using both qualitative and quantitative approaches are needed.

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Conflict of interest

The author has no conflicts of interest to declare.

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Author contributions

This is a single-authored paper.

Ethics approval and consent to participate

Not applicable as this study involves the analysis of secondary data collected by the DHS program, ICF, Rockville, Maryland, USA, and monitoring data from the project which was approved by the Ministry of Health and Population.

Consent for publication

Not applicable.

Availability of data

Data utilized in this paper are from secondary sources and available to the public. The secondary data can be freely accessed from the DHS website. The project monitoring data used in the analysis are with the author in SPSS system file and if needed it can be made available to the publisher.

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Appendix

A1: Background information about Nepal.

Nepal has a diverse geography and a landmass of 147,181 km^2. The country is situated between two huge nations. All along the Himalayan northern border there is the Tibetan region of China, while the remaining three sides of the country are surrounded by India. Nepal is characterized by three distinct ecological regions running east to west, referred to as the Mountains, the Hills, and the *Tarai*. The Mountain area in the North ranges in altitude from 16,000 ft (4,880 m) to 29,028 ft (8,848 m) above sea level and the area accounts for about 35% of the total land of the country. The Hill area in the middle runs from east to west, ranging in altitude from above 1000 ft (305 m) to about 16,000 ft and accounts for 42% of the total land of the country. The *Tarai* area along the South ranges from about 200 ft (60 m) to 1000 ft above sea level, including some of the most fertile land in the country and accounting for 23% of the total land area. The *Tarai* area is a subtropical region adjoining India. According to the 2021 preliminary population census results, about 53.7% of the total population of 29.2 million resided in the *Tarai*, while, in the hills and the high mountain regions, the corresponding figures are 40.2% and 6.1%, respectively (CBS, 2022).

In September 2015, Nepal promulgated a new Constitution, adopted a three-tier federal state (local, provincial, and center) and became a federal democratic republic. The country is now divided into seven provinces (Province No.1, *Madhesh* Province, *Bagmati* Province, *Gandaki* Province, *Lumbini* Province, *Karnali* Province, and *Sudurpashchim* Province), 77 districts (see Map), and 753 *palika* or local politico-administrative units and each *palika* is divided into wards of varying numbers which are the lowest level politico-administrative units (Ministry of Law, Justice and Federal Affairs, 2015).

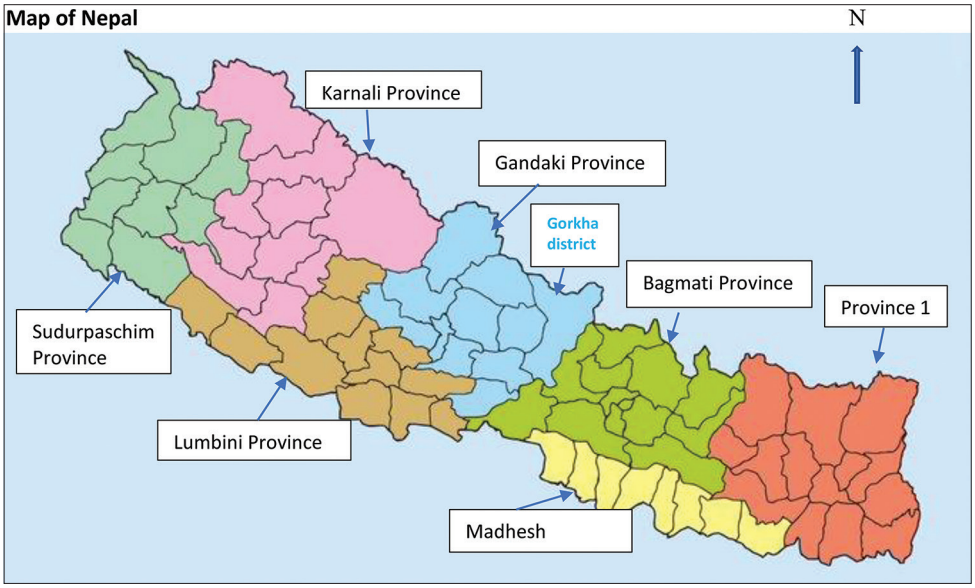

Figure A1. Each province is composed of a number of districts; there are 14 districts in Province 1, eight districts in *Madhesh* Province, 13 districts in *Bagmati* Province, 11 districts in *Gandaki* Province, 12 districts in *Lumbini* Province, ten districts in *Karnali* Province, and nine districts in *Sudurpaschim* Province. There are, in all, 6,743 wards in the country. Before 2015, the number of districts was 75. A *palika* is classified as a rural or an urban municipality. The urban municipalities are further classified as Metropolitan cities, Sub-metropolitan cities, and urban municipalities. In all, there are six metropolitan cities, 11 sub-metropolitan cities, and 276 Urban Municipalities in the country. Of the total population, 66% lives in 293 urban municipalities (CBS, 2022). Except for metropolitan and sub-metropolitan cities, the populations of 276 urban municipalities exhibit rural characteristics. The 2011 census reported 125 caste/ethnic groups with about 123 different languages spoken in Nepal (Dahal, 2014). Caste/ethnic groups can be broadly divided into four hierarchical categories such as "high" castes (*Chhetri/Bahun*), indigenous (*Janajati*) group, the *Tarai* castes, and the *Dalit castes*

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RESEARCH ARTICLE

Female genital mutilation practice, associated factors, and its consequences on women's reproductive health in Senegal

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Abstract: Female genital mutilation (FGM) practice is unhygienic and unhealthy traditional practices which have affected girls and women's health adversely for all-time, and such practice is prevalent in many African countries. This study intended to examine factors associated with the FGM prevalence, attitudes toward the discontinuation of the practice, and consequences of FGM practice on reproductive health in terms of sexual transmitted infections/symptoms (STIs/STSs) among women of reproductive ages in Senegal. To fulfill the study objective on factors associated the prevalence of FGM and attitudes toward the continuation of FGM practice, the 2019 Senegal Demographic Health Survey (DHS) data sets were used based on binary logit and multinomial logit regression models. The results show that rural areas, married women, women of Muslim religion, Poular women, women of lower education and lower wealth, and women who were never exposed to social media reported a higher prevalence rate of FGM and were more likely to support continuation of FGM practice. To fulfill the research goal on consequences of FGM practice on STIs/STSs, the 2010 – 2011 DHS was employed because the 2019 DHS did not collect data on STIs/STSs. FGM practice was associated with lower knowledge about STIs/STSs and higher prevalence of STIs/STSs. Our findings suggest that education promotion, poverty reduction, rural development, and dissemination of the adverse consequences of FGM practice could help reduce FGM practices. These findings could have important implications for achieving the sustainable development goals.

Keywords: Female genital mutilation; Traditional practices; Sexually transmitted infections; Attitude; Senegal

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1. Introduction

1.1. Status quo of the female genital mutilation practice

The World Health Organization (WHO) defined female genital mutilation (FGM) as all procedures which involve partial or total removal of the external female genitalia and injury to the female genital organs, whether for cultural or any other non-therapeutic reasons (WHO, 2012). FGM, also known as female genital circumcision or female genital cutting (FGC), is an umbrella term being used to cover various methods that involve partial or complete cutting of female genitals, which is commonly performed during childhood. FGC is carried out using knives, razors, scissors, or sometimes pieces of glass and blunt blades, etc. In some rare traditional cases, it has also been reported to use other various tools to perform genital cutting like sharp stones (Banks *et al.,* 2006; WHO, 2022). Regardless of tools that it uses, FGM is an unhygienic and unhealthy traditional practice which affected girls and women's health all time (Diop & Askew, 2009).

FGM is deeply entrenched within socio-cultural beliefs over decades and generations around preserving a girl's purity and controlling women's sexuality or chastity. Such practices are more prevail in economically and social deprived communities and among the less educated, economically, and socially weaker subpopulations (Holmes *et al*., 2017; Kloning *et al*., 2018; Rawat, 2017; Tamire & Molla, 2013; UNICEF, 2017; WHO, 2001). Women become puppets when they are uninformed and unaware of health hazards caused by such rigid practices (Alcaraz *et al.*, 2014).

It is estimated that FGM practices are widespread and deeply rooted practice, performed in more than 28 countries of Africa and in a few other scattered communities worldwide (UNICEF, 2017; UNICEF & Gupta, 2013; WHO, 2001, 2012). According to the WHO estimation, between 100 and 140 million women and girls have undergone through FGM practices, and almost 2 million or more are added each year (UNICEF, 2017; WHO, 2013). In many regions of some African countries, over more than 80% of women have ever experienced FGM practice (UNICEF, 2022).

However, FGM is not only a severe form of discrimination against girls and women but also a violation to the human rights of girls and women. The negative consequences and violation of the human rights of FGM have been recognized by several international rights treaties that affirm the rights of physical integrity and freedom from all forms of torture, inhumane, degrading treatment and discrimination. Many international organizations such as the Convention on the Elimination of all Forms of Discrimination Against Women (CEDAW) considers this practice as violence against women (CEDAW, 1992). The World Conference on Human Rights (WCHR) launched a global movement against the violence against women and has catalyzed international action on elimination of FGM several decades ago (WCHR, 1993). WCHR supports all measures by the United Nations and its specialized agencies to ensure the effective protection and promotion of human rights of the girl-child. WCHR urges its member states to repeal existing laws and regulations and remove customs and practices which discriminate against and cause harm to the girl-child (WHO, 1996). The United Nations Sustainable Development Goals (SDGs) (United Nations, 2015, p22) have explicitly stated in its Goal 5 Target 5.3 to "Eliminate all harmful practices, such as child, early and forced marriage and female genital mutilation" by 2030.

1.2. Female genital mutilation and health consequences

FGM practice can lead to various health hazards, some of which may have life-threatening consequences in later life (Klein *et al.*, 2018; WHO, 2000). Studies have shown that women and girls who experienced FGM practice may suffer from immediate or long-term health complications such as severe pain, bleeding, hemorrhage, infections, tetanus, oliguria, and sepsis(Almroth *et al*., 2005; Coomarasamy *et al*., 2016; Gebremichael, 2002; Hilber *et al*., 2007; Insight, 2010; Infections, 2012; Okonofua *et al*., 2002; Utz-Billing & Kentenich, 2008; WHO, 2012). There is a consensus that FGM plays a significant role in the development of Pelvic Inflammatory Diseases (PID). Women who had undergone infibulated have a higher risk of infection and can further cause infertility (Pastor-Bravo *et al.,* 2018; Kimani *et al*., 2020). Furthermore, young women and girls may suffer more from health compilations compared to older reproductive women.

FGM has also been evidenced to lead to the risk of sexually transmitted infections (STIs) and other related complications due to the nature and serious conditions by which the procedure is done. Women and girls who experienced FGM practice are more vulnerable to get STI and human immunodeficiency virus (HIV) as compared to their counterparts who had no such experiences (Elmusharaf *et al.,* 2006; O'Neill, 2012; Watkins, 2016; WHO, 2013, 2022). One Nigerian hospital-based study shows that FGC increases various reproductive problems (such as infections and infertility related problems) among those who experienced FGM practice and increases the vulnerability of STIs and HIV (Dare *et al*., 2004; Hilber *et al.*, 2007; Mandara, 2004). Furthermore, according to an analysis by the United Nations Children's Fund (UNICEF), the proportion of FGM undergone medicalized among the adolescents aged 15 – 19 years is twice as high compared to the women aged between 45 and 49 years (UNICEF, 2020).

1.3. Why Senegal?

Senegal is located in West African continent and is divided into 14 administrative divisions. The country covered a land area of nearly 197,000 square kilometers and had 17.14 million population (2021). According to the World Bank (2022), the adult literacy rate of the country was 52% in 2017, and the youth aged 15 – 24 years literacy rate was about 76% for men and 64% for women. Today, about 25% of women of reproductive ages in Senegal, or equivalent to or nearly 2 million, have undergone the FGM practice, with southeast the highest prevalent areas (UNICEF, 2022). This prevalence of FGM seems largely unchanged in the last two decades. Senegal is a very good research sample for studying FGM and related issues. A recent infographic report based on the Demographic and Health Survey since 2005 released by the United Nations Children's Fund (UNCIEF, 2022) has largely filled our knowledge gap about FGM in Senegal. Evidence also shows that FGM practice is most common among girls and women from the poorest families and those from the

Muslim religion. There is also a substantial variation in the prevalence of FGM by ethnicity with more than two-thirds in Pour and Soninike and < 3% in Serer and Wolof. By contrast, the difference in the prevalence of FGM by educational level and urban-rural by residence is less pronounced (UNICEF, 2022). Senegal is thus a good sample to study FGM practice and its related issues.

There is evidence that women with different demographic characteristics may have different views and practice behaviors about FGM. For example, women who have knowledge of obstetric health hazard caused by FGM are less vulnerable to have reproductive health problems, while problems are more severe among women who do not have any such knowledge (Coomarasamy *et al*., 2016; Connor *et al*., 2016; Herieka & Dhar, 2003; Setegn *et al*., 2016). Studies have shown that women with lower education are doubly vulnerable, both physically and socially because they do not have adequate information about health hazards, and thus they keep on flowing towards the wave of traditional practices. Consequently, they become a part of the rigid and wrong social practices/systems. By contrast, women with adequate knowledge about various health hazards to some extent can help themselves to unfollow traditional and unhygienic practices, and to seek necessary treatments when in need so as to avoid harmful consequences (Doucet *et al.,* 2017; Kloning *et al.,* 2014). It is thus essential to understand the connection between women's attitudes and level of FGM in Senegal whereas traditional beliefs are powerful (Tamire & Molla, 2013; Watkins, 2016; Doucet *et al*., 2017).

Furthermore, although some studies have investigated the attitudes toward continuation of FGM among Senegal women (Adigüzel *et al*., 2019; Ciment, 1999; Levy *et al*., 2021; Mohammed *et al*., 2018) it is not sufficient to understand whether women's knowledge and believes are associated with their health behaviors and treatment seeking behaviors when in need. Moreover, due to lack of data, the previous studies have not adequately investigated the relationship between STIs and FGM. Taking all together, the primary goals of this study were to (i) investigate factors associated with prevalence of FGM and associated with its performance by traditional practitioners, (ii) examine factors associated with women's attitude regarding whether FGM should continue or be stopped, and (ii) examine factors associated with having STIs and associated with treatment seeking among STIs. Below we describe the data and methods used for the current study, followed by the results, interpretations of key findings and their implications.

2. Data and Methods

2.1. Data sources

The Demographic Health Survey (DHS) of Senegal 2010 – 2011 and 2019 datasets were used to fulfill the study objectives. The reason why the present study used the 2010 – 2011 dataset is because the 2019 DHS dataset did not collect data on STIs. DHS provides profound and comprehensive information at the individual and household levels. The total sample size for this analysis was 15,688 for STIs (from the 2010 – 2011 dataset) and 8649 for FGM (from the 2019 dataset). The DHS is a nationally representative household survey with a multi-stage stratified systematic sampling design that provides data for a broad range of monitoring and impacts evaluation indicators, health, and nutrition, etc., in the area of population. The survey collected various information on the health issues of men, women, and children. Furthermore, the survey included various key indicators such as fertility rates, under-five mortality rates, contraceptive use, FGM, skilled assistance with births, childhood immunization coverage, nutritional status of children, along with knowledge and STIs, behavior regarding HIV and future perspective. There are several types of questionnaires: household questionnaires, women's questionnaires (women aged 15 – 49 years), children's questionnaires, and men's questionnaires. There are also several standardized questionnaire modules for the countries with interest in topics while information on HIV testing is also available. More details can be found at the DHS official website https://dhsprogram.com. This study focused only on the women's questionnaires.

2.2. Measures

2.2.1. Dependent variables

The six variables were used as dependent variables in this study. First, whether the respondent was circumcised or not? (No "0"/Yes "1"). Second, who performed circumcision? (Traditional circumciser, traditional birth attendant, other traditional, medical personnel, and missing/do not know). These categories were recoded into a dichotomous category of practitioners as traditional circumciser "1" versus all others "0." Third, women's attitude toward the continuation of FGM practice ("1" should continue, "2" should stop, "3" depends, and "8" don't know). The variable was recoded in to three categories: (1) should continue, (2) should stop, and (3) do not know/depends. Fourth, ever heard of a Sexually Transmitted Infections (STIs) or ST symptoms (STSs)? (Yes "1" vs. No "0"). Fifth, whether a woman had STIs/STSs

measured by three dichotomous questions: had any STIs in past 12 months, bad smelling/abnormal genital discharge, and genital sore or ulcer. If answering "Yes" to any of three questions, the woman was considered having STIs/STSs, coded 1 and 0 otherwise. Sixth, whether the respondent who had STIs/STSs sought advice/treatment in the last 12 months? (Yes "1" vs. No "0").

2.2.2. Independent variables

The study selected some key socio-economic and demographic variables which were considered as potential characteristics that could affect the outcome of the interest. In a nutshell, age group of the women (15 – 24, 25 – 34, 35 – 44, and 45 – 49 years), place of residence (rural and urban), marital status of the women (never married, married, and others), religion of the respondents (Muslim and non-Muslim), ethnic groups (Poular, Wolof, Serer and others), levels of education (no education, primary education, secondary education, and tertiary education), the wealth index (poorest, poor, middle, rich, and richest), and media exposure (*i.e*., reading magazines/newspapers, listening to radio, and watching television [yes vs. no]) were used as the independent or predictors in the study. All these variables have been identified as the key factors that are associated with our dependent variables (e.g., Sougou *et al*., 2021; Ahinkorah *et al*., 2021).

2.3. Analytical methods

In addition to bivariate analyses, binary logit (logistic) regression models were carried out to estimate the prevalence of FGM and its associated factors, factors associated with attitudes toward termination of FGM, factors associated with STIs knowledge, the prevalence of STIs, and factors associated with seek treatments among who had STI symptoms. Multinomial logit regression models were used to examine factors associated with women's attitude toward the continuation of FGM practice. The application of multinomial logit regression model is because the outcome variable has three categories (continuing, stopped, and do not know/depends). In all analyses, appropriate sampling weights were used to adjust for the complex survey design of the DHS. All analyses of this study were carried out using SPSS v20 and STATA v16.

3. Results

3.1. Sample characteristics

The weighted percentage distributions of sample by selected background characteristics are shown in the left panel of Table 1. Women aged 15 – 24, 25 – 34, and 35 – 44 years accounted for 41%, 31%, and 21%, respectively; and women of aged 45 – 49 accounted for 7%. Urban women accounted for nearly 49%. About 65% of women in reproductive ages 15 – 49 were married and approximately 97% were Muslims. Poular and Wolof ethnicities accounted for 28% and 40.2%, respectively, and Serer ethnicity accounted for 15.3%. Around half (47.2%) of Senegal women in reproductive ages had no education, and 21.1%, 27.3%, and 4.4% of them received primary education, secondary education, and tertiary education, respectively. More than 90% of Senegal women in reproductive ages had ever exposed to the mass media.

Overall, about 25% of reproductive women experienced FGM practice (Column B in Table 1). Bivariate analysis shows that. Bivariate analysis shows that there was no age difference in weighted prevalence of FGM practice, although the youngest women (aged 15 – 24 years) and the oldest women (aged 45 – 49) had lower FGM prevalence (23 – 24%) than the two other age groups (ages 25 – 34 and 35 – 44) (about 28%). Results further show that rural women reported a higher prevalence of FGM practices (29.1%) in comparison to their urban counterparts (21.1%). About 28% of married women reported a practice of FGM in comparison with only 20% among never married women and 21% in those divorced or widowed. Muslim women reported much higher prevalence of FGM (25.7%) than non-Muslim (7.5%). The higher prevalence of FGM found in Poular (54%) and others (57%) in comparison with only 1 – 1.5% among Wolof and Serer ethnicities. Women with tertiary education reported a lower prevalence rate of having FGM in comparison with those in other educational categories: 27% in women with no education, 23 – 24% in women with primary and secondary education. The prevalence rate of having FGM is linked to wealth, from nearly 48% in the poorest down to <15% in the richest. Women with media exposure reported a prevalence rate of having FGM 23%, lower than 56% among those who had non-exposure to media.

Among the women who had a FGM practice, about 96.4% of FGM cases were performed by traditional circumcisers and the remaining 3.6% of cases were performed by other practitioners. This pattern is almost universal for all subgroups of the population with few exceptions. This indicates that even today almost all FGM cases were performed by traditional practitioners in Senegal. The distributional difference was only found by education, wealth, and urban-rural residence. The lowest prevalence of FGM performed by a traditional practitioner was found in those with tertiary (90.3%) and primary education (91.6%), the richest (94.1%), and rich (95.0%) women, and urban women (95.4%).

Table 1. Distribution of 8,649 women by selected background characteristics, Senegal, DHS 2019.

Variables	% Distribution of all 8,649 women	% Women having FGM among all 8,649 women	% Traditional circumcisers among 3,303 women having FGM
	(A)	(B)	(C)
Total sample	100.0	25.2	96.4
Age group (years)			
15 – 24	41.2	23.9	95.9
25 – 34	30.9	26.5	96.6
35 – 44	20.9	26.7	96.7
45 – 49	7.0	23.0	97.4
Place of residence			
Rural	51.1	29.1***	97.1+
Urban	48.9	21.1***	95.4+
Marital status			
Never married	29.8	20.3***	96.3
Married	65.4	27.7***	96.4
Others[a]	4.8	21.4***	96.2
Religion			
Muslim	97.2	25.7***	96.4
Non-Muslim	2.8	7.5***	97.6
Ethnic group			
Poular	28.0	54.3***	96.3
Wolof	40.2	0.8***	100.0
Serer	15.3	1.1***	97.3
Others	16.5	57.5***	96.3
Levels of education			
No education	47.2	27.1+	98.4***
Primary	21.1	23.2+	91.6***
Secondary	27.3	24.1+	96.8***
Tertiary	4.4	21.9+	90.3***
Wealth index			
Poorest	16.3	47.6***	95.8*
Poor	17.7	30.0***	97.9*
Middle	19.5	23.2***	98.7*
Rich	21.6	18.2***	95.0*
Richest	24.9	14.7***	94.1*
Media exposure			
No	5.9	55.9***	97.0
Yes	94.1	23.3***	96.3

(1) [a]Widowed/divorced/separated and living with partner. (2) All the percentages in the table were weighted. (3) The statistical tests for Columns B and C were based on Pearson Chi–Square Tests. (4) $+P < 0.1$, $*P < 0.05$, $**P < 0.01$, $***P < 0.001$

3.2. Factors associated with female genital mutilation

Table 2 presents odds ratios of practicing FGM and odds ratios of FGM performances by traditional practitioners for study variables controlling for other factors from the binary logit regression models. The results show that controlling for other covariates, women of older ages were more likely to experience FGM practice, but there no difference was found

Table 2. Odds ratios of FGM practice and of traditional circumcisions, Senegal, DHS 2019.

Variables	Among all 8,649 women	Among 3,303 FGM women
	FGM practice versus no	Traditional circumcision versus others
Age group (years)		
15 – 24®	1.00	1.00
25 – 34	1.16	1.25
35 – 44	1.36*	1.24
45 – 49	1.77*	1.64
Place of residence		
Rural®	1.00	1.00
Urban	0.92	0.49***
Marital status		
Never married®	1.00	1.00
Married	1.36*	0.76
Others[a]	1.20	0.95
Religion		
Muslim®	1.00	1.00
Non-Muslim	0.07***	1.43
Ethnic group		
Poular®	1.00	1.00
Wolof	0.01***	1.00
Serer	0.01***	0.91
Others	1.97***	0.96
Levels of education		
No education®	1.00	1.00
Primary	1.11	0.16***
Secondary	1.23	0.45*
Tertiary	1.06	0.16**
Wealth index		
Poorest®	1.00	1.00
Poor	1.01	2.92***
Middle	0.68**	7.37***
Rich	0.44***	2.11***
Richest	0.24***	2.43***
Media exposure		
No®	1.00	1.00
Yes	0.35***	0.77
N	8,649	3,303
Wald Chi square (df)	783.2 (18) ***	103.9 (17) ***

(1) [A]Referring to widowed/divorced/separated and living with partner. (2) The numbers in the table refer to relative risk ratios based on binary logit regression models. All odds ratios were weighted. (3) [®]Reference category. (4) Figures in the parentheses are the degree of freedom. In the analysis among FGM women, the degree of freedom was reduced to 17 due to zero weighted cases for Wolof ethnicity. (5) + $P < 0.10$, *$P < 0.05$, **$P < 0.01$, ***$P < 0.001$

across age groups regarding who performed the FGM. Results further show that women from urban areas were associated 51% lower odds of experiencing FGM practice by a traditional practitioner than their rural counterparts, although there was no difference in experiencing FGM practice between these two groups. Married women were associated with 36% higher odds of experiencing FGM practice than never married women, but they had no difference in who performed the FGM. Non-Muslim women were associated 93% lower odds of experiencing FGM practice than Muslim women, but

their higher odds of experiencing FGM practice by traditional practitioners was not statistically significant (likely due to small cases among non-Muslim). Compared to women of Poular ethnicity, women of Wolof or Serer ethnicity were associated 99% lower odds of experiencing FGM practice, but women of other ethnicities were associated 97% higher odds to experience FGM practice. No differences were found by ethnicity regarding whether FGM was performed by a traditional practitioner or not. There is no difference in prevalence of FGM practice across educational levels, but women with higher education were associated with lower odds of experiencing FGM practice by traditional practitioners. The richer a woman, the lower odds she had FGM practice, but well-off women were associated with higher odds of experiencing FGM practice by a traditional practitioner. Women with media exposure were associated with 66% lower odds of experiencing FGM practice compared with their counterparts without media exposure, but their lower odds ratio of experiencing FGM practice by traditional practitioner was not statistically significant.

3.3. Women's attitude regarding female genital mutilation practices

Table 3 presents the weighted distribution of attitudes toward discontinuity of practicing FGM among all 8649 women of productive ages in the DHS 2019 survey. The results reveal that 15.6% and 68.6% of women viewed FGM practice should continue and discontinue, respectively. The remaining 15.8% of women opted to select an answer either depends, do not know, or refusal to answer. Bivariate analyses show that there was a statistical difference in distribution of attitudes by all study variables. Specifically, 58.3% of women who experienced FGM practice answered continuing and 38.1% answered stopping FGM practice, in comparison with 1.2% and 78.8% among those who did not experience FGM practice. The proportion of answering "depends," "do not know," or refusal is much higher among those who did not experience FGM practice (20.0%) and those who had FGM practice (3.6%).

Women who were older ages, from urban areas, not currently married, non-Muslim, Wolof or Serer ethnicity, with more education, richer, and exposed to mass media were more likely to answer to terminate FGM practice. Women with tertiary education had the highest proportion to view that FGM should be terminated (93.7%), followed by the richest women (87.2%), urban women (81.5%), and the rich women (81.1%). Women who were never exposed to social media had the lower proportion of supporting termination of FGM practice (28.5%). The poorest women (38.4%) and women who experienced FGM practice (38.1%) had a proportion of supporting the termination of FGM practice below 40%.

Columns A and B in Table 4 present relative risk ratio of women's attitude toward whether the FGM practice should be stopped or continued based on multinomial logit model using the 2019 DHS. The results show that women who experienced FGM practice were more than 52 times as high as their non-FGM counterparts to view that FGM should continue versus that FGM should be terminated. Compared to women aged 15 – 24 years, women of other ages were 36 – 47% less likely to support the continuation of FGM practice. Compared to their rural counterparts, urban women were associated 47% lower risk ratio to support the continuation of practice FGM. Women who were Wolof or Serer ethnicity were 61 – 69% less likely to support the continuation of FGM practice in comparison with Poular. The higher level of education of a woman, the lower her likelihood to support continuation of FGM practice. Similarly, the richer a woman, the lower her likelihood to support the continuation of FGM practice. Women who are exposed to media were associated with 44% of lower odds of supporting the continuation of FGM practice. These multivariable analysis findings are generally consistent with the bivariate analysis findings.

Older ages, married women, women from Wolof and Serer, women with higher socioeconomic status (educated and wealth index), and women of exposed to mass media were associated with the lower odds of selecting their views on FGM continuation with options of "depends," "do not know," and "missing."

3.4. Relationship between FGM and STI knowledge, STI prevalence, and treatment seeking

Table 5 presents odds ratios of hearing about STIs/STSs (Columns A and B), having STIs/STSs (Columns C and D), and seeking treatments among women who had STIs/STSs (Columns E and F) by FGM status. Columns A, C, and E only included FGM practice, whether the respondent knew about STIs/STSs, and age, whereas Columns B, D, and F also included other variables. Given the less reliability of results due to the small sample size for women who had FGM but performed by non-traditional practitioners (2.2%, Table 6), we mainly focused on the comparisons between women with experiencing FGM practice performed by traditional practitioners and women without FGM.

The results in Column A show that women who experienced FGM practice performed by traditional were 57% less likely to know about STIs/STSs compared with women who did not have FGM practice when age was controlled for. The lower odds were not altered even when many other key factors were controlled for (see Column B). Women with

Table 3. Distribution of attitudes toward discontinuity of FGM among all 8,649 sampled women by selected background characteristics, Senegal, DHS 2019.

Variables	% Continuing	% Stopping	% Depends/do not know/missing
Total sample	15.6	68.6	15.8
Having FGM			
No	1.2***	78.8***	20.0***
Yes	58.3***	38.1***	3.6***
Age group (years)			
15 – 24	15.4***	62.3***	22.3***
25 – 34	16.0***	71.2***	12.8***
35 – 44	16.2***	73.8***	10.0***
45 – 49	13.1***	77.9***	9.0***
Place of residence			
Rural	22.4***	56.1***	21.5***
Urban	8.5***	81.5***	10.0***
Marital status			
Never married	10.8***	68.8***	20.4***
Married	18.0***	67.6***	14.4***
Others[a]	11.8***	80.1***	8.0***
Religion			
Muslim	15.9***	68.3***	15.8***
Non-Muslim	3.7***	78.9***	18.4***
Ethnic group			
Poular	36.0***	52.6***	11.4***
Wolof	1.3***	80.5***	18.2***
Serer	1.0***	73.8***	25.2***
Others	29.4***	61.7***	8.9***
Levels of education			
No education	20.1***	61.7***	18.2***
Primary	13.6***	67.5***	18.9***
Secondary	11.3***	77.2***	11.5***
Tertiary	3.3***	93.8***	2.9***
Wealth index			
Poorest	38.4***	38.4***	23.2***
Poor	21.6***	54.0***	24.4***
Middle	14.1***	69.4***	16.5***
Rich	7.9***	81.1***	11.0***
Richest	4.3***	87.2***	8.5***
Media exposure			
No	45.3***	28.5***	26.2***
Yes	13.7***	71.1***	15.2***

(1) [a]Widowed/divorced/separated and living with partner. (2) All the percentages in the table were weighted. (3) The statistical significances were based on Pearson Square Tests with all at $P < 0.001$

FGM performed by traditional practitioners were associated with 53% higher odds of having STIs/STSs than women without FGM, and such higher risk was enhanced when other factors were taken into account (OR = 1.63). No difference

Table 4. Factors associated with attitudes toward FGM practice, Senegal, DHS 2019.

Variables	Among all 8,649 women		Among 3,303 FGM women[a]
	Should continue versus should stop	Do not know/depends versus should stop	Should continue versus should stop
	(A)	(B)	(C)
Experienced FGM			
No®	1.00	1.00	--
Yes	53.23***	0.31***	--
Age group (years)			
15 – 24®	1.00	1.00	1.00
25 – 34	0.64**	0.47***	0.53***
35 – 44	0.61**	0.33***	0.46***
45 – 49	0.53**	0.29***	0.37***
Place of residence			
Rural®	1.00	1.00	1.00
Urban	0.48***	0.65***	0.39***
Marital status			
Never married®	1.00	1.00	1.00
Married	1.14	0.59***	1.31
Others[b]	0.90	0.47*	1.05
Religion			
Muslim®	1.00	1.00	1.00
Non-Muslim	0.64	1.38	0.37*
Ethnic group			
Poular®	1.00	1.00	1.00
Wolof	0.39**	0.80+	0.71
Serer	0.31**	1.28+	0.15*
Others	0.86	1.03	0.77*
Levels of education			
No education®	1.00	1.00	1.00
Primary	0.69**	1.04	0.62***
Secondary	0.48***	0.38***	0.37***
Tertiary	0.18***	0.16***	0.11***
Wealth index			
Poorest®	1.00	1.00	1.00
Poor	0.83	0.84	0.86
Middle	0.71*	0.52***	0.81
Rich	0.43***	0.35***	0.45***
Richest	0.35***	0.31***	0.47***
Media exposure			
No®	1.00	1.00	1.00
Yes	0.56***	0.38***	0.74+
N	8,649		3,303

(Cont'd...)

Table 4. *(Continued).*

Variables	Among all 8,649 women		Among 3,303 FGM women[a]
	Should continue versus should stop	Do not know/depends versus should stop	Should continue versus should stop
	(A)	(B)	(C)
Wald Chi–square (df)	1,912.2 (38)***		322.1 (18)***

(1) [a]Cases of "do not know/depends" were excluded due to the non-convergence of models. [b]Referring to widowed/divorced/separated and living with partner. (2) The numbers in the table refer to relative risk ratios based on multivariable multinomial logit regression models. All relatively risk ratios (Columns A and B) and odds ratios (Column C) were weighted. (3) [®]Reference category. (4) Figure in the parentheses is the degree of freedom. (5) + $P < 0.10$, *$P < 0.05$, **$P < 0.01$, ***$P < 0.001$

Table 5. Associations between FGM and STI knowledge, prevalence of STIs, and treatment seeking, 2010 – 2011 DHS, Senegal.

Variables	Among all 15,688 sampled women				Among 1,417 women with STIs/STSs	
	Heard about STIs/STSs versus no		Having STIs/STSs versus no		Treatment seeking versus no[a]	
	(A)	(B)	(C)	(D)	(E)	(F)
FGM practice and type of practice						
No FGM®	1.00	1.00	1.00	1.00	1.00	1.00
FGM non-traditional	1.61***	0.83	0.88	1.05	1.69***	1.28
FGM traditional	0.43***	0.44***	1.53*	1.63*	0.88	0.92
N	15,688	15,688	15,688	15,688	1,417	1,417
Wald Chi square (df)[b]	79.8 (5)	595.6 (20)	98.8 (6)	244.9 (21)	49.2 (6)	149.1 (21)

(1) numbers in the table refer to odds ratios based on binary logit models. Results in Columns A, C, and E only controlled for age and/or whether ever heard about STIs/STSs, whereas results in Columns B, D, and F controlled for all variables in Table 5. (2) [a]Among 1,417 women who answered the question of seeking treatment. It consists of all 197 women who reported having STIs/STSs and 1,222 women who had symptoms within the past 12 months. [b]All models were significant at $P < 0.001$. (3) The percentages in the table were weighted. (4) + $P < 0.1$, *$P < 0.05$, **$P < 0.01$, ***$P < 0.001$

in treatment seeking behaviors was found between women with FGM performed by traditional practitioners and women without FGM.

4. Discussion

Ending FGM is a matter of human rights, a matter of dignity and equality, and a matter of safe health and education. It is also crucial to achieving the Sustainable Development Goal 5 for gender equality (Powell & Mwangi-Powell, 2017; United Nations, 2015). Using the latest DHS dataset in Senegal, this study analyzed the status quo of the prevalence of practicing FGM in Senegal. We found that about 25% of women in contemporary Senegal were practicing FGM, out of which 96% was performed by traditional practitioners, and these two figures witnessed little changes in the last three decades. This indicates that Senegal needs to pool greater efforts to intensity and accelerate investments in FGM prevention and responses to achieve SDG by 2030 (Shell-Duncan *et al*., 2013; UNICEF, 2022).

One recent report by UNICEF (2022) systematically analyzed the prevalence of FGM in Senegal by different demographic characteristics. However, unlike the UNICEF study that mainly focuses on bivariate or univariate tabulations, the present study investigated factors associated with prevalence of FGM practice under multivariable regression designs. Overall, we found that in presence of all other study variables, women who were young, never married, Wolof or Serer ethnicity, rich, or exposed to social media tended to have lower prevalence of practicing FGM, and that women from urban areas or women with more education were less likely to practice FGM performed by traditional practitioners, but richer women were more likely to experience FGM performed by traditional practitioners. We further found that nearly 70% of Senegal women wish to discontinue the FGM practice, and that women who were older, from urban area, Wolof or Serer ethnicity, more educated, economically well-off, or exposed to social media were more like to support the discontinuation of FGM. These findings are generally consistent with those reported by the UNICEF (2022), but our results are more robust as they are adjusted for confounding factors.

The finding that young or never married women tended to have lower prevalence of FGM practice is also consistent with a recent study focusing on Sub-Saharan countries (Ahinkorah *et al*., 2021). Such finding is likely due to their

Table 6. Sample distribution, proportion of women having knowledge about STIs, prevalence of STIs, and treatment seeking behaviors, Senegal, 2010 – 2011 DHS.

Variables	Among all 15,688 sampled women			Among 1,417 women with STIs and symptoms
	% Sample	% knowledge about STIs/STSs	% Had any STIs/STSs in last 12 months	% STIs/STSs treatment seeking[a]
	(A)	(B)	(C)	(D)
Total	100.0	94.5	9.20	59.8
No FGM	74.3	96.5***	8.83*	42.5***
FGM, non-trad.	2.2	87.7***	13.26*	50.9***
FGM, traditional	23.4	94.6***	10.00*	63.7***
Age group (years)				
15 – 24	42.4	95.1**	6.24***	48.4***
25 – 34	31.2	96.4**	12.61***	65.7***
35 – 44	20.4	96.6**	10.60***	65.6***
45 – 49	6.0	95.6**	7.62***	46.5***
Place of residence				
Rural	50.7	93.4***	9.87*	48.0***
Urban	49.3	98.4***	8.40*	74.0***
Marital status				
Never married	29.2	96.4+	2.18***	49.4
Married	66.0	95.6+	12.19***	60.8
Others[b]	4.8	96.2+	10.80***	57.0
Religion				
Muslim	95.4	95.8	9.10	58.6**
Non-Muslim	4.6	96.5	11.28	78.5**
Ethnic group				
Poular	26.5	93.5***	9.82*	52.2*
Wolof	38.7	97.1***	8.06*	63.3*
Serer	15.0	96.3***	9.37*	61.4*
Others	19.8	96.2***	10.45*	62.7*
Levels of education				
No education	57.9	93.9***	9.90*	51.6***
Primary	21.8	97.6***	9.65*	70.0***
Secondary	18.3	99.4***	6.54*	75.0***
Tertiary	2.0	99.5***	8.45*	98.3***
Wealth index				
Poorest	16.5	88.3***	11.56*	40.3***
Poor	17.9	93.9***	8.38*	50.5***
Middle	19.9	97.5***	8.83*	58.5***
Rich	22.3	97.8***	8.36*	68.7***
Richest	23.5	99.4***	9.27*	76.5***
Media exposure				
No	8.2	86.4***	10.69+	42.3***
Yes	91.8	96.7**	9.07+	61.6***

(1) [a]Among 1,417 women who answered the question of seeking treatment. It consists of all 197 women who reported having STIs and 1222 women who had symptoms within the last 12 months. [b]Widowed/divorced/separated and living with partner. (3) Levels of statistical significance were obtained from Pearson Chi-square tests. (4) $+P < 0.1$, $*P < 0.05$, $**P < 0.01$, $***P < 0.001$

increased awareness among younger generations about the negative sequences of FGM practice. Generally speaking, women who have a higher socioeconomic status or more resources (in terms of education, wealth, and urban-rural residence) tended to have a lower prevalence rate of FGM practice and a lower proportion of FGM practice performed by traditional practitioners and were more likely to support the termination of such practice. These findings are expected since more resourceful women could have more power to make their own decision to avoid harmful practice to themselves and they are also more knowledgeable about the adverse impacts of FGM practice on their health (Diop & Askew, 2009; Doucet *et al*., 2020; Santos-Hövener *et al*., 2015; UNICEF, 2022). Women who were exposed to social media were tended to have a lower prevalence rate of FGM practice and were more likely to choose non-traditional practitioners if they had to practice FGM. Literature has indicated that media exposure could play a major role in spreading knowledge related women health and knowledge about harmfulness of FGM practice (Essén & Johnsdotter, 2004; Onuh *et al*., 2006; Kloning *et al*., 2018). Our finding supports such argument. Empowerment through education is another important factor that helps in strengthening women and girls in decision making against FGM (Karmaker *et al*., 2011; Williams-Breault, 2018). Our finding also supports such statement. Indeed, promoting education and increasing exposure to social media are essential protective weapons to fight against these harmful traditional practices and to help eradicate FGM practice.

One noteworthy finding is that Muslim women and women of Poular ethnicity are found to be more likely to experience FGM practice and support the continuation of the practice, indicating that traditional beliefs and cultural practices in these subpopulations in Senegal are strong (Muthumb *et al.*, 2015). Senegal is a religiously and ethnically diverse country where the majority of women belong to Muslim religion. The Muslim communities carry out several phenomena for FGM practices (Duivenbode & Padela, 2019). Although they are hinged on some common themes, that is, parents' social status, the family's honor, marriage opportunity, inherit practice, and many others social norms (Muthumbi *et al*., 2015). Adoption of these practices among Muslin women is the common causes for high FGM practices, sometimes girls/women accepting willingly and sometimes forcefully (Morrone *et al.,* 2002). Apart from religion, women's ethnicity also causative in FGM practices. If girls/women from Poular ethnic group not accepting FGM practice, they may not get respected from their communities and may have less chance to get married. These factors are primarily responsible for continuation of FGM practices (Van Bavel, 2020; Shell-Duncan *et al*., 2021). Institutional religious structure may also play a large role in sustaining FGM among Muslims women (Hayford & Trinitapoli, 2011; Shakirat *et al.*, 2020).

Finally, our study shows a significant association between FGM, knowledge about STIs/STSs, and the prevalence STIs/STSs among reproductive age group women in Senegal, with FGM women having low knowledge about STIs/STSs and higher prevalence of STIs/STSs. These findings highlight the importance of promotion of education and publicizing the knowledge of adverse consequences of FGM practice on women's health.

4.1. Limitations

Cautions are needed when interpreting our findings. First, the cross-sectional design of this study does not allow for an investigation of long-term health effects among women who experienced FGM practice. Longitudinal panel studies are clearly needed for understanding long-term effects. Second, no examinations for intermediate effects, no comparisons over time, and no causal relationships between FGM and STIs/STSs were not performed due to data unavailability. Relatedly, some factors related to family's or husbands' characteristics were not modeled, which may bias the associations between our study variables and FGM practice. Third, information on the timing of FGM was not available. Furthermore, some key factors related to STIs/STSs were not modeled, such as contraceptive use and sexual partner's STIs/STSs, which prohibited us from examining the reliable causal relationship between FGM and the prevalence of STIs/STSs. Fourth, we only focused on consequences of FGM on STIs/STSs, while excluding its other negative consequences that have been well-documented, such as physical and psychological (Diop & Askew, 2009; UNICEF, 2022; WHO, 2012). All these could undermine the value of the current study. We welcome further studies address these limitations to shed light on the theme.

4.2. Implications

Despite the limitations, the current study contributes to the field of women's reproductive health and gender equality in relation to SDGs. Women's educational level, economic status, exposure to social media, urban-rural residence, and ethnicity were found to be strong predictors of the FGM practice and the prevalence of STIs/STSs. These findings indicate that effective intervention programs aiming to reduce or eliminate FGM practice should be targeted to rural women,

women with lower education, poor women, and Poular women. Although the Senegal's central and local governments have been working together with international governmental and non-governmental organizations and other stakeholders using a variety of strategies to reduce FGM practices and prevent women from STI and HIV, and the country even has a strong law against the FGM practices (Kloning *et al.*, 2018; Rouzi, 2013), our findings suggest that the Senegal Government needs to make more efforts to further reduce and eventually eliminate FGM practices in order to achieve SDGs within less than a decade. Specifically, the Senegal Government may consider implementing intervention programs that focus more on promotion of women's education, their economic empowerment, poverty reduction, and dissemination of knowledge about consequences of the FGM practice, especially among rural and Poular women.

5. Conclusions

To prevent and eliminate FGM harmful practice, it's essential to understand patterns associated with such practices and its adverse consequences, especially among women. With this motivation, this study used the 2019 DHS and the 2010 – 2011 DHS to examine factors associated with FMG among reproductive aged women in Senegal. Overall, the findings of this study suggest that economic empowerment, poverty reduction, education promotion among women may help reduce and eventually eliminate FGM practice in Senegal. The Senegal Government and its local governments should make more efforts in disseminating knowledge and increasing public awareness about the negative health consequences of FGM practice, launching more effective intervention programs to promote education and poverty reduction that not only target Goal 5 Target 5.4, but also target other SDGs.

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Conflict of interest

The authors have no conflicts of interest to declare.

Author contributions

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Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Availability of data

Data utilized to this paper is from secondary sources and available to public (https://dhsprogram.com/data/available-datasets.cfm).

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RESEARCH ARTICLE

Polygyny and spousal violence in India: Findings from the 2019 – 2021 national family health survey

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Abstract: Polygyny results in a variety of physical, sexual, and psychological consequences for women which has an impact on gender relations such as the subordination of women, unequal treatment of spouses, neglect of children, rivaling step-children, and inheritance issues among children/spouses. This study aims to explore the association between polygyny and spousal violence in India using the data from the fifth round of the National Family Health Survey-5 of India in 2019 – 2021, which provides information on both polygyny and spousal violence. To understand the effect of polygyny on spousal violence, multivariate logistic regressions were used to obtain unadjusted and adjusted odds ratios by controlling a number of explanatory factors. The results reveal that women in polygynous unions experience more spousal violence compared with those in monogamous unions. The results indicate that, since the law does not permit men to be married to more than one wife simultaneously, this form of marriage should be discouraged by strictly enforcing it to protect women from marital violence in polygynous unions. The analysis contributes to the body of the literature on the association between polygynous marriage and spousal violence in the Indian context.

Keywords: Polygyny; Spousal violence; India; National family health survey

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1. Introduction

Polygyny is a form of polygamy involving the practice of one man being married to multiple wives at the same time. Polygyny was commonly practiced in many cultures around the world – it existed in more than 83% of 849 cultures worldwide during 1960 – 1980 (Coult & Habenstein, 1965; Murdock, 1981; Gray, 1998) and, in 35% of cultures, it is sororal, that is, men marry sisters (Coult & Habenstein, 1965). Although polygyny is not a common practice today as opposed to the past, it is still being practiced by some sections of the communities in many parts of the world, especially in many Islamic and African nations (Jansen & Agadjanian, 2020; Kramer, 2020), and including India (Rahaman *et al.*, 2022).

The practice of polygyny exists in different ways depending on religious, customary, cultural, regional, and socioeconomic contexts (Altman & Ginat, 1996; Bretschneider, 1995; Jansen & Agadjanian, 2020). The consequences associated with the practice may also differ according to these contexts. There are several causes and consequences of polygynous marriage. Polygyny may occur for various reasons such as excess mortality of men than women, leading to a deficit of men and surplus of women, desire to have children to continue the family line, failure to produce children/son by first wife, and the cultural practices of lengthy periods of sexual abstinence after childbirth driving the man to seek another partner (Dorjahn, 1959; Ezeh, 1997; Gage-Brandon, 1992; Josephson,

2002; Kiros & Kertzer, 2000; Lardoux & van de Walle, 2003; Rice, 2000; Rahaman *et al*., 2022; Sichona, 1993; White & Burton, 1988).

Polygyny has several negative consequences such as gender inequality, subordination of women, unequal treatment of spouses, neglect of children, rivalling step-children, and inheritance issues among children/spouses (Al-Krenawi & Lev-Wiesel 2002a; Al-Krenawi *et al*., 2002b; Al-Krenawi, 2001; Cherian, 1989). Polygyny also affects spousal age differences, coital frequency, child survival, marital relationships, widowhood, and mental health (Arthi & Fenske, 2018; Ashby & Gupta, 2013; Brainard, 1991; Lardoux & van de Walle, 2003; Lesthaeghe *et al*., 1989; Shepard, 2013; Timaeus & Reynar, 1998). Contemporary social scientists have explored the effect of polygamous marriage systems on gender relations. As a part of the global effort to address the gender equality and women's empowerment, the Sustainable Development Goal five (SDG-5) of the United Nations targets to eliminate all forms of violence against women by 2030. Specifically, the indicator 5.2.1 of SDG-5 monitors "the proportion of ever-partnered women and girls aged 15 years and older subjected to physical, sexual, and psychological violence by a current or former intimate partner in the previous 12 months" (United Nations, 2015 p. 18). In view of the SDG-5 and the emerging literature pointing toward the effect of polygyny on gender relations, it would be appropriate to examine its effect on spousal violence.

Spousal violence has been linked to several health consequences for women, physical injury, unwanted or forced sex, pregnancy losses, contraction of sexually transmitted diseases, depression, and psychological distress for women (Durevall & Lindskog, 2015; Mason & Lodrick, 2013; WHO, 2013; WHO, 2021b). Studies conducted to identify the determinants of spousal violence have found the age at first marriage, spousal age difference, education, wealth index, women's autonomy, place of residence, and race/ethnicity, controlling behavior of men and alcohol use by men as some of its important predictors (Kimuna & Djamba, 2013; Goli *et al*., 2020; Parekh *et al*., 2022). Recent literature also indicates that the type of marital union (monogamy and polygamy) has an effect on spousal violence (Behrman, 2019; Jansen & Agadjanian, 2020; Ahinkorah, 2021). Polygyny is a harmful practice and a form of violence against women under international law (Boltz & Chort, 2016). In general, it results in a variety of physical, sexual, and psychological harm to women.

According to NFHS-4 (conducted in 2015 – 2016), 26.4% of the ever-married women have experienced physical, sexual, or emotional violence in India (IIPS & ICF, 2017). In India, 52% of women and 42% of men agree that a husband is justified in hitting or beating his wife, indicating that it is a gendered norm that husbands have the right to control their wives through violence (IIPS & ICF, 2017). These gendered attitudes reflect that the broader gender inequalities in India are deeply rooted in the marital system that forces a woman to be younger than her husband, dowry to be paid to the husband's family, reside in husband's residence after marriage, and lack of inheritance of parental property. Polygynous form of marriage, along with traditional patriarchal norm of male dominance in decision making and female subordination, may lead to increased risk of spousal violence. Considering the lack of research in India with respect to the prevalence of polygyny and its impact on gender relations, this study aims to explore the association between polygyny and spousal violence in India. The availability of data both on polygyny and spousal violence in the fifth round of the National Family Health Survey (NFHS) of India (conduced in 2019 – 2021) makes it possible to look into their association. The paper is presented as follows: after introduction, the paper focuses on the literature review and polygyny in India, followed by data and methods, results, discussion, conclusion, and finally limitations.

1.1. Literature review

Gender-based violence is globally recognized as a violation of basic human rights, particularly against women. It is defined by the United Nations as "any act of gender-based violence that results in, or is likely to result in, physical, sexual, or mental harm or suffering to women, including threats of such acts, coercion, or arbitrary deprivation of liberty, whether occurring in public or in private life" (United Nations, 1993, p. 3). Increasing body of the literature has highlighted its extent, pattern, causes, and consequences. Spousal or intimate partner violence is the most widespread common form of violence against women globally (Kishor & Johnson, 2004; Garcia-Moreno *et al*., 2005; Hindin *et al*., 2008; the WHO, 2021a). Analysis of prevalence data in 2000 – 2018 across 161 countries and areas by the WHO found that worldwide, nearly 1 in 3 women were subjected to physical and/or sexual violence by an intimate partner or non-partner sexual violence or both (the WHO, 2021a). Gender-based violence exists in many forms and spousal/intimate partner violence has been regarded as its most significant component. Spousal violence often serves to reinforce the prevailing gendered power relations in the families, communities, and regions. In patriarchal societies, violence against women is used as a tool to reinforce control on women (ICRW, 2004; Jakobsen, 2014; Jewkes *et al*., 2015; Weitzman, 2014).

Polygyny is a form of violence against women under international law (Boltz & Chort, 2016). In general, it results in a variety of physical, sexual, and psychological harm to women. Some studies revealed that polygamy creates inequality

amongst co-wives since the husband cannot care for and cater to the needs of more than one wife. The odds of intimate partner violence (IPV) is higher among women with co-wives compared to those in monogamous marriages (Heath *et al*., 2020; Jansen & Agadjanian, 2020; Rahaman *et al*., 2022). The literature also suggests that women involved in polygyny are susceptible to sexually transmitted diseases, infertility, and mental health complications (Ashby & Gupta, 2013; Shepard, 2013). A husband's ability to marry another wife can be used to abuse and control the current wife (Cook & Kelly, 2006). The abuse may be elicited either by the husband or the co-wives (McDermott & Cowden, 2015). The option of taking another wife allows a husband to evade the conflicts inherent in the spousal relationship such as disagreements regarding role division, sexual relations, and distribution of resources/finances/properties (Ross, 2002; UNCHR, 2002). Unresolved issues can also lead to frustration and feelings of hostility and anger on the husband's part, resulting in aggressive behavior with the earlier wife. Hence, it is pertinent to understand that the relationship between polygyny and spousal violence is causal or driven by the background characteristics of women such as residence, caste, religion, education, and wealth.

Studies that have analyzed the relationship between polygyny and spousal violence in recent years, mainly in the African context, have found that spousal violence is higher in polygynous marriages compared with monogamous marriages (Ahinkorah, 2021; Al-Krenawi & Lev-Wiesel, 2002; Amo-Adjei &Tuoyire, 2016; Behrman, 2019; Ebrahim & Atteraya, 2020; Heath *et al*., 2020; Jansen & Agadjanian, 2020). Polygyny may constitute a source of friction and conflict in the family (Amo-Adjei & Tuoyire, 2016; Uthman *et al*., 2010). Controlling behavior of men has been described as enforcing masculinity through male authority to control women (Barker & Ricardo, 2005; Heath *et al*., 2020). Polygynous relationships are usually characterized by competition for resources among competing co-wives (Wekwete *et al*., 2014). A husband, therefore, manages and controls his wives to prevent rivalry between them (Agadjanian & Ezeh, 2000). In polygynous marriages, it is difficult for the husbands to provide equal space for all wives to discuss matters and listen to their emotions and feelings. They think that they need to be fully respected and cannot tolerate the rejection of their decisions (Mukhuba, 2017). Women's autonomy does not necessarily evenly characterize all aspects of the conjugal lives of co-wives. While a husband may allow certain independence to one of his spouses with regard to handling of their resources, this may lead to disagreement and conflict with another wife. Several studies have been conducted in India to understand the predictors of spousal violence (Garg *et al*., 2021; Jejeebhoy, 1998; Jeyaseelan et al., 2007; Koenig *et al*., 2006). However, with few exceptions (Rahaman *et al*., 2022), studies on the association between polygyny and spousal violence are lacking in the Indian context. Therefore, a comprehensive study that examines the association between polygyny and spousal violence is worthwhile. Understanding the role of polygynous unions in spousal violence in India would not only be helpful to identify the factors contributing to it but also provides a benchmark for the government to frame policies to stop it.

1.2. Polygyny in India

Although monogamy was the preferred marriage system in India, historically, polygamy was permitted under certain circumstances. There are two forms of polygamy – one is polygyny (a man marries more than one woman) and another is polyandry (a woman marries more than one man). In the past, it was a common custom among the kings, upper castes, merchants, wealthy classes, and elites to have multiple wives to practice unrestricted polygyny (Bhati, 2020; Singh, 2019; Yelamanchili & Parasuraman, 2010). The Hindu Marriage Act of India prohibited the practice of polygyny in 1955. Although India banned polygyny among Hindus, this practice still exists among them (Sahoo *et al*., 2022; Yelamanchili & Parasuraman, 2010) and the Personal Law of Muslims legally allows such practice. Hence, the practice of polygyny continues in India irrespective of region, religion, caste or class at varying levels. However, over the years, due to the law prohibiting polygyny and possibly the rising cost of maintaining more than one family/wife, it is uncommon to find a man being married to more than one wife simultaneously. The analyses of three rounds of NFHS data indicate that the prevalence of polygyny is low in India, and it declined from 1.9% in 2005 – 2006 to 1.6% in 2015 – 2016 and to 1.4% in 2019 – 2021. Socioeconomic variation in polygyny is observed in India, with higher prevalence among poor, uneducated, rural, and older women compared to their counterparts. Regional variation in polygyny exhibits higher prevalence in the North-eastern region, followed by Southern and least in Northern region of India (Sahoo et al., 2022).

2. Data and Methods

The present investigation is based on a secondary analysis of the data collected in NFHS-5 during 2019 – 2021. The NFHS is a nationally representative, cross-sectional, and demographic and health survey similar in design to the general format adopted for Demographic and Health Surveys (DHS) worldwide. For this study, 512,408 currently married women

were investigated from NFHS-5. Since the data provides information about the other co-wives of women, it is possible to study polygynous marriage and its relation to spousal violence. In NFHS-5, a question was asked, "Besides yourself, does your husband have other wives?" Women who indicated that their partners had no other wives were considered to be in non-polygynous marriages (i.e., monogamy), while those who indicated that their partners had one or more other wives were considered as those being in polygynous marriages. Hence, a dichotomous outcome variable was derived from the polygyny variable and coded as 0 = non-polygynous and 1 = polygynous.

Although NFHS-5 provides information at the district level, the survey includes a section on "Domestic Violence" only at the state level (IIPS & ICF, 2021). Data were collected from only one woman in each household. The present study used the sample of currently married women aged 15 – 49 years. After applying weight, the final sample size for spousal violence was 58,699 currently married women. Women who had ever been physically, emotionally, or sexually abused by their current husband in the past 12 months were categorized as having "experienced any spousal violence." To calculate physical violence, the currently married women were asked seven questions, such as "Did your partner: (a) slap? (b) twist the arm or pull the hair? (c) push, shake, or throw something at? (d) punch with his fist or with something that could hurt? (e) kick, drag or beat? (f) try to choke or burn on purpose? and (g) threaten or attack with a knife, gun, etc.?" If a woman reported that she had experienced any of the above acts by her husband, it was considered as an incident of physical violence. Similarly, for the computation of emotional violence, currently married women were asked "If their husbands: (a) say or do something to humiliate you in front of others? (b) threaten to hurt or harm you or someone close to you? and (c) insult you or make you feel bad about yourself?" If one of the answers by a woman was affirmative, it was considered as a case of emotional violence. As for sexual violence, women were asked: "(a) ever been physically forced into unwanted sex by husband/partner? (b) ever been forced into other unwanted sexual acts by husband/partner? and (c) ever been physically forced to perform unwanted sexual acts?" If the response was positive for one of the questions by a woman, then it was considered as a case of sexual violence.

The study examined the possible association between polygyny and spousal violence by doing cross-tabulation. Multivariable logistic regressions were used to obtain unadjusted and adjusted odds ratios by controlling a number of explanatory factors such as caste, religion, residence, region, wealth index, age of the respondent, age at marriage, number of living children, spousal age difference, educational status, work status, decision-making power in the household, freedom to go out alone, control over money, attitude toward wife-beating, alcohol consumption of husband, and marital control by husband. $p < 0.05$ was considered statistically significant at 95% of the confidence interval. The odds ratio larger than one represents a greater likelihood of the outcome than the reference category (non-polygynous women) in the logistic regression analysis. Statistical analyses were conducted using Stata version 16.

3. Results

In India, around 1.4% of the currently married women (N = 7,183) in 2019 – 2021 reported that their husbands had other wives. Table 1 presents the percentage of currently married women who experienced spousal violence in the past 12 months by type of marital union. Out of 58,699 eligible women selected for the domestic violence module, 57,757 were in non-polygynous union and 942 in polygynous union. In India, 22.3% women were victims of at least one type of physical violence by their husbands. Among them, 38.5% were from polygynous union and 22.1% from non-polygynous union. It was observed that all the acts of physical violence were more than double in polygynous union than in non-polygynous union. Regarding different types of violence, slapping was the most reported act of physical violence, followed by being pushed, shaken, or having something thrown at them.

Overall, 4.9% women faced sexual violence for the past 1 year – 12.2% and 4.8% of them belonging to polygynous and non-polygynous unions, respectively. Being physically forced to have sexual intercourse was the most prevalent sexual violence (10.1% in polygynous and 3.5% in non-polygynous), followed by forced with threats and forced to perform sexual act that women did not want to. About 11.6% women reported that their husbands had emotionally abused them. Women in polygynous union (27.8%) were more likely to report emotional violence than those in non-polygynous ones (11.3%). Saying or doing something to humiliate them in front of others (19.5%) and insulting them or making them feel bad about themselves was the usual form of emotional violence. All three types of emotional violence were reported by a higher proportion of women in polygynous union than in non-polygynous union. Overall, more women in polygynous union reported experiencing either physical, sexual, and emotional violence separately or in combination of these than women in non-polygynous union.

The socioeconomic characteristics of women who endured violence are depicted in Table 2. As mentioned earlier, polygynous women experienced more violence than non-polygynous women. It was observed that 50.6% of the polygynous and 30.8% of the non-polygynous women who belonged to the scheduled castes suffered most from marital violence, followed by those from others, other backward classes, and scheduled tribes. In particular, among scheduled

Table 1. Percentage of currently married women who faced different forms of spousal violence in the past 12 months in polygynous and non-polygynous marriage in India, 2019 – 2021.

Type of violence	Non-polygynous	Polygynous	Total
Physical violence			
Any form of physical violence	22.1	38.5	22.3
Pushed her, shook her, or threw something at her	9.3	21.5	9.5
Slapped her	19.0	33.1	19.2
Punched her with his fist or with something that could hurt her	5.8	15.3	5.9
Kicked her, dragged her, or beat her up	6.1	13.4	6.2
Tried to choke her or burn her on purpose	1.6	5.5	1.7
Threatened her or attacked her with a knife, gun or any other weapon	0.8	3.9	0.9
Twisted her arm or pulled her hair	7.8	16.8	7.9
Sexual violence			
Any form of sexual violence	4.8	12.2	4.9
Physically forced her to have sexual intercourse with husband even when she did not want to	3.5	10.1	3.6
Forced her to perform any sexual acts she did not want to	1.8	3.8	1.9
Forced her with threats or in any other way to perform any sexual acts she did not want to	2.7	8.9	2.8
Emotional violence			
Any form of emotional violence	11.3	27.8	11.6
Said or did something to humiliate her in front of others	7.4	19.5	7.6
Threatened to hurt or harm her or someone close to her	4.6	13.9	4.8
Insulted her or made her feel bad about herself	6.7	18.7	6.9
Any form of physical and sexual violence	3.8	10.3	3.9
Any form of emotional and physical and sexual violence	2.4	8.2	2.5
Any form of physical and/or sexual violence	23.1	40.4	23.4
Any form of emotional or physical or sexual violence	25.8	44.5	26.1
Number of currently-married women	57,757	942	58,699

tribes, the percentage of polygynous women experiencing sexual violence was three times higher (12.2%) than that of non-polygynous women (4.8%). A large proportion of Hindu women from polygynous unions (46.0%) reported some form of violence than non-polygynous women (26.7%). The percentage of women reporting violence in Muslim polygynous families (42.5%) was almost near of the Hindus. In rural areas, the prevalence of violence was higher for polygynous (45.0%) and non-polygynous women (42.7%) than in urban areas.

Spousal violence by region shows that a higher proportion of women in polygynous union reported violence from the western region (50.4%). In non-polygynous unions, it was higher in the southern parts (30.4%) of India (Figure 1). Physical violence among polygynous unions in Southern region of India (43.4) was higher than among non-polygynous women (26.3%). As expected, spousal violence was high among the poorest women – 46.8% in polygynous unions and 34.2% in non-polygynous families. The prevalence of spousal violence among non-polygynous women declined gradually from low to high wealth quintile, violence against the richest women in polygynous unions was very high (32.4%) compared to richest women in non-polygynous unions (14.9%). A similar result was found for emotional violence.

Table 3 compares the different forms of marital/spousal violence according to individual characteristics of women, dimensions of women's agency and polygyny status. Nearly, two-fifths (44.5%) of polygynous women compared with one-fourth (25.8%) of non-polygynous women had to face marital/spousal violence. In the polygynous and non-polygynous unions, violence was more prevalent among women who got married before the legal age (18 years), had no formal education, had more than two children, and worked on a wage basis.

Decision-making power or women's empowerment has a significant impact on the incidence of violence. Notably, marital violence is higher in polygynous unions (42.0%) compared to non-polygynous unions (24.3%), where women

Table 2. Percentage of currently married women who have experienced spousal violence in the preceding 12 months according to household characteristics and by the status of polygyny, 2019 – 2021.

Background characteristics	Physical violence		Sexual violence		Emotional violence		Any violence	
	Non-polygynous	Polygynous	Non-polygynous	Polygynous	Non-polygynous	Polygynous	Non-Polygynous	Polygynous
Caste								
Scheduled castes	26.7	41.7	5.6	12.7	13.9	32.4	30.8	50.6
Scheduled tribes	24.3	30.3	4.8	12.2	11.9	30.1	28.2	40.2
Other backward classes	23.3	41.3	4.7	13.0	11.3	27.4	27.0	42.8
Others	16.2	35.5	4.3	10.4	9.4	22.6	19.8	44.2
Religion								
Hindu	22.9	39.8	4.7	12.4	11.6	27.9	26.7	46.0
Muslim	20.4	37.4	5.2	12.1	10.8	28.4	24.2	42.5
Others	14.1	27.1	3.4	10.2	8.7	28.7	17.8	34.4
Residence								
Urban	17.9	37.9	3.6	8.9	9.4	29.2	21.4	42.7
Rural	23.9	38.6	5.3	13.0	12.2	27.5	27.8	45.0
Region								
North	11.4	23.8	3.3	2.6	7.3	12.0	14.7	30.3
South	26.3	43.4	4.2	11.4	14.1	33.8	30.4	49.0
East	25.1	39.2	6.4	17.8	12.5	28.6	29.1	46.7
West	15.6	42.8	3.5	10.9	8.8	31.9	19.1	50.4
Central	25.4	30.2	4.9	6.5	10.8	18.2	28.8	32.2
North-east	21.0	23.5	5.2	4.3	9.7	10.6	24.8	27.2
Wealth Index								
Poorest	29.7	41.1	7.9	22.5	15.1	27.8	34.2	46.8
Poorer	27.4	35.7	6.0	7.1	13.1	24.9	31.4	41.3
Middle	22.7	38.3	4.2	7.8	12.0	31.4	26.6	47.5
Richer	17.8	41.8	3.4	6.1	9.5	32.0	21.3	44.5
Richest	12.0	26.7	2.2	12.3	6.7	14.4	14.9	32.4
Total	22.1	38.5	4.8	12.2	11.3	27.8	25.8	44.5

had not participated in any of the household decision making and lower where women had participated in three to four household decisions (58.2% and 34.9%, respectively). Polygynous women (45.5%) and non-polygynous women (25.4%) who had the freedom to go out alone had experienced lesser violence than those who did not. On the other hand, polygynous or non-polygynous women who had a bank account were more likely to suffer from marital violence than those who did not have a bank account. About 35% of the polygynous women agreed that beating a wife without any reason was justified, whereas 57.7% agreed that beating in just 5 – 7 situations was justified if the wife: (a) went out without telling her husband, (b) neglected the house or children, (c) argued with her husband, (d) refused to have sex with him, (e) did not cook properly, (f) was unfaithful to her husband, and (g) showed disrespect to the in-laws. Among non-polygynous women, 37.8% reported that wife-beating was justified in 3 – 4 situations. More than half of the polygynous women (58.7%) and 44.2% of non-polygynous women reported spousal violence when their husbands were alcoholics. Husband's alcohol habit appeared to increase spousal violence across all categories of violence among polygynous and non-polygynous unions. Further, marital violence was higher among polygynous (66.7%) and non-polygynous women (54.7%) when husbands had 3 – 6 types of controlling behavior over women.

The unadjusted odds ratio (UOR) and adjusted odds ratio (AOR) with 95% confidence interval (CI) of the multivariate logistic regression model is presented in Table 4 to show the relationship between polygyny and spousal violence. The unadjusted odds ratio shows that the likelihood of physical violence was 1.87 times more among polygynous women than

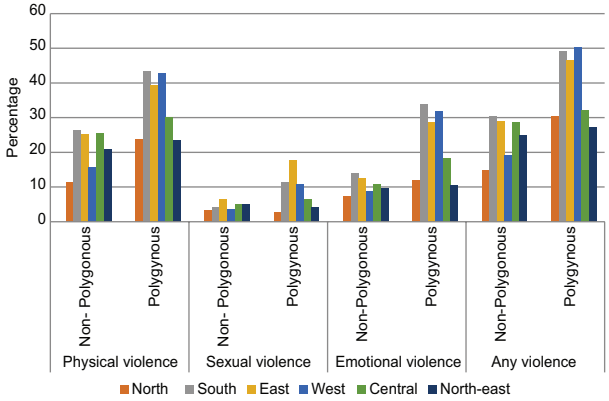

Figure 1. Percentage of Polygyny and Spousal Violence by Region, India, 2019 – 2021.

among non-polygynous women in India. After controlling the other variables, a similar result (with a lower AOR = 1.36) was found in the adjusted model. The result is also consistent for the physical, sexual, and emotional violence with higher odds in sexual and emotional violence in both unadjusted and adjusted models. Although the unadjusted odds of polygyny showed that spousal violence was higher in all the regions of India, no significant relation was found for Eastern, Northern, and Central regions while adjusting all the factors. While physical (UOR = 2.77) and sexual violence (UOR = 2.95) was higher among polygynous women in the western region, emotional violence was significantly higher among polygynous women in the southern region (UOR = 2.67, AOR = 1.64). Since the odds ratio of polygyny was greater than one, it vividly becomes a risk factor for polygynous women.

4. Discussion

Spousal violence is still widespread in India and women in polygynous marriages have higher odds of experiencing marital violence than in non-polygynous marriages. The results of the study indicate that nearly two-fifths of women from polygynous marriage and about one-fourth from non-polygynous marriage were victims of spousal violence in 2019 – 2021 in India. Several studies found that women in polygynous unions were more likely to experience spousal violence than their monogamous counterparts (Abramsky *et al*., 2011; Ahinkorah, 2021; Behrman, 2019; Bove & Valeggia, 2009; Jansen & Agadjanian, 2020; Jewkes *et al*., 2002; Rahaman *et al*., 2022; Kimuna & Djamba, 2008; Nyamayemombe, *et al*., 2010). However, most of these studies were from Africa, where the prevalence of polygyny was much higher than in India. Although Rahaman *et al*. (2022) studied women's violence between polygynous and monogamous marriages in India, their data were from the 4th wave of NFHS in 2015 – 2016. Our results are not only a merely update but also are an extension of theirs by examining factors associated with specific types of spousal violence and regional variations in a more systematic way.

In spite of the lower prevalence of polygyny in India, the association between polygyny and spousal violence is the same as that in Africa. The possible reasons attributed by the above-mentioned studies for the positive association between polygyny and spousal violence are as follows: less spousal communication and weaker emotional ties in polygynous unions; competition for resources between senior and junior wives leading to strain in familial relationships; low cooperation/interaction between co-wives attributed to competition amongst competing co-wives for various reasons; husband's controlling behavior on the first/older wife once he establishes a second/younger relationship; conflict/jealousy among co-wives pushing the husbands to control them through violence; use of violence by the husbands to resolve the power dispute among the co-wives; and socioeconomic characteristics of the husband, wife, and households.

Our study also finds that the odds of experiencing all the three types of spousal violence (physical, sexual, and emotional) was significantly higher for women in polygynous unions than for those in monogamous ones in India and across all regions. Slapping was the most common form of physical violence with the highest levels observed among polygynous women. Nearly, 12% of women in India experienced sexual violence in polygynous unions and 5% in non-polygynous unions. Among women who experienced sexual violence in polygynous unions, most (10%) were forced to have sex with their husbands. A previous study on polygyny also found that marital rape occurred when a husband forced his wife to take part in sexual acts without her consent (Ogunwale *et al*., 2020). More women in polygynous unions than non-polygynous ones suffered from emotional violence. A husband's exclusive support for one wife creates rivalry,

Table 3. Percentage of currently married women who have experienced spousal violence in the preceding 12 months according to their individual characteristics and dimensions of women's agency and by the status of polygyny, India, 2019 – 2021.

Woman level indicators and characteristics related to violence	Physical violence		Sexual violence		Emotional violence		Any violence	
	Non-polygynous	Polygynous	Non-polygynous	Polygynous	Non-polygynous	Polygynous	Non-Polygynous	Polygynous
Sociodemographic								
Current age (years)								
15 – 24	19.5	35.6	4.8	1.05	10.2	25.6	23.8	43.2
25 – 34	22.8	35.3	5.0	10.1	11.8	25.3	26.3	41.1
35 and above	22.4	40.3	4.6	14.4	11.4	29.2	26.2	46.2
Age at marriage (years)								
<18	26.5	40.5	5.8	12.7	13.0	28.3	30.2	46.4
≥18	18.6	37.2	4.0	11.9	10.1	27.5	22.4	43.4
No. of living children								
0	13.5	24.2	3.4	3.5	8.8	16.8	17.6	27.9
1	17.4	43.4	4.2	9.0	9.8	30.4	21.3	45.8
2	20.8	34.6	4.1	15.8	11.0	28.5	24.7	48.0
3 and above	28.1	46.3	6.2	16.7	13.1	30.9	31.7	49.0
Spousal age difference (years)								
Wife older or same age with husband	17.2	69.9	3.8	37.8	8.0	27.9	19.4	74.4
Husband older 1 – 2 years	22.8	44.5	5.0	5.2	10.8	36.9	26.0	45.7
Husband older of 3 and above years	22.3	36.5	4.8	11.7	11.7	27.0	26.3	43.1
Educational attainment level								
No. formal education	30.1	38.9	6.3	14.3	14.6	27.8	33.9	43.6
Primary	24.5	40.1	5.8	15.8	12.1	23.3	28.2	41.8
Secondary and higher	17.8	36.9	3.8	6.8	9.7	30.8	21.5	47.6
Wage work status								
Not worked for wages	19.7	35.0	4.0	5.5	9.5	23.6	23.1	40.6
Worked for wages	26.7	41.7	6.2	18.3	14.9	31.7	31.2	48.2
Agency								
Decision-making authority (no. of household decisions in which woman participates)								
0	20.9	37.1	4.3	9.9	10.1	23.4	24.3	42.0
1 – 2	25.9	28.5	6.1	12.1	15.1	23.6	31.2	40.8
3 – 4	29.9	54.5	9.2	23.0	21.0	51.7	34.9	58.2
Freedom of movement to visit all three locations probed alone								
No	22.9	39.3	5.1	8.2	11.9	22.4	26.7	42.5
Yes	21.7	38.1	4.6	14.1	11.1	30.4	25.4	45.5

(Cont'd...)

Table 3. *(Continued).*

Woman level indicators and characteristics related to violence	Physical violence		Sexual violence		Emotional violence		Any violence	
	Non-polygynous	Polygynous	Non-polygynous	Polygynous	Non-polygynous	Polygynous	Non-Polygynous	Polygynous
Control over money: Owns a bank account								
No	21.8	22.7	5.1	9.5	11.7	21.0	25.4	31.9
Yes	22.2	42.6	4.7	12.9	11.2	29.6	25.9	47.8
Attitudes to wife beating: Number of situations in which wife beating is justified								
0	15.1	30.4	3.2	7.4	7.3	22.1	17.9	35.0
1 – 2	25.3	42.2	4.7	8.7	12.6	26.8	29.7	44.3
3 – 4	32.9	41.9	7.3	13.5	17.2	32.8	37.8	53.5
5 – 7	32.1	51.4	8.3	28.2	18.5	37.5	37.2	57.7
Characteristics related to violence								
Alcohol consumption by husband								
No	17.1	29.9	3.2	4.9	8.4	22.1	20.6	35.9
Yes	39.3	52.6	10.3	24.2	21.4	37.2	44.2	58.7
Number of marital control behavior displayed by husband								
0	11.2	27.2	1.1	4.1	3.2	14.3	12.7	29.8
1 – 2	28.2	34.1	5.4	8.2	13.0	19.0	33.3	42.7
3 – 6	46.3	58.2	15.1	27.1	34.0	54.9	54.7	66.7
Total	22.1	38.5	4.8	12.2	11.3	27.8	25.8	44.5

violence, and bad feelings among other wives. Sometimes husbands' resort to emotional violence to control violence between wives (Adewale *et al*., 2021).

Regardless of the personal characteristics of women and the form of violence, a higher proportion of women in polygynous unions experienced spousal violence compared to non-polygynous women. Scheduled caste women (bottom of India's caste system), especially those in polygynous unions, were subjected to severe violence. Irudayam *et al*. (2012) argued that schedule caste women (known as dalit women) faced local gender-and-caste discrimination and violence due to extreme imbalance in social, economic, and political power equations. While there was a significant difference in spousal violence between polygynous and non-polygynous women, there was little difference between Hindu and Muslim polygynous women. Spousal violence was more prevalent in rural areas than in urban areas, especially in polygynous marital structures, indicating stronger patriarchal norms in rural areas than in urban areas. In this study, spousal violence was observed to be higher among working women in polygynous and non-polygynous unions. Many studies have also reported similar findings in other contexts (Schuler *et al*., 1998; Gallin, 1999; Tranchant & Mueller, 2017) and in India (Krishnan, 2005; Rocca, *et al*., 2008; Krishnan *et al*., 2010; Weitzman, 2014), indicating a conflict between financial autonomy of women and marital control behaviors of husbands. Studies by Rao (1997) and Krishnan (2005) found that economic status and alcohol consumption by the husbands played an important role in the abuse of wives in India. Consistent with other studies, poor polygynous women were more likely to be exposed to violence due to their low income and poor bargaining power (Aizer, 2011). Furthermore, the possibility of spousal violence may not carry a monotonous negative relationship with increasing wealth (Kishor & Johnson, 2005). Our results also indicate that emotional violence was higher among the richest women in polygynous unions compared to richest women in non-polygynous unions. As the evidence for the positive relationship between wealth status and emotional violence is less in the literature, the issue requires further probing. However, it should be noted that the studies have reported the higher prevalence of spousal violence if the wives were engaged in paid employment or earned more than their husbands (Dalal, 2011; Kishor & Johnson, 2005; Stöckl *et al*., 2021). As the economic empowerment of women increases spousal violence, there is a possibility that increased wealth status of the households may lead to increased emotional violence, if not physical/sexual violence.

Globally, women who married before the age of 15 years were more likely to experience violence than those who married 18 (Ahinkorah *et al*., 2022; Kidman, 2017). Under both marriage categories (<18 years and ≥18 years), women

Table 4. Unadjusted and adjusted odds ratios showing the effect of polygyny on spousal violence by region, India, 2019 – 2021.

Region	Physical violence		Sexual violence		Emotional violence		Any violence	
	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted
India	1.87 (1.63, 2.14)***	1.36 (1.17, 1.58)***	2.17 (1.74, 2.70)***	1.36 (1.07, 1.74)*	2.18 (1.87, 2.55)***	1.47 (1.23, 1.76)***	1.93 (1.69, 2.19)***	1.39 (1.19, 1.61)***
North	2.58 (1.44, 4.64)**	1.69 (0.85, 3.35)	1.04 (0.25, 4.25)	0.54 (0.12, 2.32)	1.90 (0.90, 4.01)	0.95 (0.40, 2.24)	2.63 (1.52, 4.52)***	1.80 (0.94, 3.50)
South	2.28 (1.75, 2.98)***	1.50 (1.10, 2.05)*	2.95 (1.94, 4.50)***	1.62 (0.99, 2.63)	2.67 (1.99, 3.58)***	1.64 (1.14, 2.25)***	2.26 (1.74, 2.95)***	1.45 (1.06, 1.99)*
East	1.47 (1.10, 1.96)**	1.09 (0.79, 1.50)	2.43 (1.62, 3.64)***	1.68 (1.07, 2.65)*	1.92 (1.37, 2.71)***	1.34 (0.91, 1.96)	1.67 (1.27, 2.21)***	1.25 (0.92, 1.71)
West	2.77 (1.61, 4.77)***	2.13 (1.14, 3.97)*	2.95 (1.25, 6.95)*	2.38 (0.90, 6.20)	2.23 (1.15, 4.33)*	1.68 (0.77, 3.66)	2.73 (1.61, 4.64)***	2.20 (1.19, 4.90)*
Central	1.41 (1.04, 1.92)	1.24 (0.88, 1.74)	1.16 (0.63, 2.14)	0.87 (0.44, 1.76)	1.87 (1.29, 2.71)**	1.55 (1.01, 2.38)*	1.32 (0.97, 1.78)	1.12 (0.79, 1.57)
North-east	1.81 (1.36, 2.41)***	1.41 (1.02, 1.94)*	1.86 (1.15, 2.99)*	1.23 (0.73, 2.07)	2.19 (1.50, 3.07)***	1.46 (0.99, 2.14)*	1.94 (1.49, 2.53)***	1.47 (1.08, 2.00)*

Note: Unadjusted model examining the independent association of polygyny and spousal violence; Adjusted model for the variables listed in Table 2 and 3; and 95% confidence intervals in brackets. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

from polygynous unions experienced more violence than those in non-polygynous ones. Similar to several previous studies, this study also found that lack of formal education was significantly associated with greater spousal violence. The present study observed that women who had two or more children were more likely to be victims of spousal violence and this was higher in polygynous unions compared to non-polygynous ones. The positive association between spousal violence and the number of children had also been observed earlier by others (Garg *et al*., 2021; Solanke *et al*., 2018; Weitzman, 2014). In addition, women who were relatively older than their husbands, or in cases where the age gap between the spouses was less, faced a higher risk of spousal violence. This finding is in order with other studies from different contexts. Several individual and multi-country studies have reported that the lower age difference between the spouses works as a risk factor for different forms of spousal violence (Abramsky *et al*., 2011; Hindin *et al*., 2008; Jewkes *et al*., 2002; Kishor & Johnson, 2004; Otieno, 2017; Pandey *et al*., 2009). Our analysis indicates a significant negative association between women's participation in decision-making in the household and violence against them in both polygynous and non-polygynous unions. This result is in line with the finding of a study in Myanmar, where it was observed which found that women's decision-making power had a negative effect on domestic violence (Kabir *et al*., 2019). Similarly, Ebrahim & Atteraya (2019) observed that women who made decisions jointly with their spouses in Ethiopia faced a lower risk of domestic violence than those with lower levels of family decision-making autonomy. Women's participation in household decision making indicates an increased interaction and cordial relationship between spouses. As the patriarchal power and control are the basis for the continuation of spousal violence, an increased participation of woman in household decision making helps her to negotiate the allocation of household resources for the benefit of all household members. Several studies have highlighted involvement of women in household decision making in reducing the spousal violence in different contexts (Jewkes *et al*., 2002; Svec & Andic, 2018). This study also revealed that justification for wife beating was higher in polygynous unions than in non-polygynous ones. Similar results were also observed in seven sub-Saharan African countries (Rani *et al*., 2004). The study observed a positive association between the controlling behavior of husbands and marital violence, and it was higher in polygynous than in non-polygynous unions. A similar finding was reported in other studies as well (Antai, 2011). Husbands' alcohol consumption had been associated with spousal violence against women in India (Wagman *et al*., 2018). While our findings reiterated the same, it, further, highlighted that higher proportion women with alcoholic husbands in polygynous unions faced violence compared to their counterparts in non-polygynous unions. The unadjusted effect of polygyny was found to be significantly higher with spousal violence in all the six regions

of India and also at the national level. Although the adjusted effect of polygyny on spousal violence was also significant at the national level, it was found to be insignificant in three regions of India (North, East, and Central). This may be due to the much stronger contribution of women empowerment-related variables (education, participation in household decision-making, freedom of movement, control over money, attitudes toward wife-beating, and marital control behavior displayed by husband) which are controlled in the model. It should also be noted that adjusted effect of polygyny on sexual violence was significant in eastern regions and emotional violence in central region.

4.1. Limitation

Although this study used a large sample size from a nationally representative dataset, a few important limitations need to be noted. The results of this study are limited by the cross-sectional nature of the analyzed data; therefore, it could not have captured all the known risk factors of spousal violence at the individual and community levels. Future studies may focus on the variables omitted in the current study such as history of abuse, residential status of polygynous women (co-residing with husband or not), and rank order of the polygynous women (first/second wife). Furthermore, the results of the study were not supplemented with qualitative data because the goal of the study was to determine the effect of spousal violence on the marital structure (more specifically in polygynous marriage). Since polygyny is a rare marital union in India, a qualitative study can be undertaken to understand, in depth, what other factors affect spousal violence. Despite all these limitations, this study helps to understand the importance of eliminating polygyny and also its impact on spousal violence.

5. Conclusions

Spousal violence is one of the major social problems globally, especially in India and other South Asian countries. The analysis indicates that polygyny, further, amplifies spousal violence against currently married women. There are several individual and household level factors that cause spousal violence. Notwithstanding the higher odds of spousal violence among women in polygynous unions compared with those in monogamous ones across different socioeconomic characteristics of women and across regions of India, the findings of the present study call for a uniform approach to deal with spousal violence at the national level. Further, irrespective of polygynous or non-polygynous unions, this research provides evidence for the need for a proactive and integrated approach to empowering women economically, promoting social environments that are intolerant toward the controlling behavior of men and spousal violence, thus breaking the norms that sustain women's vulnerability to violence within the society. An environment of intolerance toward violence against women needs to be created by removing sociocultural barriers that prevent women from reporting spousal violence. The findings of the study also call for strengthening the implementation of the laws designed to remove more than one marriage simultaneously by men (polygyny). Lack of implementation of marital laws leads to polygynous unions and makes women even more vulnerable to violence by their husbands. The newly enacted protection of women against domestic violence legislation, 2005, in India will go a long way in strengthening the existing goal of reducing the prevalence of domestic violence. Education could provide a woman with more opportunities for financial independence, allowing her to leave an abusive husband. Public education through media channels should be used to target women who may fall outside the formal education system. Involvement of men in all these interventions is essential to change people's attitude toward violence against women. Moreover, as the law does not permit men to marry more than one wife simultaneously in India (except for one religious minority group), this form of marriage should be discouraged by strictly enforcing it to protect women from marital violence in polygynous unions. To conclude, the analysis has contributed to the body of the literature by analyzing the association between polygynous marriage and spousal violence in India.

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Conflict of Interest

The authors declare that they do not have any competing interest.

Author Contributions

Conceptualization: Harihar Sahoo, Rangasamy Nagarajan
Data curation: Harihar Sahoo
Writing – original draft: Harihar Sahoo
Writing – review & editing: Rangasamy Nagarajan

Ethics Approval and Consent to Participate

Not applicable as this study involves the analysis of secondary data collected by the DHS program (NFHS-5) in India.

Consent for Publication

Not applicable.

Availability of Data

The use is secondary that is freely available to everyone on request at DHS website https://dhsprogram.com/ Countries/ Country-Main.cfm?ctry_id=57&c=India

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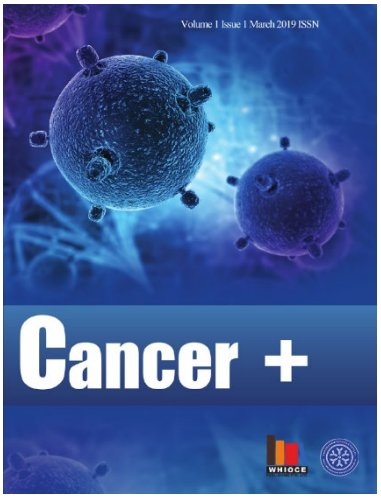

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