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RESEARCH ARTICLE

Revisiting the predisposing, enabling, and need factors of unsafe abortion in India using the Heckman Probit model

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Abstract
Unsafe abortion refers to induced abortions performed without trained medical assistance. While previous studies have investigated predictors of unsafe abortion in India, none have addressed these factors with accounting sample selection bias. This study aims to evaluate the contributors to unsafe abortion in India by using the latest National Family Health Survey data conducted during 2019–2021, incorporating the adjustment of sample selection bias. The study included women aged 15 to 49 who had terminated their most recent pregnancy within five years prior to the survey (total weighted sample (N) = 4,810). Descriptive and bivariate statistics and the Heckman Probit model were employed. The prevalence of unsafe abortion in India was 31%. Key predictors of unsafe abortion included women's age, the gender composition of their living children, gestation stage, family planning status, and geographical region. Unsafe abortions were typically performed in the early stages of gestation, often involving self-administered medication. The primary reasons cited were unintended pregnancies and health complications. This study underscores the urgent need for targeted interventions that take into account regional, demographic, and social dynamics influencing abortion practices in India.

Keywords: unsafe abortion; geographical pattern; sample selection bias; India; Heckman model

Introduction

Unsafe abortion stands out as a significant global public health issue, particularly in low and middle-income countries (Kaur *et al.*, 2022). Unsafe abortion is when a pregnancy is terminated without skilled professionals or in substandard medical conditions, often a combination of both. It holds the unfortunate distinction of being the fourth most prominent contributor to maternal deaths (Khan *et al.*, 2006). Shockingly, on a worldwide scale, approximately 56 million abortions occur annually (Ganatra *et al.*, 2017). Out of total abortions, 25 million were performed in unsafe settings (by untrained health providers and in unhealthy settings), which resulted in more than 68,000 causalities and 5 million cases of disabilities (Ganatra *et al.*, 2017). South Asia alone constitutes 13% of the casualties of unsafe abortion (WHO, 2012). Within South Asia, India stands out as a focal point of concern, bearing a substantial burden of unsafe abortion practices and the associated health risks (MoHFW, 2023; Swain *et al.*, 2021).

In India, the Medical Termination of Pregnancy (MTP) Amendment Act 2021 legalised abortion for various medical and social reasons. Women are granted the right to terminate pregnancies when they jeopardise physical safety or mental well-being, result from rape or contraceptive failure, or are likely to result in a child with physical or mental defects (Ministry of Law and Justice, 2021). Simultaneously, the Government of India introduced the Comprehensive Abortion Care (CAC) Training and Service Delivery Guidelines, known as the National CAC Guidelines, in 2010 (updated in 2014). These guidelines aim to enhance access to CAC services and reduce mortality and morbidity from unsafe abortions (MoHFW, 2023). Despite the legal status of abortion in India since 1971 and the availability of CAC services since 2014, research reveals a troubling trend of unsafe abortion practices (Kumari *et al.*, 2022). About 56% of the estimated 6.4 million abortions in the country occurred in unsafe healthcare settings (Kumari *et al.*, 2022; Rahaman *et al.*, 2022). While variations in estimates may exist due to factors like study settings, datasets, and periods, the prevalence of unsafe abortions remains alarmingly consistent across all studies (Kumari *et al.*, 2022). This issue carries dire consequences, contributing to 8% of maternal deaths in India, equating to nearly ten women losing their lives daily due to complications from unsafe abortions (MoHFW, 2023). Based on the above circumstances, comprehensive research on the context of induced abortion practices in India is imperative. This knowledge can profoundly impact public health initiatives and policymaking, ensuring the safety and well-being of women as they navigate reproductive health choices.

According to the fifth round of the National Family Health Survey (NFHS) conducted between 2019 and 2021, nearly 3% of women in India reported that their most recent pregnancies ended in induced abortions (IIPS and ICF, 2021). Notably, unintended pregnancies, accounting for 48%, emerged as the primary reason for induced abortions in the country (IIPS and ICF, 2021). Regarding the healthcare sought for abortion, a concerning statistic reveals that approximately one-third of women (27%) in India underwent abortions without the assistance of skilled healthcare providers, often performed in the home setting (Rahaman *et al.*, 2022). This practice, called unsafe abortion, exhibits significant variation across socio-demographic and economic backgrounds (Rahaman *et al.*, 2022; Sharma and Pradhan, 2020). The issue of unsafe abortions is disproportionately prevalent among socio-economically marginalised groups and regions with limited access to healthcare facilities (Rahaman *et al.*, 2022). Furthermore, aside from economic challenges and inadequate healthcare infrastructure, sociocultural stigma is pivotal in driving women towards unsafe abortion methods in India (Banerjee *et al.*, 2013; Hurley and Wilkins, 2017). Despite India's legal prohibition of sex-selective abortions (Ministry of Law and Justice, 2021), the illegal practice of female foetus abortion continues, facilitated by untrained medical practitioners (Saikia *et al.*, 2021). This troubling phenomenon is especially pronounced in India's patriarchal social settings, exacerbating concerns about distorted sex ratios and heightened health vulnerabilities among women (Purewal, 2018; Saikia *et al.*, 2021; Unisa *et al.*, 2007).

A substantial number of studies contextualised the level, pattern, and determinants of induced abortion practice (Ahmad *et al.*, 2020), reason for induced abortion (Saikia and Pradhan, 2023), and choice of healthcare services for induced abortion (Rahaman *et al.*, 2022; Sharma and Pradhan, 2020) in India using both small and large-scale sample survey datasets, which provide insightful information on induced abortion and choice of healthcare facility. Regarding large-scale data on abortion in India, the NFHS is the only nationally representative data source that provides nationally representative data on induced abortion and the choice of abortion care services (IIPS and ICF, 2021). However, the sample size of the women with induced abortion and the practice of unsafe abortion is markedly low compared to the total sample in the NFHS data (Rahaman *et al.*, 2022). As a result, contextualising unsafe abortion in India using the NFHS data without adjusting for sample selection bias affects the reliability of the results. Most previous studies identified predictors of unsafe abortion practice using multivariate logistic regression in India using the NFHS data without addressing sample selection bias (Rahaman *et al.*, 2022; Sharma and Pradhan, 2020), which might have failed to present reliable estimations. Therefore, the present study uses

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the Heckman Probit Model as the multivariate analysis. The model is important to correct sample selection bias and endogeneity, two prevalent issues when dealing with observational data (Marchenko and Genton, 2012; Saulo *et al.*, 2023). Since a large sample is excluded from the statistical analyses, this model was chosen to reduce the bias in the results due to sample selection and optimise the findings. By addressing these issues, the Heckman Model enables researchers to obtain more accurate and reliable estimates, thus advancing the understanding of research findings. The broad objective of the present study is to revisit the predictors of unsafe abortion practice in India using the Heckman Probit Model and how the results are similar and dissimilar to existing findings in India and elsewhere. The study will assist policymakers in identifying target groups and formulating effective interventions in order to promote safe abortion service utilisation.

Methods

Data sources and sample selection

The data from the fifth round of the National Family Health Survey (NFHS) 5 conducted during 2019–2021 were used. The NFHS is an Indian version of the Demographic and Health Survey (DHS) and a well-known nationally representative sample survey, which provides consistent and reliable data on fertility, mortality, reproductive and child health indicators, utilisation of maternal and child health care services, and other related indicators (IIPS and ICF, 2021). The data are available in the public domain and can readily be accessed upon request online on the DHS website. The present study included only the women aged 15–49 who terminated their last pregnancy by induced abortion in the five years prior to the survey (total weighted sample (N) = 4,810). The details of the study sample selection are presented in Figure 1.

Outcome variable

In the present study, 'unsafe abortion' is considered as an outcome variable. This study's outcome variable was constructed using a specific question: 'Who performed the abortion?' Respondents provided various responses, including doctor, nurse/auxiliary nurse midwife (ANM)/lady health visitor (LHV), dai (traditional birth attendant), family member/relative/friend, self, and others (IIPS and ICF, 2021). To simplify the analysis, these responses were categorised into two distinct groups: 'safe abortion', comprising abortions conducted by doctors and nurse/ANM/LHV, and 'unsafe abortion', encompassing abortions performed by anyone other than doctors and nurse/ANM/LHV, following the guidelines set by the World Health Organization (Khatri *et al.*, 2019; Rahaman *et al.*, 2022; WHO, 2012). The outcome variable was dichotomous in nature (0 = safe abortion and 1 = unsafe abortion).

Explanatory variables

The selected explanatory variables were divided into three groups: predisposing, enabling, and need factors (Figure 2), based on a systematic literature review (Andersen, 1995; Khatri *et al.*, 2019; Rahaman *et al.*, 2022). Predisposing factors included place of residence (urban, rural), geographical region (northern, central, eastern, north-eastern, southern, and western), women's age (<20, 20–34, 34–49 years), education level (no education, primary, and secondary/higher), husband's education level (no education, primary, and secondary/higher), social group (general, other backward class, and scheduled caste and scheduled tribe [SC/ST]), religion (Muslim, non-Muslim), and sex composition of living children (no child, daughter only, son only, and both). The selected enabling factors were household wealth status (rich, middle, and poor), degree of mass media exposure (low, medium, and high), and women's autonomy (low, medium, and high).

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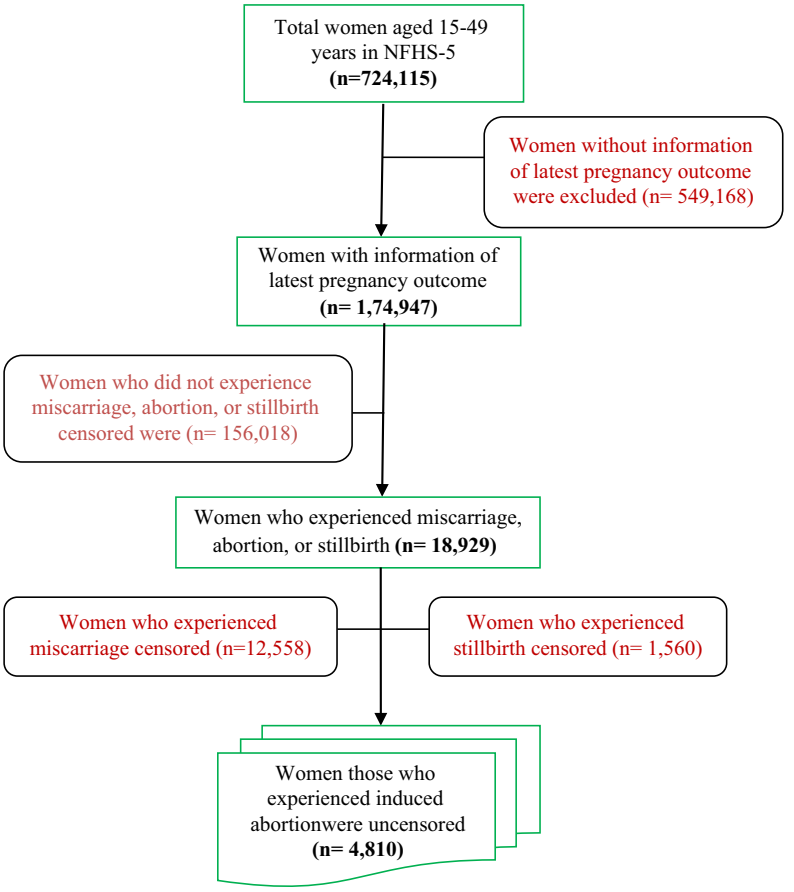

Figure 1. Graphical Presentation of Study Sample Selection, India, National Family Health Survey 5, 2019–2021.

Unmet need for family planning (yes, no) and gestational period (≤12 weeks, 13–20 weeks, ≥20 weeks) were selected as need factors (Figure 2).

The NFHS 5 dataset featured four pieces of information linked to decision-making, which was combined to create a composite variable for women's autonomy (IIPS and ICF, 2021). These are (i) the person who usually decides on the respondent's healthcare; (ii) the person who usually decides on visits to family or relatives; (iii) the person who usually decides on large household purchases; and (iv) the person who usually decides what to do with money husband earns. Responses ranged respondent alone, respondent and partner together, partner alone, someone else, and others for each of the aforementioned items. These variables were marked as '1' in the first two responses that stated women's participation in decision-making and '0' in the remaining responses, which indicated that women played no part in those decisions. After combining these four factors, we produced a score of 0 to 4 and divided it into three decision-making autonomy groups. Women with scores of 4 were referred to as having a high level of overall decision-making autonomy, followed by scores of 1–3 as having a medium level, and scores of 0 as having a low level (Karjee *et al.*, 2023). A similar process was also applied to measure the degree of mass media exposure. The questions related to the frequency of listening radio, watching television, and reading newspapers were included in scoring the degree of mass media exposure. The responses were not at all, less than once a week, at least once a week, and almost every day. These responses were marked as '1' in the last three, which stated women's involvement with mass media, and '0' in

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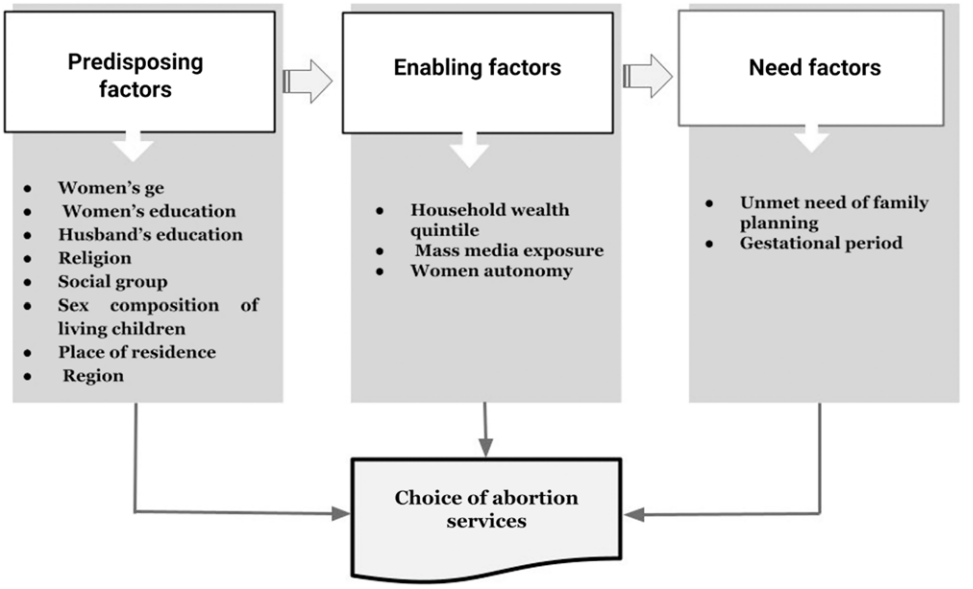

Figure 2. Conceptual Framework of Choice of Abortion Services and Determining Factors (Andersen, 1995; Khatri *et al.*, 2019; Rahaman *et al.*, 2022).

the first response, which indicated women without mass media exposure. After combining these four factors, we produced a total score of 0 to 3 and divided into three decision-making autonomy groups. Women with scores of 3 were referred to as having a high level of mass media exposure, followed by scores of 1–2 as having a medium level, and a score of 0 as having a low level (Karjee *et al.*, 2023).

Statistical analysis

Descriptive statistics bivariate and multivariate analyses were performed to accomplish the study objectives. Descriptive statistics presented the per cent distribution of the study sample, including standard error of the mean and 95% confidence interval (95% CI) with background characteristics. Bivariate analysis with 95% CI was applied to present the prevalence of unsafe abortion with background characteristics. Furthermore, the Pearson chi-square (χ^2) test was also performed to evaluate the independence of two variables. Finally, the Heckman Probit model was applied to obtain an unbiased coefficient of unsafe abortion with background characteristics. The results from the Heckman Probit model are presented as a beta coefficient (β) along with a 95% CI, considering a significance level of $p \leq 0.050$. All statistical analyses were performed in the Stata software version 14.0.

Results

Participant's characteristics

Table 1 presents the descriptive statistics of the study population, i.e., the women aged 15–49 years whose last pregnancy ended with induced abortion. The majority of these women were aged between 20 and 34 years (91.1%; 95% CI: 90.3, 91.9). Almost 40% reported having both daughters and sons (39.7%; 95% CI: 38.3, 41.1), 32.5% with daughters only (95% CI: 31.2, 33.8), and 27% with sons only (95% CI: 25.7, 28.2). About three-fourths of the women reported having a secondary education or higher (77.4%; 95% CI: 76.2, 78.6). Most women were non-Muslim (89%;

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Table 1. Descriptive Statistics of the Study Population, India, National Family Health Survey 5, 2019–2021

Background characteristics	Weighted sample (*n*)	SE	Per cent [95% CI]
Total (*n*)	4,810		
Women's age			
34–49 years.	337	0.005	7.0 [6.3, 7.8]
20–34 years.	4,383	0.005	91.1 [90.3, 91.9]
< 20 years.	90	0.002	1.9 [1.5, 2.3]
Sex composition of children			
No child	42	0.002	0.9 [0.7, 1.2]
Daughter only	1,563	0.008	32.5 [31.2, 33.8]
Son only	1,297	0.008	27.0 [25.7, 28.2]
Both	1,908	0.008	39.7 [38.3, 41.1]
Women's education level			
Secondary/Higher	3,725	0.007	77.4 [76.2, 78.6]
Primary	529	0.005	11.0 [10.1, 11.9]
No education	556	0.005	11.6 [10.7, 12.5]
Religion			
Non-Muslim	4,283	0.005	89.0 [88.1, 89.9]
Muslim	528	0.005	11.0 [10.1, 11.9]
Social group			
General	1,275	0.008	26.5 [25.3, 27.8]
OBC	2,103	0.009	43.7 [42.3, 45.1]
STs/SCs	1,433	0.008	29.8 [28.5, 31.1]
Husband's education level			
Secondary/Higher	579	0.006	12.0 [11.1, 13]
Primary	80	0.002	1.7 [1.3, 2.1]
No education	65	0.002	1.4 [1.1, 1.7]
Missing	4,086	0.006	84.9 [83.9, 85.9]
Place of residence			
Urban	1,656	0.008	34.4 [33.1, 35.8]
Rural	3,154	0.008	65.6 [64.2, 66.9]
Region			
South	1,050	0.008	21.8 [20.7, 23]
Central	1,200	0.007	25.0 [23.8, 26.2]
Eastern	1,080	0.007	22.5 [21.3, 23.7]
North-East	234	0.004	4.9 [4.3, 5.5]
West	682	0.007	14.2 [13.2, 15.2]
North	564	0.005	11.7 [10.8, 12.7]

(*Continued*)

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Table 1. (*Continued*)

Background characteristics	Weighted sample (*n*)	SE	Per cent [95% CI]
Household wealth quintile			
Rich	2,174	0.009	45.2 [43.8, 46.6]
Middle	1,054	0.007	21.9 [20.8, 23.1]
Poor	1,582	0.008	32.9 [31.6, 34.2]
Exposure to mass media			
Low	875	0.006	18.2 [17.1, 19.3]
Moderate	3,585	0.008	74.5 [73.3, 75.7]
High	351	0.005	7.3 [6.6, 8.1]
Degree of autonomy			
Low	82	0.002	1.7 [1.4, 2.1]
Moderate	193	0.003	4.0 [3.5, 4.6]
High	441	0.005	9.2 [8.4, 10]
Missing	4,094	0.006	85.1 [84.1, 86.1]
Unmet need for family planning			
No	4,742	0.002	98.6 [98.2, 98.9]
Yes	68	0.002	1.4 [1.1, 1.8]
Gestation period			
≤12 weeks	4,112	0.007	85.5 [84.5, 86.4]
13-20 weeks	504	0.006	10.5 [9.6, 11.4]
≥20 weeks	195	0.004	4.0 [3.5, 4.6]

Note: SE stands Standard Error of Mean; CI refers Confidence Intervals; OBCs refers Other Backward Classes; SCs/STs indicates Scheduled Castes and Tribes.

95% CI: 88.1, 89.9) and belonged to other backward classes (43.7%; 95% CI: 42.3, 45.1) and rural areas (65.6%; 95% CI: 64.2, 66.9). One-third of the women belonged to households in the poor wealth quintile (32.9%; 95% CI: 31.6, 34.2), and one-fifth reported low exposure to mass media (18.2%; 95% CI: 17.1, 19.3). Similarly, women's autonomy was also low among the study population. Most induced abortions were performed at 12 weeks of gestation or earlier (85.5%; 95% CI: 84.5, 86.4).

Prevalence of unsafe abortion with background characteristics

The prevalence of unsafe abortion in India was 30.7% (95% CI: 29.5, 32.1). However, there were significant variations in the prevalence of unsafe abortion based on women's background characteristics (Table 2). The prevalence was somewhat high among women aged 20–34 (31.4%; 95% CI: 30.1, 32.8), women with no formal education (38.3%; 95% CI: 34.4, 42.4), women with sons and daughters (35%; 95% CI: 32.9, 37.1), and those belonging to SCs/STs groups (33.4%; 95% CI: 31.0, 35.8) or living in rural areas (32.8%; 95% CI: 31.2, 34.5) (Table 2). Additionally, the prevalence was comparatively high in the east (47.1%; 95% CI: 44.2, 50.1), central (42.6%; 95% CI: 39.9, 45.5), and north (34.1%; 95% CI: 30.3, 38.1) regions. Women whose husbands had no formal education (53.5%; 95% CI: 41.3, 65.3) and those from households in the poor wealth quintile (38.8%; 95% CI: 36.4, 41.2) had a notably higher prevalence of unsafe abortion. Most of the

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Table 2. Prevalence of Unsafe Abortion Out of Total Induced Abortion Among the Women Aged 15–49 Years with Background Characteristics, India, National Family Health Survey 5, 2019–2021 (n = 4,810)

Background characteristics	Per cent	SE	95% CI	χ^2 p value
India	30.7	0.006	29.5, 32.1	
Women's age				
34–49 years.	23.5	0.023	19.3, 28.3	$p \leq 0.001$
20–34 years.	31.4	0.007	30.1, 32.8	
< 20 years.	24.1	0.045	16.4, 34	
Sex composition of children				
No child	2.7	0.025	0.4, 15.4	$p \leq 0.001$
Daughter only	31.2	0.012	28.9, 33.5	
Son only	24.9	0.012	22.6, 27.3	
Both	35.0	0.011	32.9,37.1	
Women's education level				
Secondary/Higher	28.6	0.007	27.2, 30.1	$p \leq 0.001$
Primary	37.6	0.021	33.6, 41.8	
No education	38.3	0.021	34.4, 42.4	
Religion				
Non-Muslim	31.0	0.007	29.7, 32.4	$p = 0.055$
Muslim	28.3	0.020	24.6, 32.3	
Social group				
General	29.3	0.013	26.9, 31.9	$p = 0.090$
OBC	29.8	0.01	27.9, 31.8	
STs/SCs	33.4	0.012	31.0, 35.8	
Husband's education level				
Secondary/Higher	32.3	0.019	28.6, 36.2	$p = 0.003$
Primary	45.3	0.056	34.7, 56.3	
No education	53.5	0.062	41.3, 65.3	
Missing	29.9	0.007	28.5, 31.3	
Place of residence				
Urban	26.7	0.011	24.7, 28.9	$p = 0.007$
Rural	32.8	0.008	31.2, 34.5	
Region				
South	10.1	0.009	8.4, 12.0	
Central	42.6	0.014	39.9, 45.5	
East	47.1	0.015	44.2, 50.1	$p \leq 0.001$
North-East	32.0	0.031	26.4, 38.3	
West	12.5	0.013	10.2, 15.2	
North	34.1	0.020	30.3, 38.1	

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Table 2. (*Continued*)

Background characteristics	Per cent	SE	95% CI	χ^2 p value
Household wealth quintile				
Rich	26.7	0.009	24.9, 28.6	$p \leq 0.001$
Middle	27.0	0.014	24.4, 29.8	
Poor	38.8	0.012	36.4, 41.2	
Exposure to mass media				
Low	37.0	0.016	33.9, 40.3	$p \leq 0.001$
Moderate	30.4	0.008	28.9, 31.9	
High	18.9	0.021	15.1, 23.3	
Degree of autonomy				
Low	29.1	0.05	20.3, 39.9	$p = 0.013$
Moderate	33.9	0.034	27.6, 40.9	
High	37.8	0.023	33.4, 42.4	
Unmet need for family planning				
No	30.6	0.007	29.3, 31.9	$p = 0.114$
Yes	43.7	0.060	32.4, 55.7	
Gestation period				
≤12 weeks	34.9	0.007	33.4, 36.3	$p \leq 0.001$
13-20 weeks	8.0	0.012	5.9, 10.7	
≥20 weeks	2.4	0.011	1.0, 5.8	

Note: SE means Standard Error of Mean, χ^2 refers Chi-square, CI refers Confidence Intervals, OBCs refers Other Backward Classes, SCs/STs indicate Scheduled Castes and Tribes.

women who lacked access to family planning (43.7%; 95% CI: 32.4, 55.7) and those who underwent induced abortions at 12 weeks or earlier (34.9%; 95% CI: 33.4, 36.3) reported utilisation of unsafe abortion services.

State-level variation in the prevalence of unsafe abortion

There was a significant variation in the prevalence of unsafe abortion across the Indian states (Figure 3). Unsafe abortion practice was observed to be substantially high in Odisha (60.8%), followed by Chhattisgarh (55.9%), National Capital Territory Delhi (51.6%), Bihar (50.1%), and Uttar Pradesh (42.6%).

Results from the Heckman Probit selection model

Coefficient of unsafe abortion

Geographical region, women's age, and the sex composition of the living children were found to be significant predictors of performing an unsafe abortion in India (Table 3). As compared to the south region, the coefficient of unsafe abortion was found to be significantly positive in the central ($\beta = 0.96$; $p \leq 0.026$; 95% CI: 0.12, 1.81), east ($\beta = 1.14$; $p \leq 0.002$; 95% CI: 0.43, 1.86), and north-east ($\beta = 0.70$; $p \leq 0.006$; 95% CI: 0.20, 1.21) regions. Women aged 20–34 years ($\beta = 0.35$; $p \leq 0.001$; 95% CI: 0.18, 0.53) had a significantly higher coefficient of unsafe abortion than the

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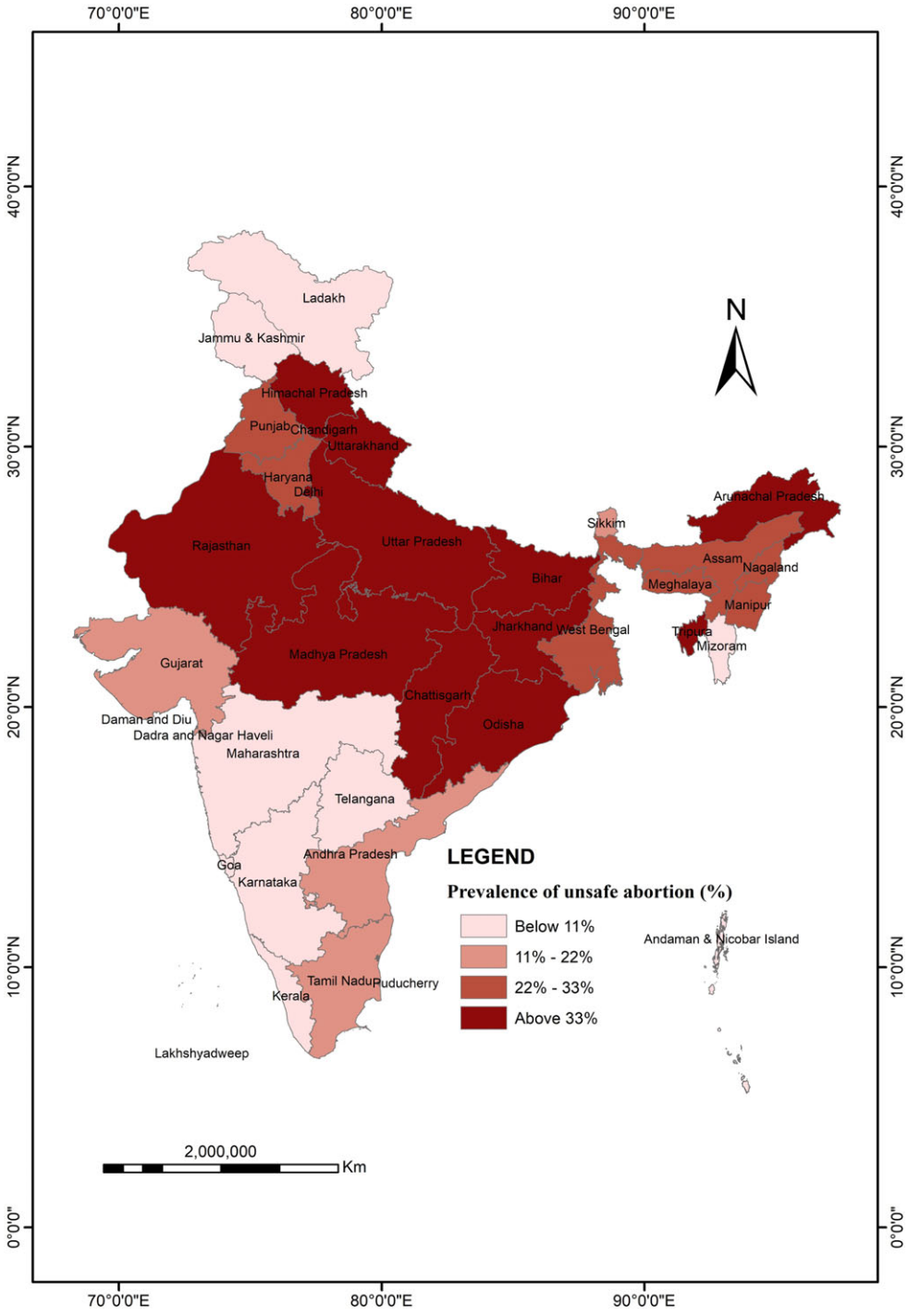

Figure 3. State Level Variations in Prevalence of Unsafe Abortion Among Women Aged 15–49 Years, India, National Family Health Survey 5, 2019–2021.

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Table 3. Coefficient of Unsafe Abortion Among Women Aged 15–49 Years with Background Characteristics India, National Family Health Survey 5, 2019–2021 ($N = 4{,}810$)

Background characteristics	Beta (β) coefficient	*p*-value	95% Confidence Interval	
Women's age				
34–49 years. ®				
20–34 years.	**0.35**	**0.001**	**0.18**	**0.53**
< 20 yrs.	0.38	0.331	−0.39	1.16
Sex composition of children				
No child ®				
Daughter only	**1.25**	**0.027**	**0.14**	**2.36**
Son only	1.04	0.063	−0.06	2.14
Both	**1.21**	**0.030**	**0.12**	**2.3**
Women's education level				
Secondary/Higher ®				
Primary	−0.01	0.870	−0.16	0.14
No education	0.10	0.986	−0.40	0.41
Religion				
Non-Muslim ®				
Muslim	−0.17	0.358	−0.54	0.2
Social group				
General ®				
OBCs	−0.01	0.880	−0.18	0.15
STs/SCs	−0.01	0.949	−0.41	0.38
Husband's education level				
Secondary/Higher ®				
Primary	0.16	0.329	−0.16	0.48
No education	0.06	0.735	−0.3	0.43
Place of residence				
Urban ®				
Rural	−0.11	0.146	−0.25	0.04
Region				
South ®				
Central	**0.96**	**0.026**	**0.12**	**1.81**
Eastern	**1.14**	**0.002**	**0.43**	**1.86**
Northeast	**0.70**	**0.006**	**0.20**	**1.21**
West	0.04	0.873	−0.41	0.49
North	0.67	0.092	−0.11	1.45

(*Continued*)

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Table 3. (*Continued*)

Background characteristics	Beta (β) coefficient	*p*-value	95% Confidence Interval	
Household wealth quintile				
Rich ®				
Middle	−0.02	0.747	−0.14	0.10
Poor	0.11	0.518	−0.22	0.43
Exposure to mass media				
Low ®				
Moderate	0.09	0.481	−0.16	0.33
High	−0.20	0.189	−0.49	0.10
Degree of autonomy				
Low ®				
Moderate	0.27	0.206	−0.15	0.68
High	0.23	0.234	−0.15	0.6
Unmet need for family planning				
No ®				
Yes	**0.13**	**0.002**	**0.27**	**0.53**
Gestation period				
≤12 weeks ®				
13–20 weeks	**−0.90**	**0.001**	**−1.44**	**−0.37**
≥20 weeks	**−1.28**	**0.002**	**−2.09**	**−0.47**

Note: ® = Reference category, Number of observation = 1,74,947; Censored observation = 170,137; Uncensored observation = 4,810; Log likelihood = −22648.03; Wald $chi^2(29) = 368.01$; Prob > $chi^2 = 0.0001$, OBCs refers Other Backward Classes, SCs/STs indicates Scheduled Castes and Tribes, Conf. refers confidence.

reference category, i.e., 34–49 years. Women who had only daughters ($\beta = 1.25$; $p \leq 0.027$; 95% CI: 0.14, 2.36) performed significantly higher unsafe abortions than the women with no children. Similar patterns were also observed among the women who had both son and daughter children. Based on household wealth status, women's mass media exposure, and autonomy, the changes in the coefficient of unsafe abortion were statistically insignificant. The gestation period was discovered to be a significant need factor in determining whether abortion facilities are safe or unsafe. The coefficient of performing an unsafe abortion was found to be significantly negative as the gestation period increased. For instance, the coefficient of unsafe abortion was negative among those who performed induced abortions at 20 weeks or more gestation ($\beta = -1.28$; $p \leq 0.002$; 95% CI: −2.29, −0.47) than those who performed during 12 or less weeks of gestation.

Coefficient of induced abortion

Place of residence, geographical region, women's age and educational attainments, social group, religion, household wealth quintile, mass media exposure, unmet need for family planning, and gestation period were found to be significant predictors of performing an induced abortion in India (Table 4). In rural areas, the coefficient of induced abortion was negative ($\beta = -0.06$; $p \leq 0.001$; 95% CI: −0.10, −0.03) than urban counterparts. In reference to the south region, central, east, northeast, west, and north regions show negative coefficients of induced abortions.

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Table 4. Coefficient of Induced Abortion Among Women Aged 15–49 Years with Background Characteristics India, National Family Health Survey 5, 2019–2021 ($N = 1,74,947$)

Background characteristics	Beta (β) coefficient	*p*-value	95% Confidence Interval	
Women's age				
34–49 years. ®				
20–34 years.	**0.11**	**0.001**	**0.06**	**0.15**
< 20 years.	**−0.18**	**0.002**	**−0.28**	**−0.07**
Sex composition of children				
No child ®				
Daughter only	0.07	0.326	−0.07	0.22
Son only	0.04	0.634	−0.11	0.18
Both	0.08	0.287	−0.07	0.23
Women's education level				
Secondary/Higher ®				
Primary	−0.03	0.170	−0.07	0.01
No education	**−0.15**	**0.001**	**−0.19**	**−0.11**
Religion				
Non-Muslim ®				
Muslim	**−0.17**	**0.001**	**−0.21**	**−0.13**
Social group				
General				
OBCs	−0.05	**0.003**	**−0.09**	**−0.02**
STs/SCs	−0.15	**0.001**	**−0.19**	**−0.11**
Husband's education level				
Secondary/Higher ®				
Primary	0.16	0.329	−0.16	0.48
No education	0.06	0.735	−0.30	0.43
Missing	−0.01	0.975	−0.87	0.85
Place of residence				
Urban ®				
Rural	**−0.06**	**0.001**	**−0.10**	**−0.03**
Region				
South ®				
Central	**−0.12**	**0.001**	**−0.16**	**−0.08**
Eastern	−0.03	0.247	−0.07	0.02
Northeast	−0.04	0.143	−0.08	0.01
West	**−0.15**	**0.001**	**−0.20**	**−0.10**
North	**−0.15**	**0.001**	**−0.20**	**−0.11**

(*Continued*)

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Table 4. (*Continued*)

Background characteristics	Beta (β) coefficient	*p*-value	95% Confidence Interval	
Household wealth quintile				
Rich ®				
Middle	−0.01	0.58	−0.05	0.03
Poor	**−0.09**	**0.001**	**−0.13**	**−0.06**
Exposure to mass media				
Low ®				
Moderate	**0.10**	**0.001**	**0.07**	**0.14**
High	0.04	0.188	−0.02	0.10
Unmet need for family planning				
No ®				
Yes	**0.11**	**0.05**	**0.03**	**0.23**
Gestation period				
≤12 weeks ®				
13–20 weeks	**−0.19**	**0.001**	**−0.25**	**−0.12**
≥20 weeks	**−0.82**	**0.001**	**−0.91**	**−0.74**

Note: ® = Reference category, Number of observation = 1,74,947 includes both censored observation = 170,137 and uncensored observation = 4,810; LR test of indep. eqns. (rho = 0): $chi^2(1) = 0.010$ Prob > $chi^2 = 0.9032$; OBCs refers Other Backward Classes, SCs/STs indicates Scheduled Castes and Tribes.

The women aged 20–34 years ($\beta = 0.11$; $p \leq 0.001$; 95% CI: 0.06, 0.15) performed higher induced abortions than the women aged 34 years and above. The coefficient of induced abortion was negative among OBCs ($\beta = -0.05$; $p \leq 0.003$; 95% CI: −0.09, −0.02) and STs/SCs ($\beta = -0.15$; $p \leq 0.001$; 95% CI: −0.19, −0.11) than the general group. Similar patterns were also observed among Muslims as reference to non-Muslims. The women with no formal education ($\beta = -0.15$; $p \leq 0.001$; 95% CI: −0.19, −0.11) were less likely to perform induced abortion than their higher-educated counterparts. The coefficient was negative among poor household quintiles ($\beta = -0.09$; $p \leq 0.001$; 95% CI: −0.13, −0.06) than rich counterparts. The unmet need for family planning was positively associated with the coefficient of induced abortion ($\beta = 0.13$; $p = 0.050$; 95% CI: 0.11, 0.23). Similarly, the coefficient of induced abortion was negative among the women who terminated pregnancies during 13–20 weeks ($\beta = -0.19$; $p \leq 0.001$; 95% CI: −0.25, −0.12) and 20 and above weeks ($\beta = -0.82$; $p \leq 0.001$; 95% CI: −0.91, −0.74) of gestation than reference category, i.e., 12 weeks and below.

Discussion

The current study contextualised the unsafe abortion practice in India using the latest NFHS 5 (2019–2021) data and robust analytical approaches. The result revealed that the unsafe abortion practice is substantial (31%) in India, with significant variations across geographical, socioeconomic, and demographic factors. While these findings align with previous studies in India (Rahaman *et al.*, 2022; Sharma and Pradhan, 2020), the current study reported a slightly higher prevalence (31% vs. 27%) than the NFHS 4 (2015–2016) (Rahaman *et al.*, 2022). The present study also displayed a significant spatial variation in the prevalence of unsafe abortions, highlighting the diverse landscape of this issue. Notably, high prevalence was observed in states like Odisha, Chhattisgarh, Delhi, Bihar, and Uttar Pradesh (Figure 3). These regions, excluding

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Delhi, are all characterised by high levels of socioeconomic poverty, substantial unmet needs for contraception, elevated total fertility rates, limited utilisation of maternal healthcare services, and reduced women's autonomy (Bango and Ghosh, 2022), which may positively influence the utilisation of unsafe abortion services. Despite Delhi's status as the national capital and its robust socioeconomic settings, the present study has unearthed a concerning reality: a high prevalence of unsafe abortions. The result emphasises the need for a comprehensive primary field-based mixed-methods investigation to unravel the underlying issue.

Consistent with prior research (Kumari *et al.*, 2022; Rahaman *et al.*, 2022; Sharma and Pradhan, 2020; Shekhar *et al.*, 2018), the present study has identified that women's age, the sex composition of their living children, and the geographical region are significant predisposing factors for unsafe abortions in India. In the context of geographical region, the unsafe abortion practice is prevalent in the central, eastern, and northern regions of India found in the present study; the result is similar to previous studies (Rahaman *et al.*, 2022; Shekhar *et al.*, 2018). These regions grapple with a complex web of challenges, including socioeconomic poverty, inadequate public healthcare services, and sociocultural complexities (Bango and Ghosh, 2022). In particular, the eastern region (comprising Bihar, Uttar Pradesh, and adjoining areas) is characterised by frequent devastating floods, which increase livelihood and health vulnerability (Roy *et al.*, 2021). Simultaneously, female illiteracy and autonomy are limited in these areas, and inadequate public healthcare facilities further compound the issue, collectively creating barriers to safe abortion services (Kumari *et al.*, 2022). Additionally, the northern region, including areas bordering the eastern region, is characterised by a rigidly patriarchal society, further entangled in the complex issue of sex-selective abortion (Retherford and Roy, 2003). Consequently, individuals may resort to unsafe abortion services to circumvent legal abortion laws and regulations. Furthermore, in the intricate sociocultural fabric of India, where abortion is often shrouded in secrecy and stigma, a substantial number of women opt for clandestine home abortions, bypassing skilled healthcare providers to safeguard their privacy (Banerjee *et al.*, 2013). This clandestine practice underscores the urgent need for comprehensive interventions to address the multifaceted challenges associated with unsafe abortions across different regions of India.

Consistent with previous research (Kumari *et al.*, 2022; Rahaman *et al.*, 2022), our study revealed a notably high prevalence of unsafe abortions among women aged 20–34 in India. This elevated incidence of induced abortions within this age group can be attributed to the substantial burden of unintended pregnancies (Saikia and Pradhan, 2023). In the Indian context, most women tend to achieve their desired family size between 25 and 35 due to early marriage and childbearing practices (Rahaman *et al.*, 2022). Consequently, when they encounter unwanted pregnancies, they often resort to induced abortions to address the situation (Saikia and Pradhan, 2023). In addition to the issue of unintended pregnancies, previous studies also displayed a higher prevalence of reproductive health complications among women aged 30 and above (Roy *et al.*, 2021). Therefore, the burden of health complications may contribute positively to the incidence of induced abortions among this age group, potentially amplifying the overall prevalence of unsafe abortions. Existing pieces of literature (Karjee *et al.*, 2023; Kumari *et al.*, 2022; Saikia and Pradhan, 2023) have pointed out that factors such as illiteracy, social stigma, and limited awareness of healthcare services are more pronounced among older women compared to their younger counterparts (15–19 years). These factors also may be positively linked to the choice of unsafe abortion care services among advanced reproductive-aged women (Rahaman *et al.*, 2022). These findings underscore the need for a comprehensive approach to addressing the multifaceted issue of unsafe abortions in India. Such an approach should consider age-related dynamics and the broader factors of education, awareness, and healthcare accessibility among distinct segments of the population. In the present study, the sex composition of children is identified as a significant predictor of unsafe abortions in India, a finding that aligns with several prior studies (Rahaman *et al.*, 2022; Retherford and Roy, 2003; Yokoe *et al.*, 2019). The result revealed that both induced and unsafe abortions were more prevalent among women who had only daughters as well as those

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who had both sons and daughters. The higher incidence of unsafe abortions among women with only daughters may be attributed to sex-selective abortion practices (Retherford and Roy, 2003). However, among those with both male and female children, induced abortions may occur due to unplanned pregnancies (IIPS and ICF, 2021; Singh *et al.*, 2018). It's worth noting that the under-reporting of sex-selective abortions poses a significant challenge when contextualising it as a predictor of unsafe or induced abortions (Singh *et al.*, 2018). Similar to the recent publication of NFHS 5 (IIPS and ICF, 2021), our result suggests that only a small fraction (3%) of induced abortions are attributed to sex-selective reasons. Nonetheless, the issue of distorted sex ratios at birth (SRB) in India, particularly in states like Punjab, Chandigarh, Haryana, Delhi, Himachal Pradesh, Rajasthan, Gujarat, and Madhya Pradesh, indirectly indicates the widespread practice of sex-selective abortions (United Nations Population Fund, 2020). With advancing technology, prenatal sex selection has become more widespread. Despite India's efforts to curb gender-biased sex selection through legislation such as the Pre-Conception and Prenatal Diagnostic Techniques (Prohibition of Sex Selection) Act, initially enacted as the Prenatal Diagnostic Techniques (Regulation and Prevention of Misuse) Act, 1994 and revised in 2003, the practice continues to persist. Due to restrictive abortion laws in India, a substantial proportion of couples resort to abortions performed by untrained healthcare professionals (Potdar *et al.*, 2015; United Nations Population Fund, 2020). Furthermore, without consultation with trained abortion care professionals, 90% of women used medication abortion, which is a concerning issue for women's health in India. Previous research has also indicated a higher prevalence of unsafe abortion practices in countries with stringent abortion regulations (Rasch, 2011). Further research is warranted to explore the relationship between the prevalence of unsafe abortions, fertility levels, and SRB. This will help contextualise whether the observed abortions are driven by sex-selective factors or other reasons related to unwanted pregnancies.

The MTP Amendment Act (2021) in India permits women to terminate pregnancies resulting from contraceptive failure, irrespective of marital status (Ministry of Law and Justice, 2021). However, in line with the latest NFHS 5 report (IIPS and ICF, 2021), our study reveals that unintended pregnancies (48%) significantly outnumber those caused by contraceptive failure (4%) as the primary reason for induced abortions, regardless of the geographic region (Figure 4). Similarly, our study demonstrates a positive correlation between the unmet need for family planning and induced abortions and accessing unsafe abortion care, consistent with previous research in India (Rahaman *et al.*, 2022). Therefore, to safeguard women's reproductive rights, it is imperative to consider legalising abortion in cases of unmet contraception needs and to provide contraception to couples facing such needs. In line with previous research (Khatri *et al.*, 2019; Rahaman *et al.*, 2022), our study highlights the significant influence of the gestation period as a determinant of induced abortions and the choice of abortion care. Notably, in our study, more than 90% of women terminated their last pregnancy within the first 12 weeks of gestation, often resorting to unsafe abortion practices. Among those who terminated their last pregnancy during the early stage of gestation, over 70% favoured medication abortion (Table 5), typically using mifepristone, combination pack pills, or other publicly available medications (Singh *et al.*, 2018). The MTP Act (Amendment 2003) allows medication abortion up to 7 weeks of gestation, prescribed by certified abortion providers (Ministry of Law and Justice, 2021). However, our study, in line with a recent report (United Nations Population Fund, 2020), also highlights the widespread practice of medication abortion in India without consultation with skilled abortion providers (Table 5), a concerning issue in the country (WHO, 2011). Furthermore, our findings reveal that nearly 4% of women terminated pregnancies beyond 20 weeks of gestation, with almost 48% preferring medication abortion. It is important to note that while terminating pregnancies beyond 20 weeks can be safe with modern medical procedures, preferring medication abortion at this stage poses health risks. The recent amendment to the Indian MTP Act (2021) extended the permissible gestation period for abortion from 20 weeks to 24 weeks, providing comprehensive guidelines and provisions (Ministry of Law and Justice, 2021). Nonetheless, our study found that

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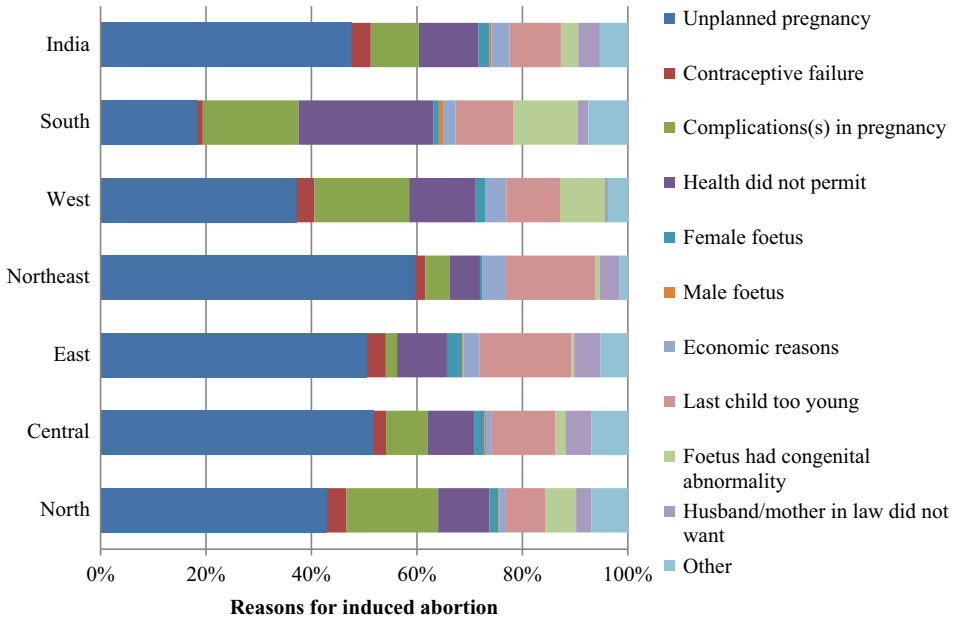

Figure 4. Regional Patterns of Reasons for Induced Abortion Among Women Aged 15–49 Years, India, National Family Health Survey 5, 2019–2021.

2.4% of women chose unsafe abortion methods beyond 20 weeks of gestation. This underscores the need for increased awareness regarding the provisions for abortion beyond 20 weeks and the importance of accessing standardised abortion care.

While the Indian government has enlisted Accredited Social Health Activists (ASHAs) to improve healthcare services, including reproductive health and contraceptive distribution, at the community level (Bango and Ghosh, 2022), our findings emphasise the critical importance of enhancing both the quality and coverage of ASHA services. This emphasis is essential in addressing the issue of induced abortions resulting from unintended pregnancies. Concurrently, long-term efforts aimed at enhancing the quality of CAC services, promoting socioeconomic development, empowering women, and increasing autonomy are essential. These multifaceted approaches are vital for effectively addressing the complex challenges associated with unmet family planning needs, unintended pregnancies, induced abortions, and the utilisation of unsafe abortion care in India.

Limitations and strengths of the study

It is important to acknowledge several limitations in this study. Firstly, our reliance on NFHS data, primarily designed to track child nutrition, family planning programmes, under-five mortality, and common morbidities, means that information related to abortion is sparse and likely underreported. Secondly, the absence of data on the doctor-patient ratio, the quality of health infrastructure, and the reasons behind opting for unsafe abortions represent a drawback of the NFHS dataset. This limitation constrains our ability to explore individual, institutional, and societal-level factors that may influence the preference for unsafe abortions. Thirdly, the nature of the data is cross-sectional, which restricts our ability to conduct causal analyses. Therefore, a comprehensive study is warranted to assess causality in the relationship between the underutilisation of safe abortion practices and associated predictors. Fourthly, the dataset lacks information on other relevant factors, such as the stigma associated with abortion, the approval or

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Table 5. Distribution of Used Methods for Induced Abortions by Gestation Period and Abortion Care Providers Among Women Aged 15–49 Years, India, National Family Health Survey 5, 2019–2021 (n = 4,810)

Per cent [95% CI]	Medicines	Manual vacuum aspiration	Other surgical method	Other	Don't know
Gestation period					
≤12 weeks	71.9 [70.5, 73.3]	10.2 [9.3, 11.1]	14.5 [13.4, 15.6]	1.2 [0.9, 1.6]	2.3 [1.9, 2.8]
13–20 weeks	56.5 [52.1, 60.8]	14.4 [11.6, 17.8]	22.2 [18.8, 26.1]	3.0 [1.9, 5.0]	3.8 [2.4, 5.8]
≥20 weeks	46.8 [39.9, 53.8]	18.7 [13.8, 24.8]	24.9 [19.4, 31.5]	3.1 [1.4, 6.8]	6.5 [3.7, 10.9]
Abortion care provider					
Skilled care providers	57.4 [55.7, 59.1]	15.5 [14.3, 16.8]	22.2 [20.8, 23.7]	1.5 [1.2, 2.0]	3.3 [2.8, 4.0]
Unskilled care providers	96.0 [94.9, 96.9]	0.7 [0.3, 1.2]	1.0 [0.6, 1.7]	1.3 [0.9, 2.1]	0.9 [0.6, 1.6]
National average	69.3 [68, 70.6]	10.9 [10.1, 11.9]	15.7 [14.7, 16.8]	1.5 [1.2, 1.8]	2.6 [2.2, 3.1]

disapproval of partners or in-laws regarding abortion decisions, and the choice of healthcare services. This limitation hinders our ability to interpret the impact of individual-level stigma and the role of partners in determining the choice of healthcare facility for abortion. Furthermore, the study did not delve into the in-depth aspects of why individuals prefer unsafe abortion methods, given the quantitative study settings. Therefore, there is a need for a qualitative study to explore the socio-cultural, community, and individual-specific factors that drive the practice of unsafe abortion in India. Finally, the study measured the outcome variable based on only the information of abortion care providers; therefore, the study suggests further examination of unsafe abortion using other measuring indicators like place of abortion care and gestation period adjusted latest definition of unsafe abortion.

Despite these limitations, our study possesses strengths, notably its use of the Heckman probit model to address sample selection bias effects. Many previous studies have reported that when a research study selects a small subset of samples from a large dataset based on specific criteria, the findings can be affected by sample selection bias due to the censoring of a large portion of the dataset (Saulo *et al.*, 2023). Our study is unique in that it employs the Heckman probit model to adjust for sample selection biases in the context of unsafe abortion research using NFHS data. This approach makes our results more robust and free from sample selection bias.

Conclusion

This study concludes that unsafe abortion is widespread in India, with significant variations based on spatial, demographic, and sociocultural factors. Several key determinants of unsafe abortion were identified, including women's age, the sex composition of their living children, gestation stage, family planning status, and geographical region. Unsafe abortions were notably prevalent among women aged 20–34, those with only daughters, and those residing in the central and eastern regions. A significant portion of unsafe abortions occurred during the early stages of gestation, often involving medication use without consultation with skilled healthcare providers. The primary reasons cited for induced abortions were unintended pregnancies, followed by health complications. In light of these findings, it is essential to promote the active engagement of ASHAs in raising community awareness regarding the pathways to safe abortion practices and reproductive rights. Furthermore, there is a pressing need for targeted interventions that consider the regional, demographic, and social dynamics influencing abortion practices in India. Such efforts are crucial for reducing the prevalence of unsafe abortions, safeguarding the health and well-being of women, and advancing their reproductive rights across the country.

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Ethical standard. The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

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