

Trimester specific determinants of Pregnancy loss among women in Reproductive age group from India -Evidence from National Family Health Survey (2015-16)

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Abstract

Background:

Abortions are the most common causes of pregnancy loss among women of reproductive age. In a country like India, there is not enough effort being done to address this problem.

Methods:

The National Family Health Survey (2015-16) was used in this study, and bivariate and multivariate logistic regression analysis were used. The GIS map is used to understand the spatial distribution of abortions.

Results:

Our results show that the rates of abortions rise with women's age, education, and place of residency, according to our findings. Muslim women have a lower risk of abortion than Hindu women. The rich women have a higher chance of having an abortion than the poor women. The socioeconomic characteristics were also linked to the loss of pregnancy.

Conclusions:

Abortion care for women that is both affordable and well-informed can improve women's reproductive health. In the backward districts, the government should strengthen the use of contraceptives.

Introduction

The Cairo's International Conference of Population and Development (ICPD) highlighted the importance of women's reproductive health for global health and population development. The United Nations' Sustainable Development Goals (SDGs) reiterates the same, and are committed to reducing the global maternal mortality rate to less than 70 per 1000 live births (1). The morbidity and mortality estimates among women of reproductive age are significantly affected by pregnancy loss. Miscarriage and induced abortion are the two primary dimensions of pregnancy loss. As per the World Health Organization (WHO) definition, the spontaneous loss of a baby before the 28 weeks of gestational pregnancy is termed as miscarriage and on the other hand, induced abortion is the intentional termination of pregnancy by evacuating the products of conception from the uterus to avoid unwanted pregnancy. Pregnancy loss is linked with complications like retained products, hemorrhage, sepsis leading to multiple organ dysfunction, and disseminated Intravascular Coagulation (DIC) (2). In addition, miscarriage and abortions are a cause of psychological trauma to the women and their families (3).

The incidence rate of recurrent miscarriage in India is higher compared to western countries (4). As estimated, miscarriage occurs in 26% of all pregnancies and up to 10% in clinically documented pregnancies (5). In a population-based study in India, the miscarriage and induced abortion rates were

estimated as 44 and 27 per thousand population of women aged 15–49 (6) (7). Another secondary data analysis of the National Family Health Survey reported 14.3% of pregnancy loss in India (8). The spontaneous loss of a pregnancy or the decision to intentionally terminate the pregnancy is a complex phenomenon influenced by various physiological and socio-demographic factors. The miscarriage is strongly linked with maternal age and similar related factors (9). A study in India reported that intimate partner violence is a significant risk factor for unintended pregnancy, requiring abortion in future (10). A study conducted in Ghana depicted women's age, schooling, marital status, occupation, and the economic group as significant predictors of pregnancy loss (11). Tiwary et al. found that struggles in women's life, education status, desire to have a child, and family pressure for fewer children were associated with pregnancy loss among women in India. Also, northern and northeastern regions of India depicted higher pregnancy loss and unwanted pregnancies, potentially resulting in induced abortion or unwanted children (8).

The prevalence of pregnancy loss varies significantly with the period of gestation. The miscarriage rate is highest in early pregnancy i.e. 6–8 weeks (115.3), followed by 9–11 weeks (101.9) and 12–20 weeks (60.3) per thousand pregnancies. Though most studies found that pregnancy loss due to miscarriage and induced abortion occurs mainly in the first trimester (12) the second trimester still constitutes a considerable share of pregnancy loss and the prevalence of induced abortions can be as high as 40.2, 45.4, and 48.3 per thousand pregnancies in the different gestational periods (13). A regional study of rural Maharashtra reported that 26% of abortions came about in the second trimester (14). Unmarried pregnancy is the most important reason for induced abortions, and a study from Maharashtra reveals that 72.2% of induced abortions among unmarried women occurred in the second trimester compared to the married women (42.6%). Illegal sex-determination leads to a large number of abortions in the second trimester. Delayed abortions can be attributed to delay in seeking and accessing the abortion services. For instance, sterilization failure and poor nutritional status are associated with the delayed realization of pregnancy and hence delayed abortions (15). Early diagnosis of miscarriage and accessing a safe abortion may prevent many complexities and maternal complications (16). With this background we understand that miscarriage and abortions in different trimesters of pregnancy are driven by various factors. Many studies have estimated miscarriage and abortion rates in India, but only a few have studies them w.r.t to the trimester of pregnancy. Therefore, the present study has been done to fill this void and we examine the prevalence and associated risk factors of pregnancy loss due to miscarriage and induced abortion in the first and second trimesters. Also, we highlight the geographical disparities in the prevalence rates of pregnancy losses in India.

Methodology

Data Source

We used the data from the Indian nationally representative household survey, the National Family Health Survey (NFHS). Four rounds of NFHS were carried out across all the states and union territories of India in 1992–93, 1998–99, 2005–06, and 2015–16, respectively. The fourth round of the National Family Health

Survey (NFHS- \square) furthermore includes calendar data from the previous five years' events of pregnancy, childbirth, contraceptive usage, and contraception discontinuation reasons. The NFHS- \square covered 723,875 eligible women aged 15–49 years in 572,000 households. Interviews were conducted for 699,686 women, with a response rate of 97%.

Sample Selection

We included women who were pregnant for at least once in last five years ($n = 224,976$) (Fig. 1). Despite having a complete five-year pregnancy history, we only included the most recent pregnancy outcomes, and excluded all pregnancy outcomes that occurred before their most recent pregnancy. We also eliminated women whose pregnancy outcomes were not clear ($n = 715$) (Fig. 1).

The final analysis included a total of 2,24,261 respondents with clear pregnancy outcomes were further categorized as per their pregnancy outcomes. The outcomes were labelled as currently pregnant (32,423), or the last pregnancy have resulted in either live birth (174,795), or pregnancy terminating into miscarriage (9,817), abortions (6,065), or stillbirth (1,161). Of the total abortions, 5,466 occurred in the first trimester and the remaining 599 occurred after 1st trimester. Similarly, of the total 9,817 miscarriages, 7,875 were reported to have happened in the first trimester, and the remaining 1,942 cases occurred beyond the first trimester.

Outcome Variables

Pregnancy termination among the respondents between 15–49 years who had become pregnant at least once in last five years before to the survey date was the primary dependent variable. The primary outcome variable was further categorised as abortion and miscarriage, both of which were coded in a binary format.

Predictor Variables:

The predictor variables considered in this study were based on detailed literature review. The primary independent variable was trimester of the pregnancy termination categorised as first and second trimesters of pregnancy.

Other independent variables included age group of the women ('15–19', '20–24', '25–29', '30–34', '35–39', '40–44', and '45–49' years); marital status ('Not in Union', 'currently married'); religious affiliation ('Hindu', 'Muslims', 'Christian', and 'Other religion'); Urban-rural residence ('rural', 'urban'); social class (Scheduled Caste (SC), Scheduled tribe (ST), Others categories included as the Other Backward Classes and Forward Caste); Educational attainment of the women ($<= 10$ and > 10 years); household's wealth index ('Poorest', 'Poorer', 'Middle', 'Richer', and 'Richest'); further desire of children ('yes' and 'undecided or no more'); mass media exposure ('low', 'moderate' and 'high'); and the geographical regions of India classified as six regions ('East', 'West', 'North', 'South', 'Central', and 'North-east').

Statistical Analysis

We used bivariate analysis, spatial analysis, and then a generalized linear model with a binomial distribution assumption and a log link for the binary outcome in this study.

The overall miscarriage or abortion rate of a population is defined as the number of miscarriages/abortions occurring in a specified reference period per 1000 pregnant women in the reproductive age 15–49 years.

Miscarriage/Abortion Rate=

$$\frac{\text{Number of Miscarriage / Abortions}}{\text{Total no. of pregnant women in 15 – 49 age group}} * 1000$$

The **abortion ratio** for a population, regularly estimated in a given year (but with the measurement period variable in principle) is the number of abortions for each 100 live births in the population. In other words:

$$\text{Abortion Ratio} = \frac{\text{number of abortions in a specified time}}{\text{total live birth in the 15 – 49 age group in the same period}} * 100$$

The abortion ratio could be any non-negative real value, and in principle may be more than 1000 (indicating more abortions than live births). Such high abortion rates, though rare, have been recorded, such as in Russia during Communist rule. Furthermore, abortion prevalence was estimated among overall pregnant women.

Bivariate analysis was performed to estimate the prevalence of induced abortion and miscarriage in India as per various socio-demographic factors and gestational trimesters. The prevalence of induced abortion and miscarriage at the district level is shown using a spatial map. Finally, a generalized linear model with a binomial distribution assumption and a log link for the binary outcome was used to determine the risk of induced abortion and miscarriage in response to some specific demographic features after assessing the multi-collinearity between independent variables using VIF (variance inflation factor). The model's output shows the adjusted relative risk of induced abortion and miscarriage among reproductive-aged women, together with their 95 percent confidence interval (95 percent CI). P-values of < 0.05 were considered significant. Stata software (version 16.0; Stata Corp LLC, College Station, TX) and Arc GIS were used to analyse the data (version 10.3).

Results

Table 1 depicts the sample characteristics of the women who experienced pregnancy loss in their last pregnancy through abortion or miscarriage as per various socio-demographic characteristics. Of them, more than one-third were between 25–29 years. Further, we observed a higher number of pregnancy losses in currently married, Hindu women, living in urban areas, belong to SC/ST social castes, higher years of education, and belonging to middle wealth index category, with no further desire to have children, having moderate exposure to mass media, and living in south-west region of the country.

Table 1
 Sample characteristics of gestational pregnancy loss among women aged 15–49 by selected socio-demographic characteristics

Variables	Total Pregnancy	Abortion			Miscarriage		
		1st trimester	2nd and above trimester	P- Value	1st trimester	2nd and above trimester	P- Value
		n (%)	n (%)	n (%)	n (%)	n (%)	
Age Group							
15–19	9640 (4.3)	142 (89.9)	16 (10.1)	0.001	434 (79.6)	111 (20.4)	0.591
20–24	65380 (29.2)	940 (86.7)	144 (13.3)		2087 (79.7)	530 (20.3)	
25–29	78550 (35.0)	1699 (91.1)	166 (8.9)		2413 (80.1)	598 (19.9)	
30–34	43807 (19.5)	1431 (90.9)	143 (9.1)		1663 (81.3)	383 (18.7)	
35–39	19063 (8.5)	874 (91.8)	78 (8.2)		848 (80.7)	203 (19.3)	
40–44	5944 (2.7)	302 (88)	41 (12)		336 (79.8)	85 (20.2)	
45–49	1877 (0.8)	78 (87.6)	11 (12.4)		94 (74.6)	32 (25.4)	
Marital Status							
Not in Union	4079 (1.8)	203 (86.8)	31 (13.2)	0.078	140 (76.9)	42 (23.1)	0.260
Currently married	220182 (98.2)	5263 (90.3)	568 (9.7)		7735 (80.3)	1900 (19.7)	
Religion							
Hindu	162507 (72.5)	4134 (89.6)	480 (10.4)	0.040	5766 (79.9)	1450 (20.1)	0.053
Muslim	34363 (15.3)	841 (91.4)	79 (8.6)		1295 (82.4)	277 (17.6)	
Others	27391 (12.2)	491 (92.5)	40 (7.5)		814 (79.1)	215 (20.9)	
Place of Residence							

Variables	Total Pregnancy	Abortion			Miscarriage		
		1st trimester	2nd and above trimester	P-Value	1st trimester	2nd and above trimester	P-Value
Urban	57471 (25.6)	1892 (90.9)	190 (9.1)	0.157	2533 (84)	484 (16)	0.000
Rural	166790 (74.4)	3574 (89.7)	409 (10.3)		5342 (78.6)	1458 (21.4)	
Caste							
SC/ST	85201 (38)	1599 (89.8)	182 (10.2)	0.146	2656 (78)	749 (22)	0.000
OBC	86816 (38.7)	2169 (89.5)	254 (10.5)		3141 (81)	735 (19)	
Other	52244 (23.3)	1698 (91.2)	163 (8.8)		2078 (81.9)	458 (18.1)	
Education in years							
<=10years	175420 (78.2)	4080 (89.7)	467 (10.3)	0.075	5923 (78.8)	1595 (21.2)	0.000
>10years	48841 (21.8)	1386 (91.3)	132 (8.7)		1952 (84.9)	347 (15.1)	
Wealth Index							
Poorest	53180 (23.7)	788 (89.2)	95 (10.8)	0.296	1381 (74.2)	479 (25.8)	0.000
Poorer	51038 (22.8)	1157 (88.9)	145 (11.1)		1714 (78.8)	462 (21.2)	
Middle	45373 (20.2)	1280 (90.8)	129 (9.2)		1645 (79.4)	426 (20.6)	
Richer	39624 (17.7)	1185 (90.9)	119 (9.1)		1605 (84.3)	299 (15.7)	
Richest	35046 (15.6)	1056 (90.5)	111 (9.5)		1530 (84.7)	276 (15.3)	
Desire of Children							
Yes	87424 (39.1)	1576 (85.6)	265 (14.4)	0.000	4741 (79.3)	1237 (20.7)	0.006

Variables	Total Pregnancy	Abortion			Miscarriage		
		1st trimester	2nd and above trimester	P-Value	1st trimester	2nd and above trimester	P-Value
Undecided or No-more	136404 (60.9)	3777 (92.2)	321 (7.8)		3112 (81.6)	703 (18.4)	
Mass Media							
Low	137814 (61.5)	2894 (89.2)	350 (10.8)	0.028	4353 (78.3)	1207 (21.7)	0.000
Moderate	61956 (27.6)	1821 (91.5)	170 (8.5)		2481 (82.6)	522 (17.4)	
High	24491 (10.9)	751 (90.5)	79 (9.5)		1041 (83)	213 (17)	
Region							
East	45570 (20.3)	986 (91.2)	95 (8.8)	0.000	1478 (78.5)	404 (21.5)	0.000
West	16156 (7.2)	309 (89)	38 (11)		439 (76.1)	138 (23.9)	
North	42323 (18.9)	795 (88.2)	106 (11.8)		1692 (81.2)	391 (18.8)	
South	23411 (10.4)	415 (76.6)	127 (23.4)		490 (76.2)	153 (23.8)	
North east	61702 (27.5)	1765 (91.6)	161 (8.4)		2614 (81.8)	580 (18.2)	
South west	35099 (15.7)	1196 (94.3)	72 (5.7)		1162 (80.8)	276 (19.2)	
Total	2,24,261	5466(90.1)	599 (9.9)		7875 (80.2)	1942 (19.8)	

Most of the women reported abortion ($n = 5466$) and miscarriages ($n = 7875$) in their 1st trimester. The 1st trimester abortions and miscarriages were higher between 30–39 years' age group, among women who were currently married, others and Muslim women, living in urban areas, with more years of education, belonging to SC/ST and other castes, richer or richest wealth quintile, with undecided or no future desire for children, moderate to high mass media exposure, and living in south west and North-east parts of the country. However, 2nd trimester abortions and miscarriages were common between 20–24 and 45–49 years, not-in-union women, living in rural areas, having OBC or SC/ST caste, with less years of education, poorer or richest wealth quintile, having a desire for more children, low mass-media exposure, and living in south and Western parts of the country.

The prevalence of abortion and miscarriage in the first and second trimesters of pregnancy, as well as total pregnancy, is shown in Table 2. The overall prevalence of abortions and Miscarriage in India is estimated to be 2.8 (2.7-3.0), and 4.2 (4.1–4.4). The prevalence of abortions and miscarriages were highest between 40–44 years, with a 6.3% and 7.4% incidence. Women who were not in a union reported a higher prevalence of pregnancy loss. Abortions were higher in 1st trimester among women who were not in union, while miscarriages were higher in married women in their 1st trimester. Higher prevalence of abortion was observed in Muslim women, living in urban areas, belong to other caste of India, with a greater number of years in education, high exposure to mass media, not having further desire to have children, and living in the South-West regions of the country. The prevalence of Miscarriage were higher in all these socio-demographic variables except where the women had desire for more children and among those who were living in the North-East regions of the country. Figure 2 depicts the geographical pattern of abortion prevalence in India's 640 districts. Dhemaji district in Assam reported highest (15%) prevalence of abortions, followed by 4 districts from Manipur (Bishnupur, Imphal East, Thoubal and Imphal West), and 4 districts from Uttar Pradesh (Gautam Buddha Nagar, Mahamaya Nagar, Aligarh and Farrukhabad) where the prevalence ranges between 8.5–15%. Other 75 districts reported prevalence between 4.0-8.4%. Abortion in the first trimester was high in 31 districts located in the North eastern and northern states of India, whereas abortion in 2nd trimester was high in 17 districts located in the southern and eastern states of India.

Table 2

Prevalence of abortion and miscarriage within and after first trimester among reproductive women for their last pregnancy

Variables	Abortion			Miscarriage		
	Total Pregnancy	1st trimester	2nd and above trimester	Total	1st trimester	2nd and above trimester
Total	2.8 [2.7 3.0]	14.7 [14.1 15.3]	0.4 [0.3 0.4]	4.2 [4.1 4.4]	19.5 [18.9 20.1]	1.1 [1.0 1.1]
Age Group						
15–19	1.6 [1.2, 2.0]	7.8 [5.8, 9.7]	0.2 [0.1, 0.4]	5.5 [4.9, 6.1]	23.0 [20.5, 25.5]	1.5 [1.1, 1.9]
20–24	1.8 [1.6 ,2.0]	12.3 [11.1, 13.4]	0.3 [0.3, 0.4]	4.0 [3.8, 4.2]	25.1 [23.7, 26.4]	1.0 [0.9, 1.1]
25–29	2.5 [2.3,,2.7]	14.2 [13.2,15.2]	0.3 [0.2, 0.4]	3.6 [3.4, 3.8]	18.0 [17.0, 19.0]	0.9 [0.7, 1.0]
30–34	4.0 [3.6 ,4.3]	16.5 [15.0, 18.0]	0.4 [0.3, 0.5]	4.6 [4.3, 4.9]	17.2 [15.9, 18.4]	1.0 [0.9, 1.2]
35–39	5.6 [5.0, 6.1]	19.5 [17.7, 21.4]	0.7 [0.5, 0.9]	5.5 [5.0, 5.9]	16.9 [15.4, 18.5]	1.5 [1.2, 1.7]
40–44	6.3 [5.4, 7.3]	18.5 [15.6, 21.3]	1.1 [0.7, 1.5]	7.4 [6.4, 8.4]	18.3 [15.8, 20.9]	2.7 [1.8, 3.6]
45–49	4.9 [3.6, 6.2]	12.5 [9.0, 16.0]	1.1 [0.3, 1.9]	6.4 [5.0 ,7.9]	13.0 [9.7, 16.3]	3.2 [1.7, 4.7]
Marital Status						
Not in Union	6.0 [4.7 ,7.3]	20.2 [15.8, 24.5]	1.4 [0.6, 2.1]	4.8 [3.6, 5.9]	12.9 [9.7, 16.1]	2.1 [1.0, 3.2]
Currently married	2.8 [2.7 ,2.9]	14.6 [14.0, 15.2]	0.4 [0.3, 0.4]	4.2 [4.1, 4.4]	19.6 [19, 20.2]	1.0 [1.0, 1.1]
Religion						
Hindu	2.8 [2.7, 3]	14.6 [14.0, 15.3]	0.4 [0.3, 0.4]	4.2 [4.1, 4.4]	19.3 [18.6, 20]	1.1 [1.0, 1.2]

Variables	Abortion			Miscarriage		
	Total Pregnancy	1st trimester	2nd and above trimester	Total	1st trimester	2nd and above trimester
Muslim	2.9 [2.6, 3.3]	15.6 [13.9, 17.3]	0.3 [0.2, 0.4]	4.5 [4.2, 4.8]	21.2 [19.7, 22.8]	1.0 [0.9, 1.2]
Others	2.5 [2.0, 3.0]	13.0 [10.6, 15.5]	0.3 [0.1, 0.6]	3.5 [3.1, 4.0]	16.4 [14.1, 18.8]	0.9 [0.6, 1.1]
Place of Residence						
urban	3.9 [3.6, 4.2]	18.4 [17.1, 19.8]	0.5 [0.4, 0.6]	4.8 [4.5, 5.1]	20.9 [19.5, 22.2]	1.0 [0.8, 1.2]
rural	2.4 [2.3, 2.5]	12.8 [12.2, 13.4]	0.3 [0.3, 0.4]	4.0 [3.9, 4.1]	18.8 [18.1, 19.4]	1.1 [1.0, 1.2]
Caste						
SC/ST	2.4 [2.2, 2.6]	13.4 [12.3, 14.6]	0.3 [0.3, 0.4]	4.0 [3.8, 4.2]	19.1 [18.1, 20.0]	1.1 [1.0, 1.2]
OBC	2.7 [2.6, 2.9]	13.8 [13, 14.6]	0.4 [0.3, 0.5]	4.2 [4.0, 4.4]	19.4 [18.5, 20.3]	1.0 [0.9, 1.1]
Other	3.5 [3.2, 3.8]	17.6 [16.2, 19.0]	0.4 [0.3, 0.4]	4.6 [4.3, 4.9]	20.1 [18.8, 21.4]	1.2 [1.0, 1.3]
Education in years						
<=10years	2.8 [2.6, 2.9]	14.2 [13.6, 14.9]	0.4 [0.3, 0.4]	4.2 [4.0, 4.3]	18.9 [18.2, 19.6]	1.1 [1.0, 1.2]
> 10years	3.1 [2.9, 3.4]	16.2 [14.8, 17.5]	0.4 [0.3, 0.4]	4.5 [4.2, 4.8]	21.3 [20.0, 22.7]	0.9 [0.7, 1.1]
Wealth Index						
poorest	1.8 [1.6, 2.0]	10.1 [9.2, 11.1]	0.3 [0.2, 0.3]	3.6 [3.4, 3.9]	17.1 [16.0, 18.1]	1.2 [1.0, 1.3]
Poorer	2.6 [2.4, 2.8]	13.9 [12.7, 15.1]	0.4 [0.3, 0.4]	4.2 [4.0, 4.5]	20.2 [19.0, 21.4]	1.1 [1.0, 1.3]

Variables	Abortion			Miscarriage		
	Total Pregnancy	1st trimester	2nd and above trimester	Total	1st trimester	2nd and above trimester
Middle	3.0 [2.8, 3.3]	15.6 [14.3 ,17.0]	0.4 [0.3, 0.5]	4.1 [3.8, 4.4]	18.7 [17.5, 20.0]	1.1 [0.9 ,1.2]
Richer	3.4 [3.1 ,3.6]	16.8 [15.4 ,18.2]	0.4 [0.3, 0.5]	4.4 [4.1, 4.7]	20.9 [19.6, 22.3]	0.8 [0.7, 0.9]
Richest	3.7 [3.4 ,4.1]	17.1 [15.4 ,18.8]	0.4 [0.3, 0.6]	4.9 [4.5, 5.4]	20.5 [18.8, 22.1]	1.1 [0.8, 1.4]
Desire of Children						
yes	2.4 [2.2, 2.6]	12.4 [11.4 ,13.3]	0.5 [0.4, 0.6]	6.9 [6.6 ,7.1]	33.1 [31.9, 34.4]	1.8 [1.6, 2.0]
Undecided or No More	3.1 [2.9, 3.2]	15.8 [15.0 ,16.6]	0.3 [0.3, 0.3]	2.6 [2.5 ,2.7]	11.7 [11.1, 12.3]	0.6 [0.5, 0.7]
Mass Media						
Low	2.5 [2.4, 2.7]	13.5 [12.8,14.3]	0.3 [0.3, 0.4]	4.0 [3.8, 4.1]	18.8 [18.1, 19.6]	1.1 [1.0, 1.1]
Moderate	3.3 [3.1, 3.6]	16.6 [15.5, 17.8]	0.4 [0.3, 0.4]	4.7 [4.4, 4.9]	20.8 [19.7, 21.9]	1.1 [0.9, 1.2]
High	3.4 [3.0, 3.8]	15.5 [13.6, 17.5]	0.5 [0.4, 0.7]	4.5 [4.0, 5.0]	19.3 [17.3, 21.4]	1.0 [0.8, 1.3]
Region						
East	2.8 [2.5, 3.0]	15.6 [14.2, 17.0]	0.2 [0.2, 0.3]	3.9 [3.7, 4.2]	18.1 [16.9, 19.4]	1.1 [1.0, 1.3]
West	2.6 [2.2, 3.0]	14.4 [12.1 ,16.8]	0.3 [0.2, 0.5]	3.7 [3.2, 4.2]	16.4 [14.3, 18.6]	1.2 [0.8, 1.6]
North	2.3 [2.0 ,2.6]	11.4 [9.9 ,12.9]	0.3 [0.2, 0.4]	5.2 [4.8, 5.5]	23.5 [21.8, 25.3]	1.1 [0.9, 1.2]
South	2.4 [2.1 ,2.7]	11.4 [10.0,12.8]	0.7 [0.6, 0.9]	2.8 [2.5, 3.2]	14.0 [12.3, 15.7]	0.8 [0.6, 0.9]

Variables	Abortion			Miscarriage		
	Total Pregnancy	1st trimester	2nd and above trimester	Total	1st trimester	2nd and above trimester
North east	3.4 [3.2, 3.6]	16.4 [15.5 ,17.3]	0.3 [0.3, 0.4]	5.4 [5.2, 5.6]	23.5 [22.6, 24.4]	1.2 [1.1, 1.3]
South west	4.2 [3.8, 4.6]	23.6 [21.6 ,25.6]	0.3 [0.2, 0.4]	3.8 [3.5 ,4.1]	17.6 [16.1, 19.1]	1.0 [0.8, 1.1]

Whereas abortion in 2nd trimester was found to be high in 17 districts of India, and most of these districts belongs to southern and eastern states of India. Around 22 districts of India depicted the highest prevalence of miscarriage ranges between 8.5–11.5%, with the highest prevalence (11.5%) reported from the Jajapur district of Odisha. Miscarriage within first trimester of pregnancy were found to be high in 5 districts of India and were in the range of 9.9 to 19.5%. It is pertinent to mention that 293 districts were having miscarriage prevalence greater than the national prevalence in 1st trimester i.e., 19.5%. After the first trimester, the prevalence of miscarriage was highest in Janjgir–Champa district (4.0%) of Chattisgarh, followed by other 38 districts with the highest rate of miscarriage, while the next 172 districts had a prevalence of miscarriage bewteen 0.0 to 0.5%.

Certain Predictors of abortions and miscarriages emerged from results of the generalized linear model (Table 3). Overall, the chances of abortions increased with age and was highest between 40–44 years (OR:5.12,95% CI:4.11,6.36), in Hindu women, living in urban areas, and belonging to 'Other' social caste, richer wealth quintile, with >10 years of education, and from the North-East region of the country. However, the predictors for 1st trimester abortions were age 35–39 years, currently married women, Hindu religion, urban residence, 'other' social caste, middle wealth quintile, no further desire of having children, moderate mass media exposure, and eastern region of India. On the other hand, predictors of abortion beyond 1st trimester included 45–49 years, not-in union, 'other' social caste, less years of education, richest wealth quintile, having a desire for more children in future, and south region of India. Likewise, the predictors for miscarriages were higher age (45–49 years), not-in-union, Hindu religion, urban areas, 'other' social caste, < 10 years of education, middle wealth quintiles, further desire of having children, and North East region of India. Further, the predictors of miscarriage in 1st trimester were 40–44 years, Hindu religion, urban residence, < 10 years of education, 'other' social caste, richer wealth quintile, further desire of having children, moderate media exposure, and North-east region of India. On the other hand, predictors for miscarriage beyond 1st trimester were higher age (45–49 years), not-in-union marriage status, Hindu religion, < 10 years of education, middle wealth quintile, and East region of India.

Table 3
Generalized linear model with a binomial distribution assumption and log link for binary outcome as
Abortion and Miscarriage for India

Characteristics	Abortion			Miscarriage		
	Total	1st trimester	2nd and above trimester	Total	1st trimester	2nd and above trimester
Age Group						
15–19	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
20–24	1.22* [1.00,1.48]	1.77*** [1.46,2.16]	1.41 [0.82,2.45]	0.81*** [0.74,0.89]	1.36*** [1.20,1.54]	0.80* [0.65,0.98]
25–29	1.78*** [1.47,2.15]	2.08*** [1.71,2.53]	1.66 [0.96,2.88]	0.99 [0.91,1.09]	1.41*** [1.25,1.60]	1.05 [0.86,1.29]
30–34	2.75*** [2.27,3.34]	2.29*** [1.88,2.78]	3.13*** [1.79,5.48]	1.45*** [1.32,1.60]	1.63*** [1.43,1.86]	1.58*** [1.28,1.97]
35–39	4.05*** [3.32,4.94]	2.64*** [2.16,3.23]	4.81*** [2.69,8.60]	1.97*** [1.78,2.19]	1.83*** [1.59,2.11]	2.33*** [1.84,2.96]
40–44	5.12*** [4.11,6.36]	2.63*** [2.12,3.26]	9.90*** [5.32,18.40]	2.80*** [2.47,3.18]	2.22*** [1.86,2.63]	3.59*** [2.69,4.79]
45–49	4.75*** [3.57,6.32]	2.05*** [1.55,2.71]	10.21*** [4.58,22.76]	2.97*** [2.46,3.59]	1.77*** [1.37,2.28]	4.91*** [3.30,7.29]
Marital Status						
Not in Union	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Currently married	0.89 [0.73,1.08]	1.24* [1.02,1.51]	0.41*** [0.26,0.66]	0.70*** [0.60,0.82]	0.93 [0.76,1.14]	0.51*** [0.37,0.70]
Religion						
Hindu	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Muslim	0.74*** [0.69,0.80]	0.89*** [0.82,0.95]	0.59*** [0.46,0.75]	0.87*** [0.82,0.92]	1.02 [0.94,1.10]	0.75*** [0.65,0.86]
Others	0.40*** [0.36,0.45]	0.53*** [0.48,0.59]	0.41*** [0.28,0.61]	0.74*** [0.69,0.80]	0.88* [0.80,0.98]	0.77** [0.64,0.92]
Place of Residence						
Rural	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Urban	1.23*** [1.15,1.31]	1.19*** [1.11,1.28]	1.16 [0.95,1.42]	1.20*** [1.14,1.27]	1.18*** [1.10,1.26]	1.09 [0.96,1.23]
Caste						

Characteristics	Abortion			Miscarriage		
	Total	1st trimester	2nd and above trimester	Total	1st trimester	2nd and above trimester
SC/ST	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
OBC	1.25*** [1.17,1.34]	1.16*** [1.08,1.23]	1.26* [1.03,1.55]	1.07** [1.02,1.12]	1.05 [0.98,1.12]	1.02 [0.91,1.14]
Others	1.48*** [1.37,1.60]	1.32*** [1.23,1.41]	1.53*** [1.20,1.94]	1.11*** [1.05,1.18]	1.07 [0.99,1.15]	1.13 [0.99,1.29]
Education in years						
>10years	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
<=10 years	1.13*** [1.05,1.22]	0.96 [0.89,1.04]	1.44** [1.13,1.82]	1.18*** [1.12,1.26]	1.06 [0.99,1.14]	1.47*** [1.28,1.68]
Wealth Index						
Poorest	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Poorer	1.69*** [1.55,1.85]	1.43*** [1.31,1.56]	1.71*** [1.30,2.25]	1.30*** [1.22,1.38]	1.25*** [1.15,1.36]	1.11 [0.97,1.26]
Middle	2.14*** [1.95,2.35]	1.69*** [1.54,1.84]	1.71*** [1.28,2.30]	1.41*** [1.32,1.51]	1.26*** [1.15,1.37]	1.20* [1.04,1.38]
Richer	2.17*** [1.96,2.40]	1.66*** [1.50,1.83]	1.71** [1.24,2.36]	1.41*** [1.31,1.52]	1.27*** [1.15,1.40]	0.96 [0.81,1.14]
Richest	2.04*** [1.81,2.30]	1.59*** [1.42,1.77]	1.82** [1.26,2.63]	1.34*** [1.23,1.46]	1.16** [1.04,1.30]	0.97 [0.79,1.18]
Desire of Children						
Yes	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Undecided or No More	1.05 [0.99,1.12]	1.22*** [1.15,1.29]	0.53*** [0.44,0.63]	0.32*** [0.31,0.33]	0.25*** [0.23,0.26]	0.27*** [0.24,0.30]
Mass Media						
Low	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Moderate	1.20*** [1.12,1.28]	1.13*** [1.07,1.20]	0.95 [0.77,1.17]	1.11*** [1.06,1.17]	1.07* [1.01,1.15]	1.07 [0.95,1.19]
High	1.13** [1.03,1.23]	1.05 [0.96,1.13]	0.99 [0.76,1.32]	1.15*** [1.07,1.23]	1.08 [0.99,1.18]	1.12 [0.95,1.32]
Region						
East	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.

Characteristics	Abortion			Miscarriage		
	Total	1st trimester	2nd and above trimester	Total	1st trimester	2nd and above trimester
West	0.67*** [0.59,0.76]	0.71*** [0.63,0.81]	0.99 [0.67,1.47]	0.76*** [0.70,0.84]	0.70*** [0.62,0.79]	0.99 [0.82,1.22]
North	0.67*** [0.61,0.74]	0.65*** [0.59,0.71]	1.13 [0.84,1.52]	1.07* [1.00,1.14]	1.07 [0.98,1.17]	1.14 [0.98,1.32]
South	0.73*** [0.65,0.81]	0.69*** [0.62,0.77]	2.50*** [1.87,3.33]	0.57*** [0.52,0.62]	0.50*** [0.44,0.56]	0.79* [0.65,0.95]
North east	1.12** [1.03,1.21]	1 [0.93,1.08]	1.21 [0.93,1.57]	1.17*** [1.10,1.23]	1.12** [1.04,1.21]	1.10 [0.97,1.25]
South west	1.58*** [1.44,1.73]	1.52*** [1.39,1.65]	1.14 [0.81,1.61]	0.91* [0.85,0.99]	0.87** [0.79,0.96]	0.87 [0.72,1.04]

* p < 0.05, ** p < 0.01, *** p < 0.001

Discussion

We estimated the prevalence of abortions and miscarriages and their predictors specifically in 1st trimester and beyond. We found few significant findings from our analysis. First, abortion rate was high in the 1st trimester, but there was a higher proportion of miscarriages reported beyond 1st trimester compared to abortions. Prevalence of abortions and miscarriages increased with age, and depicted disparities across various socio-economic domains. There were conspicuous differences in socio-demographic and regional factors for pregnancy losses in the 1st and 2nd trimester both.

In our study, 31% of women in the **25–29 age group suffered** pregnancy losses in 1st trimester. According to the bivariate analysis, education, urban-rural residence, religion, caste, marital status, and geographical location are significantly associated with abortion and miscarriages in India. Further, the prevalence of abortion and pregnancy loss in 1st trimester is higher among women residing in urban areas and in the Northern region of India. These findings can be attributed to the high burden of unmet need for family planning in the northern region, and are in concordance to prior studies (17)(Rahman et al.,2001).

The bivariate analysis established that **unmarried and not-in-union women** account for roughly 20% of abortions, which could be due to early onset of unsafe sexual activity, lack of awareness and access to the modern contraceptive methods, and unintended pregnancies (19). The fact that about 20% of currently married women have miscarriages is particularly concerning because it can be a result of domestic violence, and lack of access to adequate antenatal care (20). Miscarriage in the 1st trimester is more common among **Muslim women**. A plausible reason could be that a majority of the Muslim women marry before reaching the legal marriage age [REF], resulting in early pregnancies, combined with low awareness about reproductive health, and the concept of consanguineous marriages with high

prevalence of genetically non-viable mutation leading to high prevalence. Nonetheless, Muslim women have the less demand of the abortion which is owing to the religious norms (Pallikkadavath and Stones 2006). Our research also discovered that the women from **richest wealth quantile** had the highest abortion prevalence since abortion is common and health care facilities are readily available to them. In another study from India, about 80% of the induced abortions were carried out at a private health facility denoting ability to pay for such services. Thus, women with requisite resources (social, financial, etc) were able to avail induced abortion services.

The multivariate results showed that the risk of **abortion increases with the woman's age**. We found out that women in their 40–44 ages have a 5.12 times higher likelihood of having an abortion than women in their 15–19 ages. This finding is in line with prior research (23), which found that women beyond the age of 30 had a higher odds of abortion. One possible explanation is that around the age of 30, a pregnancy may be unintended or clearly medically difficult, prompting women to terminate the pregnancy. It is also feasible that in India's elder reproductive ages, most women had already completed their family sizes.

Women's educational attainment also has an effect on abortion and miscarriage; it is found that those with 10 years or more of education had a lower chance of miscarriage and abortion than women with no education. Perhaps one of the reasons is that the highly educated women have the control of their reproductive behaviour, are economically active and empowered enough to handle the cost of childbearing. Also the higher levels of education have **lower fertility**, and this negative relation is well established for India (Das, 2021). In contrast it is also possible that the more educated women have the higher abortion because the higher educated **women deny for sterilization** in India. However, higher abortion prevalence was found among women with secondary and higher education, and corroborates with earlier research from India and Abroad as per which educated women had easier access to abortion information (Adjei et al. 2015; Bose and Trent 2006).

Urban-rural residences are also linked with abortion related incidence. The study also found that rural areas have a lower likelihood of abortion. The lower risk of abortion among rural women's is attributed to less awareness about reproductive rights and, subsequently less demand for contraceptives and abortion services. Less exposure to mass media is a prominent factor to decreased awareness (21). Differences in the incidence of abortion between rural and urban residence may also point towards regional disparities in reproductive healthcare services (Patra et al., 2016). The present study also found the significant **regional and caste variation** in abortion and miscarriages. The differences in educational patterns, the preference for a male child and their current societal status, assimilate to highlight the regional differences. The north Indian families are typical example of the patrilineal and patrilocal residence, which motivates the son preference and the higher abortion rates. Illegal sex determination is also to be put to blame for subsequent late abortions. Previous studies also pointed out that the caste differentials of abortion and miscarriages will be dwindling if socio-economic status is also taken into account (21).

The highest rates of abortion and miscarriage have been found in the districts of **Assam, Manipur, and Uttar Pradesh**. Also, these are the states that are listed among the states with the highest Total Fertility Rates. So there is an obvious high unmet need for family planning and abortion services. According to previous surveys, few of public health institutions that provide abortion services exist in these areas (8). This is worsened by a high prevalence of domestic intimate partner violence and unintended pregnancies. (25). We also could not explore the reasons behind abortions and miscarriages that may have a genetic, physiological, or societal context behind and should be further assessed through cohort studies.

The study has specific policy implications. The high prevalence of abortions and miscarriages in socially neglected sections of society points toward the unmet need for family planning and abortion services. The unmet need is also the root cause of women seeking an abortion, which reflects the failure of family planning programmes to meet the contraceptive needs of all women at risk of unintended pregnancy. The increase in Unintended pregnancies and inaccessibility to appropriate abortion services have been further worsened by the COVID-19 pandemic. The new Medical Termination of Pregnancy (Amendment) Act 2021 is a welcome step in this regard. It expands the access to safe and legal abortion services on therapeutic, eugenic, humanitarian and social grounds to ensure universal access to comprehensive care. This will further our efforts to control the rates of unsafe abortions in India which are a significant yet preventable cause of maternal mortality and morbidity in developing countries. On the other hand, abortion is perceived as an extension of the Government's population stabilisation programme. There is a growing tendency to use abortion as yet another means of family planning which is a cause of concern. There is a dearth of medically approved abortion providers and registered facilities and an inadequacy of post-abortion family planning counselling and services. Lastly, healthcare service providers and policymakers have yet to recognize abortion as a women's health issue to realize the target of maternal mortality nationally.

There are some strengths and limitations of this study that should be considered when interpreting the results of this study. It is an analysis of a nationally representative datasets that were collected using a robust methodology, which makes the results generalizable. This is among the few studies from India that have segregated abortions and miscarriages based on trimesters, as the time period influences the management of pregnancy. However, the secondary data analysis limits the use of more reproductive health variables that can help us better to understand the process of abortions and consequences. Also, the cross-sectional nature of the data collection restrains us from making causal interpretations. Further, abortion was self-reported during this survey and can be subjected to under-reporting, especially among the women not-in-union, due to the societal taboos associated with pregnancy among the unmarried and not-in-union women. Lastly, we cannot comment upon the type of abortions (induced or spontaneous), and miscarriages, access to health facilities, and long-term effects of the event on women's health.

Conclusions

In conclusion, the outcomes of this study provide information on the socioeconomic predictors of abortion and pregnancy loss among Indian women. In order to reach the selected target population,

family planning services must be strengthened to reduce the unmet needs in India. The high prevalence of abortion is more likely to attain low intended family sizes due to the trend toward small families and the promotion of two-child norm. Women should have access to more inexpensive and well-equipped pregnancy termination facilities as part of their right to reproductive health. On the other hand, pregnancy loss is one of the leading reproductive health problems exacerbated by child marriage and domestic violence, and lack of access to competent health care. The recent proposal by the Indian government to raise the age of marriage for women is a good move that will help empower women and to have a favourable impact on reproductive health. Apart from this, evidence-based and safe abortion and contraceptive services, along with a comprehensive reproductive health services may reduce the maternal morbidity and mortality.

Declarations

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Not Applicable

Authors' contributions

M.S., M.D. conceived the idea, M.S. performed data analysis. M.D., A.B.R., M.S. interpreted the data and prepared the manuscript. P.G. editing language of the manuscript. All the authors have read and approved the submitted version of the manuscript.

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Availability of data and materials

Data and Materials are freely available upon making an official request to the DHS team through the DHS website at <https://dhsprogram.com/what-wedo/survey-Types/dHscfm>.

Declarations

Ethics approval and consent to participate

DHS is a secondary analysis of a nationally representative survey dataset NFHS-4(2015-16) in the public domain. Ethical approval was not deemed necessary. However, all methods carried out in compliance with relevant guidelines.

Consent for publication

Not applicable

Competing interests

None declared

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Figures

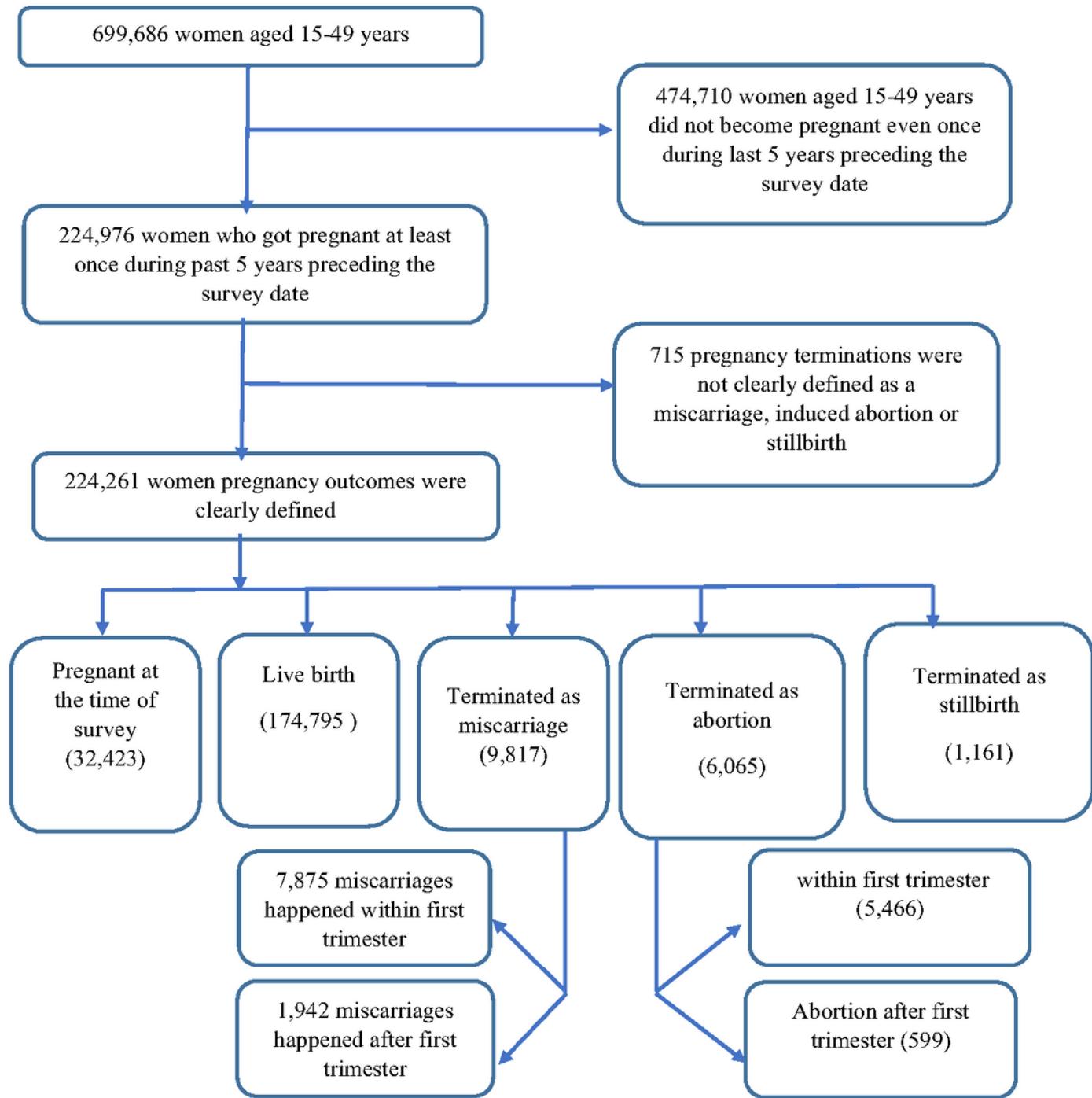


Figure 1

Flowchart for determining the final analytical study sample

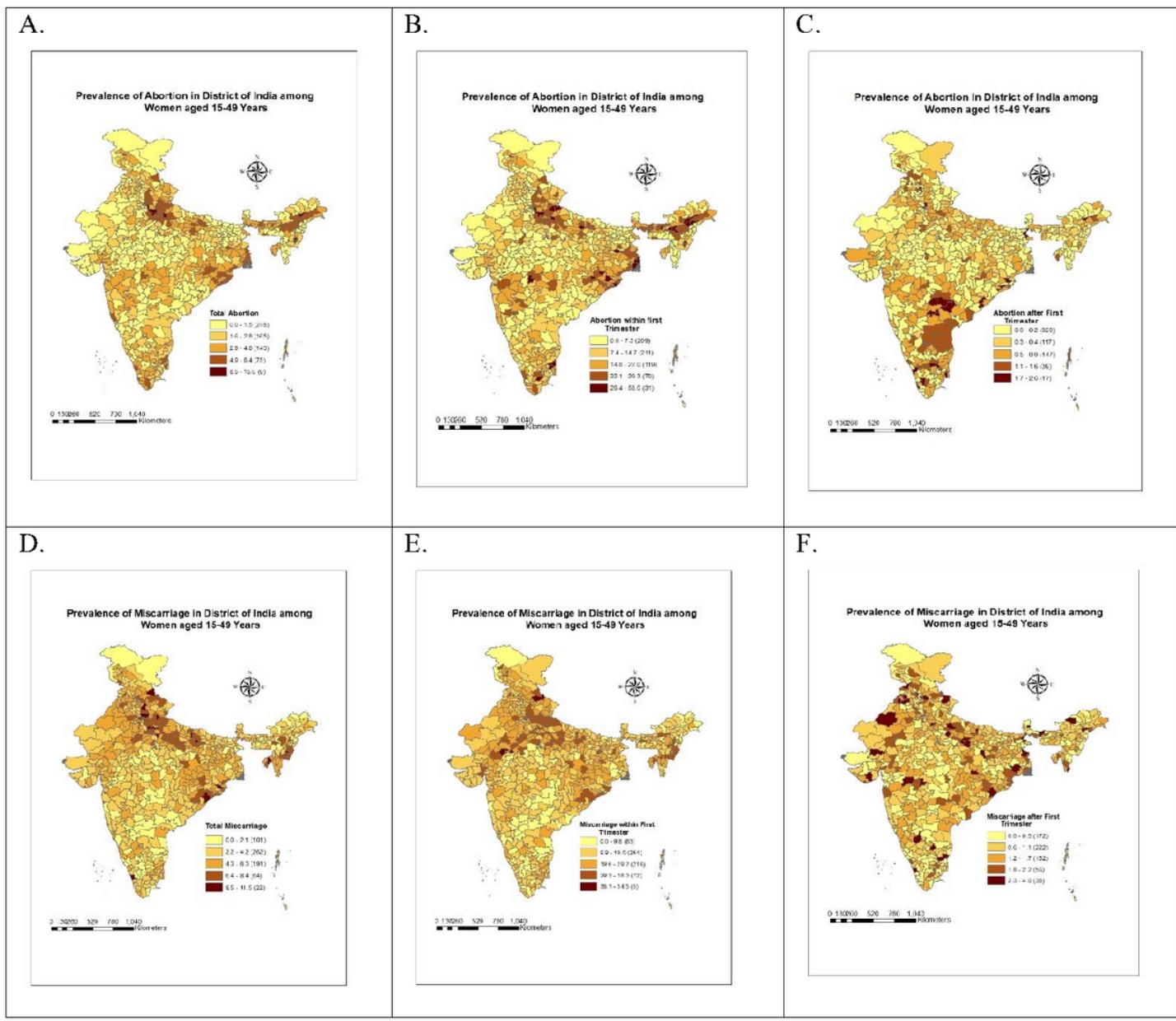


Figure 2

Distribution of gestational abortion and miscarriage prevalence within districts of India