Prevalence of Primary Infertility and Associated Risk Factors: Evidence from NFHS-5

Shreyash Deshmukh

Abstract

Infertility remains a critical but often overlooked public health concern in developing countries. This study examines the prevalence and risk factors associated with primary infertility among women in India using data from the National Family Health Survey (NFHS-5, 2019–2021). Primary infertility, defined as the inability to conceive after at least one year of trying, is influenced by multiple socioeconomic, biological, and lifestyle factors. The study employs Poisson regression analysis to identify key determinants, including education levels, caste, dietary habits, obesity, and anemia. Findings indicate that the prevalence of primary infertility has declined from 1.9% (NFHS-4) to 1.7% (NFHS-5), with significant regional variations. Higher education levels, Scheduled Tribe background, poor dietary intake, and short stature were identified as major risk factors. Despite declining trends, infertility remains a socioeconomically stratified issue, with limited access to assisted reproductive technologies (ART) in marginalized communities. The study underscores the need for targeted policy interventions to improve reproductive health awareness, access to fertility treatments, and overall well-being.

Introduction

Infertility in developing countries is an understudied concern in sexual and reproductive health, yet its impact can be staggering. An inability to conceive or bear children can result in being socially ostracized or divorced, and may have economic, mental, or other health implications, such as adverse pregnancy outcomes and later-onset adult diseases [10, 11, 12].

Primary infertility generally refers to the inability of a woman to conceive a child after at least one year of trying to conceive. In India, primary infertility is a significant issue that affects a significant proportion of women [13]. There are several factors that contribute to primary infertility in women in India. One of the most significant factors is the high prevalence of conditions such as polycystic ovary syndrome (PCOS) and endometriosis. These conditions can make it difficult for women to conceive by affecting their ovulation and the health of their reproductive organs. Additionally, certain infections, such as sexually transmitted infections, can lead to pelvic inflammatory disease (PID), which can also result in infertility [14].

Lifestyle factors also play a role in primary infertility among women in India. Many women in India have a high prevalence of obesity, which can affect their ability to conceive. Poor diet, lack of exercise, and exposure to environmental toxins can also contribute to infertility [14]. Age is also a significant factor in primary infertility among women in India. As women age, their fertility naturally declines, and this decline can be accelerated

by lifestyle factors such as smoking and alcohol consumption. Furthermore, women who delay childbirth to pursue education or careers may have difficulty conceiving later in life. Cultural factors, such as a lack of awareness about reproductive health and a reluctance to seek medical assistance for fertility issues, can also contribute to primary infertility among women in India. Additionally, stigma and social pressures to conceive a male child can create additional stress and anxiety for women trying to conceive [15]. Men and women are equally likely to be infertile, but women are often blamed [16]. The DHS report on levels and trends of infertility and childlessness indicated that primary infertility is plateauing or decreasing in most countries. Earlier studies of DHS surveys from 1986-2000 have also shown decreases in primary infertility, although with a slightly different definition of infertility, with 67% of 27 countries showing decreases among women aged 25-49 [17]. Mascarenhas and colleagues [18], who used the same definition of infertility as in this study, found relatively steady rates of primary infertility between 1990 and 2010 in 190 countries, with declines in sub-Saharan Africa. To address primary infertility among women in India, it is essential to increase awareness about reproductive health, promote healthy lifestyle habits, and improve access to medical care. This includes providing access to fertility treatments such as in vitro fertilization (IVF) and intrauterine insemination (IUI). By addressing these factors, we can help women in India to overcome primary infertility and achieve their dreams of starting a family. Available literature does suggest that dietary patterns and co-morbidities could have an association with reproductive health. This study was motivated to examine the role of socioeconomic determinants of primary infertility among women in India and explore the risk factors associated.

Literature Review

The literature on infertility in India highlights significant trends and contributing factors. Ganguly & Unisa (2010) analyzed data from NFHS-2 (1998–1999) and NFHS-3 (2005–2006), revealing a decline in childlessness from 3.01% to 2.65% and a 7.7% reduction in infertility rates, with urban areas showing higher infertility rates due to lifestyle changes and delayed marriages [19]. Baudin & Sarkar (2018) explored the U-shaped relationship between women's education and childlessness, emphasizing that economic opportunities and empowerment, alongside poverty and sterility, influence childlessness [20]. Unisa et al. (2022) used NFHS-4 (2015–2016) data to link primary infertility to dietary patterns and comorbidities, suggesting that promoting healthy diets and lifestyles could mitigate infertility [21]. Mascarenhas et al. (2012) proposed a standardized definition for infertility in global surveys, estimating primary infertility rates between 0.6% and 3.4% and secondary infertility between 8.7% and 32.6%, while highlighting the importance of exposure time and potential biases in household survey data [22]. Collectively, these studies underscore the multifaceted nature of infertility, influenced by socioeconomic, lifestyle, and biological factors, and call for targeted interventions to address this issue.

1 Methods

1.1 Data

We considered the prospectively collected secondary data from the NFHS-5 (2019–2021), a periodic survey conducted by the International Institute of Population Sciences (IIPS) and field-based organizations in the Indian states and UTs [**?**]. It is a multi-staged representative national survey comprising representative households from the 28 states and 8 UTs in India to provide disaggregated data up to the district level. The survey utilizes questionnaires to collect data from selected sample households from each district in India. This large-scale survey is conducted by the Ministry of Health and Family Welfare (MoHFW) to study various individual and household-level data related to health and demographics across the country.

For the present study, 420,751 currently married women aged 20–49 years who had been married for five or more years were selected. Women below the age of 20 were excluded from the analysis to avoid the influence of adolescent sterility. The representative sample included 724,115 ever-married women aged 15–49 years and 101,839 men aged 15–54 years.

1.2 Definition of Infertility

Few papers in the literature present estimates of infertility prevalence using clear and complete definitions. Household surveys provide a robust alternative to published studies for obtaining comparable prevalence estimates. Mascarenhas et al. (2012) propose a standard definition of primary and secondary infertility that can be applied to these surveys, as detailed below:

Primary infertility is defined as the absence of a live birth for couples that have been in a union for at least five years, during which neither partner used contraception, and where the female partner expresses a desire for a child. The prevalence of primary infertility is calculated as the number of women in an infertile union divided by the combined number of women in fertile and infertile unions. Women in a fertile union have had at least one live birth and have been in a union for at least five years at the time of the survey (Figure **??**).

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Notes:

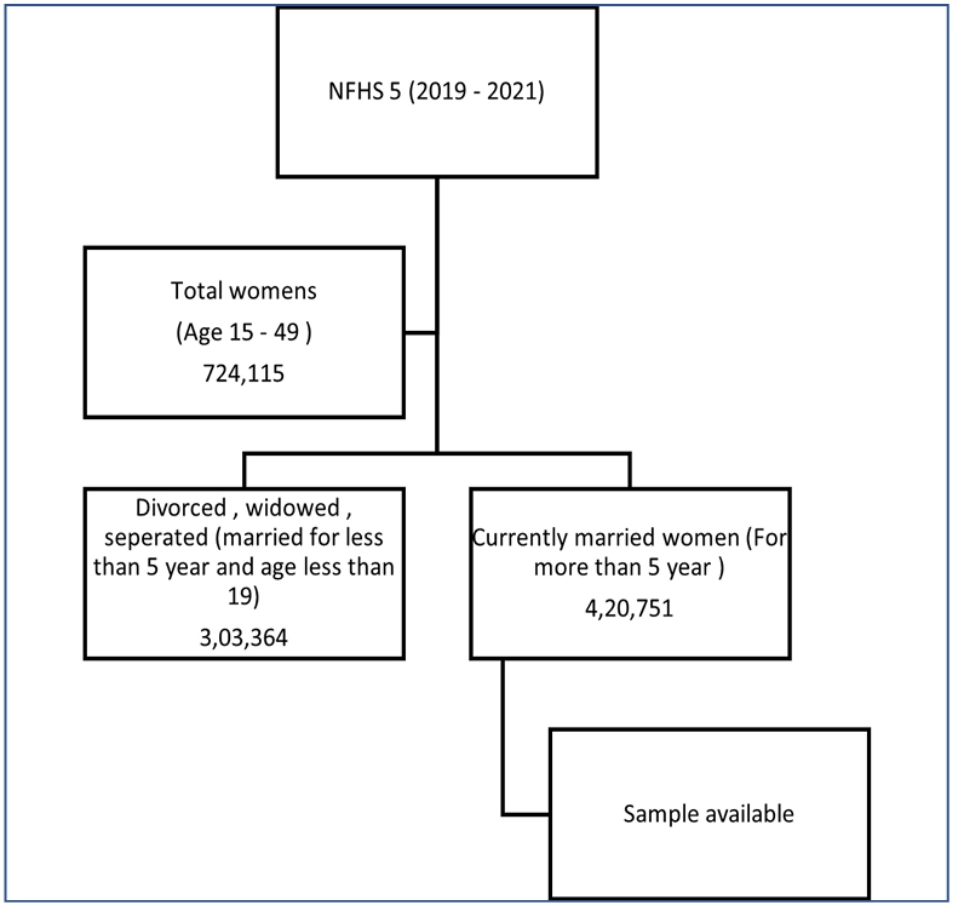

Figure 1: Illustration of infertility classification.

1. Union is defined as marriage or cohabitation.

2. Desire for a child is defined as wanting a child, undecided, or declared infecund.

Variables

Dependent Variable

Following the definition by Mascarenhas et al. (2012), the dependent variable for primary infertility was created. The NFHS questionnaire collects data from women of reproductive age on couple status, birth history, contraceptive use, and desire to have a child. A subset of NFHS includes the reproductive health calendar, a tool used to collect detailed information on couple status, contraceptive use, and birth history for each month spanning the five years prior to the survey. Here, the interested group of women termed as primarily infertile are those aged between 20–49, currently married, intending to have children, who have not used any contraception for five years, who have never had any pregnancy terminated, and who have zero ever-born children.

Independent Variables

The risk factors in this study include age, place of residence (urban/rural), religion, caste (Scheduled Caste/Scheduled Tribe [SC/ST]/Other Backward Class [OBC] and other),

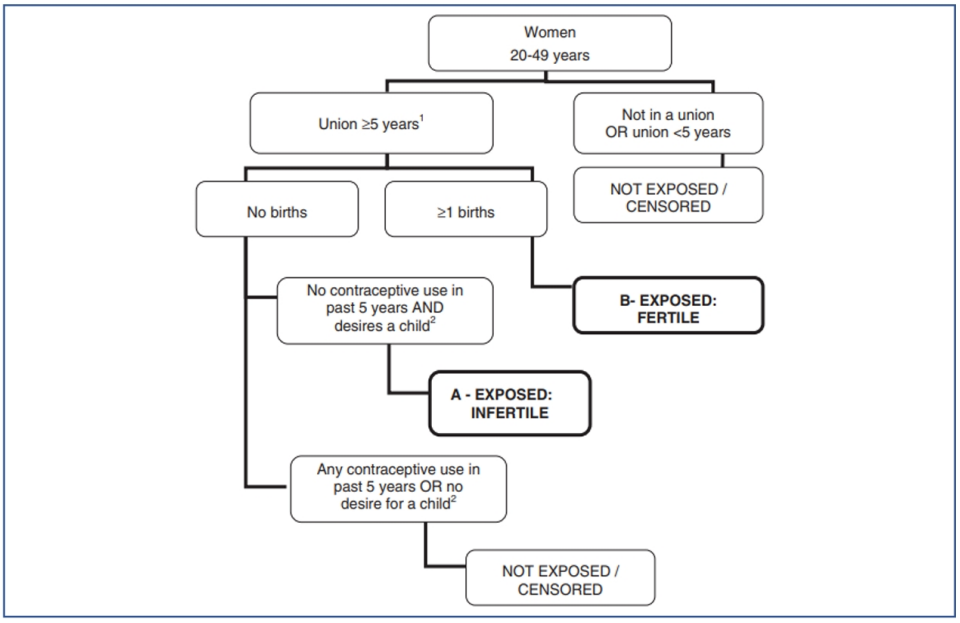

Figure 2: Primary infertility among women aged 20 to 49 years using a five-year exposure period. Primary infertility prevalence is calculated as the number of infertile women (A) divided by the number of women who are both infertile and fertile (A and B).

education (none, primary, secondary, and higher secondary or above), wealth index (poor/middle/rich), age at marriage, and the body-mass index (BMI) of the respondent and anaemia. Along with these risk factors, the status of anaemia and obesity has also been taken into consideration as morbidity factors. Factors contributing to primary infertility in women globally include age-related decline in fertility, lifestyle factors such as obesity and anaemia, exposure to environmental toxins, and underlying medical conditions such as polycystic ovary syndrome (PCOS) and endometriosis. Blood specimens were collected from the respondents in the NFHS-5 to test for anaemia. Non-pregnant women with a hemoglobin count less than 8.0 g/dl and pregnant women with a hemoglobin count less than 7.0 g/dl are defined as having severe anaemia. Non-pregnant women with a hemoglobin count less than 12 g/dl and pregnant women with a count less than 11.0 g/dl are identified as having any anaemia. The respondent's BMI was calculated as the ratio of weight in kilograms to the square of their height in meters. All women with a BMI ¿ 18.5 and ¡ 24.9 are considered to have a normal BMI, BMI ¡ 18.5 as thin, mildly thin as 17.0 ¡ BMI ¡ 18.4, those with BMI ¿ 25 as overweight, and BMI ¿ 30 as obese.

2 Data Analysis

All analyses were conducted using STATA version 16.1. A p-value of ¡0.05 was considered to indicate statistical significance. We used NFHS-recommended specific weights that accounted for the sample weights and the multistage cluster survey sampling design. Since primary infertility is rare, Poisson regression was performed instead of the commonly employed logistic regression technique, as logistic regression only provides the odds ratio, whereas the incidence rate ratio (IRR) can be estimated by Poisson regression, which is a better measure for reporting the effect estimate in cross-sectional surveys.

The Chi-square test was used for bivariate analysis, while Poisson regression analysis was used in the multivariate analysis to identify risk factors and covariates of infertility. All analyses were performed with appropriate sampling weights. Bivariate and multivariate Poisson regression were used to estimate the prevalence of primary infertility and its associations with selected variables, respectively. Chi-squared statistics were used to test the relationship between covariates and primary infertility.

Since several of the socioeconomic and demographic characteristics were interrelated, multivariate Poisson regression models were used to assess the influence of various factors on primary infertility, controlling for other predictors in the model (95% confidence interval). The multivariate model only included variables that showed a significant relationship with primary infertility using the bivariate Poisson regression.

3 Results

3.1 Prevalence of Primary Infertility in India and Its States

The prevalence of primary infertility in India (2019-2021) is 1.7%, a decrease from 1.9% (NFHS-4). South Indian states show a higher prevalence of primary infertility in women. Significant variation is observed between states, with Karnataka, Telangana, Chhattisgarh, and Tamil Nadu exhibiting a prevalence higher than the national level.

3.2 Socioeconomic Factors and Covariates

Women of lower ages are at a higher risk of being infertile. Among rural women, 1.7% have primary infertility, compared to 1.8% in urban areas. The prevalence is slightly higher in urban (1.8%) than in rural women (1.7%). Primary infertility is relatively higher among richer women (1.8%) compared to the poorest women (1.7%).

Primary infertility is more prevalent among Scheduled Tribe women (2.2%), followed by Scheduled Caste women (1.8%), and is lowest among women in other categories (1.6%). Higher educational attainment is associated with a higher prevalence (2.3%), while women with no education exhibit the lowest prevalence (1.5%).

Overweight or obese women have a higher prevalence (1.8%) compared to women with normal BMI (1.6%). The prevalence of infertility is higher in obese women than in non-obese women. Women with a height under 145 cm have the highest prevalence (2.0%). Mild anemic and severely anemic women both have a prevalence of 1.7%.

Dietary habits also influence primary infertility. Women who never consume milk or curd have a higher prevalence (2.1%) than those who consume these daily or weekly (1.7%). Similarly, primary infertility prevalence is higher among women who never consume pulses or beans (2.3%) compared to those who consume them daily or weekly (1.6%–1.8%). The highest prevalence (2.8%) is observed among women who never eat dark green leafy vegetables. Women who never eat fried food have a higher prevalence (2.3%) compared to those who consume it daily or weekly (1.5%–1.6%).

3.3 Risk Factors

Bivariate Poisson regression analysis identifies risk factors associated with primary infertility, with the probability of infertility expressed as the incidence rate ratio (IRR).

- Younger women are at higher risk of infertility. Among urban women, the IRR is 8% higher than among rural women, and this difference is statistically significant. - Women's education has a statistically significant negative impact on infertility risk, with IRR being higher among literate women than illiterate women. - Poorer women are more prone to primary infertility than richer women (IRR = 0.83, CI: 0.77–0.90). - The risk of infertility is 1.5 times higher (CI: 1.39–1.63, p¡0.05) in women with higher educational levels than in those with no education. - Scheduled Tribe women have a 21% higher IRR than Scheduled Caste women (p¡0.05, CI: 1.13–1.31).

Regarding dietary intake: - Women who never consume milk or curd have a 22% higher IRR than those who consume it daily (IRR = 0.78, CI: 0.71–0.85, p¡0.05). - Women who eat fruits daily (IRR = 0.59, CI: 0.57–1.16) or weekly (IRR = 0.62, CI: 0.41–0.96) have significantly lower IRR than those who never eat fruits. - Women who eat pulses, beans, or dark green leafy vegetables daily have lower IRR (0.78, CI: 0.71–0.85 and 0.81, CI: 0.57–1.16, respectively), but these were not statistically significant. - Women who consume aerated drinks daily have a significantly lower IRR (0.79, CI: 0.69–0.89).

Other health factors include: - Women with a height under 145 cm have a significantly higher IRR (1.19, CI: 1.10–1.28, p¡0.05). - Women with a normal BMI have a lower IRR, but this was not statistically significant. Obese women have a 9% higher IRR.

3.4 Regression Models

Model 1 considers socioeconomic and dietary variables. The results show: - Women who consume pulses or beans (IRR = 0.806***, CI: 0.731–0.889) and aerated drinks (IRR = 0.715***, CI: 0.624–0.819) have a lower incidence of primary infertility than those who never consume them. - Women who eat eggs daily (IRR = 1.281*, CI: 1.026–1.599) and those who eat chicken or meat daily (IRR = 1.221**, CI: 1.051–1.418) experience a higher incidence of primary infertility.

Model 2 examines the association between anemia, obesity, and height, adjusted for socioeconomic variables. - Women with any anemia (IRR = 1.098, CI: 0.945–1.276) and severe anemia (IRR = 1.098, CI: 0.945–1.27) have higher infertility prevalence, though not statistically significant. - Women shorter than 145 cm have a significantly higher incidence (IRR = 1.188***, CI: 1.100–1.284) compared to taller women. - Thin women have a lower IRR (IRR = 0.884*, CI: 0.785–0.996), while obese women have a higher IRR (IRR = 1.072*, CI: 1.013–1.135).

The prevalence of primary infertility in India decreased from 1.9% (NFHS-4) to 1.7% (NFHS-5). Higher rates were observed in Karnataka, Telangana, Chhattisgarh, and Tamil Nadu. Factors significantly associated with infertility included:

- Higher education levels ($IRR = 1.5, CI : 1.39 - 1.63$)
- Scheduled Tribe background ($IRR = 1.21, CI : 1.13 - 1.31$)
- Never consuming milk or curd ($IRR = 1.22, CI : 1.13 - 1.31$)
- Women with height <145 cm ($IRR = 1.19, CI : 1.10 - 1.28$)
- Obesity ($IRR = 1.09$)

4 Discussion

The prevalence of primary infertility among currently married women in India in 2019-2021 is 1.7%, with state-wise variation in the prevalence ranging from minimum to maximum values. The prevalence has decreased from 1.9%. The present analysis shows that age at marriage, dietary habits, severe anemia, obesity, and stunting are causative factors of primary infertility. There is a need to explore the regional variation in the country.

According to Chourasia and Unisa, the prevalence of primary infertility among currently married women in India in 2015–16 was 1.9%, providing compelling evidence that primary infertility among women is related to dietary patterns and morbidities. Using the most recent data from 16 countries in the demographic health surveys, the average prevalence of primary infertility is 1.7%, down from 2.1% in the first survey in each country. The decrease in primary infertility may be due in part to increased availability of assisted reproductive technology (ART) in many parts of the world [**?**, **?**].

However, the study has the following limitations:

1. Only women's data is considered. Since infertility is a couple's problem, paternal factors should also be considered.

2. There is no direct method for measuring infertility; the proportion of self-declared infecund women is not reliable.

3. In some contexts, responses on sensitive topics such as contraceptive use may not be accurate [**?**, **?**].

4. We used data from the contraceptive calendar, which has a five-year recall period, to adjust the prevalence of primary infertility. Contraceptive calendar data may be misreported, particularly among women who use condoms or traditional methods [**?**].

5. More life course covariates should be included.

Though the level of primary infertility is decreasing in India, future research is necessary to examine the trends and drivers of these trends. Policy interventions regarding the treatment of primary infertility, such as the availability and accessibility of ART, are recommended.

Although the prevalence of primary infertility is low and trends show a decline, the emotional, financial, and social toll on couples who experience it can be significant. It is important to examine the consequences of primary infertility and the coping mechanisms couples adopt to formulate evidence-based programs and policies for infertility care and management.

5 Limitations

1. Only female infertility was considered; male factors should be examined.

2. Infertility definitions rely on self-reported data.

3. Sensitive topics like contraceptive use may be misreported.

4. Life-course variables should be incorporated in future research.

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Table 1: Prevalence of primary infertility among currently married women aged 20–49 by socioeconomic characteristics, NFHS-5, India

Characteristics	Primary Infertility (%)	Percent Distribution	n
Age Categories			
20-24	3.6	5.1	21,589
25-29	2.3	18.1	76,313
30-34	1.8	20.8	87,725
35-39	1.3	21.3	89,635
40-44	1.3	17.3	72,977
45-49	1.2	17.2	72,512
Total	1.7		4,20,751
Place of Residence			
Urban	1.8	24.1	1,01,289
Rural	1.7	75.9	3,19,462
Total	1.7		4,20,751
Highest Educational Level			
No Education	1.5	32.7	1,37,759
Primary	1.6	15.4	64,864
Secondary	1.8	43.3	1,82,368
Higher	2.3	8.5	35,760
Total	1.7		4,20,751
Wealth Index Combined			
Poorest	1.7	21.4	90,169
Poorer	1.7	22.1	92,982
Middle	1.7	20.7	87,204
Richer	1.8	19.0	79,779
Richest	1.6	16.8	70,617
Total	1.7		4,20,751
Caste			
Scheduled Caste	1.8	20.1	80,482
Scheduled Tribe	2.2	18.7	75,011
OBC	1.6	40.9	1,63,991
Other	1.7	20.3	81,121
Educational Attainment			
No Education	1.5	32.7	1,37,759
Incomplete Primary	1.6	15.4	64,864

Table 2: Prevalence of primary infertility among currently married women aged 20–49 years by dietary pattern

Characteristics	Primary Infertility (%)	Percent Distribution	n
Frequency Takes Milk or Curd			
Never	2.1	6.3	26,526
Daily	1.7	46.2	1,94,520
Weekly	1.7	23.7	99,901
Occasionally	1.7	23.7	99,804
Total	1.7		4,20,751
Frequency Eats Pulses or Beans			
Never	2.3	0.4	1,542
Daily	1.6	48.5	2,04,089
Weekly	1.8	43.2	1,81,953
Occasionally	2.0	7.9	33,167
Total	1.7		4,20,751
Frequency Eats Dark Green Leafy Vegetables			
Never	2.8	0.2	764
Daily	1.6	53.9	2,26,876
Weekly	1.8	37.0	1,55,842
Occasionally	1.9	8.9	37,269
Total	1.7		4,20,751
Frequency Eats Fruits			
Never	1.7	1.6	6,577
Daily	1.8	11.3	47,427
Weekly	1.7	36.6	1,53,889
Occasionally	1.6	50.6	2,12,858
Total	1.7		4,20,751
Frequency Eats Eggs			
Never	1.7	28.2	1,18,611
Daily	1.7	4.6	19,174
Weekly	1.7	38.0	1,60,049
Occasionally	1.7	29.2	1,22,917
Total	1.7		4,20,751
Frequency Eats Fish			
Never	1.7	33.7	1,41,955
Daily	1.7	4.6	19,151
Weekly	1.6	29.2	1,22,723
Occasionally	1.8	32.5	1,36,922
Total	1.7		4,20,751
Frequency Eats Chicken or Meat			
Never	1.7	31.0	1,30,364
Daily	1.7	1.5	6,303
Weekly	1.6	33.3	1,40,311
Occasionally	1.7	34.2	1,43,773
Total	1.7		4,20,751
Frequency Eats Fried Food			
Never	2.3	4.8	20,146
Daily	1.5	8.9	37,376
Weekly	1.6	33.2	1,39,563

Table 3: Prevalence of primary infertility among currently married women aged 20-49 years by anaemia, height, and obesity

Characteristics	Primary Infertility (%)	Percent Distribution	n
Any anemia - women			
No	1.9	43.9	176,981
Yes	1.6	56.1	225,732
Total	1.7		402,713
Mild anemia - women			
No	1.7	75.0	301,967
Yes	1.7	25.0	100,746
Total	1.7		402,713
Moderate anemia - women			
No	1.8	71.7	288,552
Yes	1.4	28.3	114,161
Total	1.7		402,713
Severe anemia - women			
No	1.7	97.3	391,888
Yes	1.7	2.7	10,825
Total	1.7		402,713

Table 4: Results of the Poisson regression analysis of infertility on selected characteristics of the respondents

Characteristics	IRR	95% CI	p-value
Age in 5-year groups			
20-24 (Ref)	-	-	-
25-29	0.66	(0.61, 0.72)	0
30-34	0.50	(0.46, 0.54)	0
35-39	0.39	(0.36, 0.43)	0
40-44	0.36	(0.33, 0.40)	0
45-49	0.34	(0.31, 0.38)	0
Type of place of residence			
Urban (Ref)	-	-	-
Rural	0.92	(0.87, 0.97)	0
Age at marriage	1.20	(0.89, 1.50)	0
Highest educational level			
No education (Ref)	-	-	-
Primary	1.00	(0.93, 1.08)	0.97
Secondary	1.13	(1.07, 1.20)	0
Higher	1.50	(1.39, 1.63)	0
Wealth index combined			
Poorest (Ref)	-	-	-
Poorer	0.92	(0.85, 0.98)	0.01
Middle	0.95	(0.89, 1.02)	0.16
Richer	0.96	(0.90, 1.04)	0.31
Richest	0.83	(0.77, 0.90)	0
Belong to a scheduled caste, tribe, or other backward class			
Scheduled caste (Ref)	-	-	-
Scheduled tribe	1.21	(1.13, 1.31)	0
OBC	0.99	(0.93, 1.06)	0.86
None of them	0.88	(0.81, 0.95)	0
Don't know	1.49	(1.16, 1.91)	0