

Sterilization Regret Among Married Women in India: Trends, Patterns and Correlates

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CONTEXT: Female sterilization has been the dominant contraceptive method in India since the late 1970s; however, evidence on sterilization regret—including on trends and on changes in correlates—is limited.

METHODS: Data from the 1992–1993, 2005–2006 and 2015–2016 rounds of the Indian National Family Health Survey were used to examine trends in sterilization regret among ever-married women aged 15–49. Multivariable binary logistic regression analyses were conducted to examine the correlates of sterilization regret in 2005–2006 and 2015–2016, and multivariate decomposition was used to estimate the contribution of correlates to the change in sterilization regret between surveys.

RESULTS: Sterilization regret in India increased by 2.3 percentage points, from 4.6% in 2005–2006 to 6.9% in 2015–2016. Most variables associated with regret in 2005–2006 remained so in 2015–2016: For example, women who lost a child after sterilization were more likely than those who had not experienced child loss to express regret (odds ratios, 2.8 in 2005–2006 and 1.9 in 2015–2016). Other associations were significant only in 2015–2016: For example, women informed that they would not be able to have children after sterilization had elevated odds of expressing regret (1.4). Changes in the composition of women by parity and by being informed of not being able to have children after sterilization each contributed 5–6% of the increase in sterilization regret between surveys.

CONCLUSIONS: Efforts to increase use of reversible contraceptive methods and to reduce infant and child mortality may help reduce rising sterilization regret in India.

International Perspectives on Sexual and Reproductive Health, 2018, 44(4):167–176, doi: <https://doi.org/10.1363/44e7218>

First published: July 30, 2019

In 1952, India became the first country in the world to launch an official family planning program.^{1,2} Male and female sterilization were introduced to the program in 1966,³ and vasectomy made up the majority of sterilizations through the late 1970s, when aggressive sterilization camps were held across the country to curb the high population growth of the 1960s.^{3,4} In the early 1980s, method acceptance shifted to female sterilization with the evolution of a new family planning agenda focused on voluntary acceptance of family planning.⁴

Female sterilization has since been the dominant method of family planning in India. According to data from the Indian Ministry of Health and Family Welfare, more than four million female sterilizations were carried out in India in 2014–2015;⁵ however, the actual number is likely considerably higher, given that the estimate does not include procedures conducted in private facilities. Data from the two most recent rounds of the Indian National Family Health Survey (NFHS) show that the prevalence of sterilization among married women aged 15–49 has remained high—37% in 2005–2006⁶ and 36% in 2015–2016;⁷ in comparison, in 2015–2016, only 9% of married women of reproductive age were using condoms, 4% the pill and 2% the IUD.⁷

Use of female sterilization varies considerably by state: In 2015–2016, the rate ranged from 10% in Assam in the

Northeast to 68% in Andhra Pradesh in the South.⁷ The median age at sterilization is particularly low in some southern states. For example, in 2005–2006, the median age at sterilization was 23.3 in Andhra Pradesh and 23.9 in Karnataka, compared with 25.5 in India overall.⁶ In addition, women in southern states tend to undergo sterilization at lower parity than women elsewhere in India, and southern states have the lowest fertility levels and the strongest political will for population stabilization.^{6,7}

An important issue in countries with a high prevalence of female sterilization is regret. According to studies that measured sterilization regret in different settings, approximately 10% of women report regretting having been sterilized.^{8–12} In Brazil, where the use of female sterilization is the highest in the world, sterilization regret has been estimated at 10–20%.^{8–10,13–16} In India, 5% of the sterilized women aged 15–49 reported regret in 2005–2006.¹⁷

Various factors have been found to be associated with sterilization regret in different global settings, including India. Women sterilized at younger ages are more likely than those sterilized at older ages to regret the procedure.^{13,17–23} Experience of child loss has been shown to be positively associated with sterilization regret,^{11,14,15,17,24–26} whereas higher parity at the time of sterilization has been shown to be negatively associated with regret.^{16,17,20,22} In addition, women who have only male children are less

likely than those who have only female children to regret sterilization,^{15,17,20} and women who are divorced, separated or widowed are more likely than currently married women to express regret.^{12,15,16,23–29} A number of other socioeconomic and residence-related variables—including education, employment, religion and geographic region—have also been associated with regret.^{17,21}

India has undergone tremendous socioeconomic transformation since the 2005–2006 NFHS, and the government has launched a number of ambitious programs, such as the National Health Mission, to improve the health of the population in general and of vulnerable populations in particular. Studies suggest that such programs have started to pay dividends. According to findings from the 2015–2016 NFHS, improvements have been made in such indicators as female literacy and attendance of 10 or more years of schooling; use of improved sanitation and clean fuel for cooking; and use of antenatal care, delivery and postnatal care services.⁷ Indicators of maternal and child health, including neonatal and infant mortality, have improved as well.^{30–32} In addition, the institution of marriage seems to be undergoing dramatic changes in India, with increases in divorce and separation.³³

Research on sterilization regret in India is limited, with most studies either focusing on a few states or utilizing small samples.^{11,19,20,34} One study has examined sterilization regret nationally using the 2005–2006 NFHS;¹⁷ however, that study only examined correlates. No previous study could be found that investigated trends in sterilization regret or estimated the amount that individual characteristics contribute to change in regret. In addition, although quality of care during and immediately after sterilization has been linked to sterilization regret,^{11,16,34,35} no previous study from India could be found that included a variable of quality of care during or immediately after sterilization. Moreover, important variables associated with sterilization regret have not been defined precisely in past research: For example, previous studies on sterilization regret that included a child loss measure failed to identify whether the loss occurred before or after sterilization.

Given these gaps in the existing scholarship, the dramatic changes in India in regard to health care and other domains, and the availability of a more recent large-scale data set, this study aimed to examine trends in sterilization regret in India, whether the correlates of sterilization regret have changed since 2005–2006 and, if so, the contribution of correlates to the change in sterilization regret.

METHODS

Data and Sample

The present study uses data from the first, third and fourth rounds of the Indian NFHS, conducted in 1992–1993, 2005–2006 and 2015–2016, respectively.* The NFHS is

a nationally representative population-based survey that covers more than 99% of India's population. Its main objective is to provide state- and national-level estimates of fertility, mortality, family planning, maternal and child health, and nutrition. The survey has evolved over the various rounds by strengthening existing domains and adding relevant new ones.⁷ The NFHS uses a two-stage sampling design in both rural and urban areas. In rural areas, villages are selected in the first stage using a probability proportional to size scheme, and then households are selected in the second stage using systematic sampling. In urban areas, census enumeration blocks are selected in the first stage and households are selected in the second stage. In the first round, interviews were conducted with a nationally representative sample of 89,777 ever-married women aged 13–49 residing in 88,562 households. The third round collected data from 124,385 ever-married women aged 15–49 in 109,041 households; in comparison, the fourth round collected data from 699,686 ever-married women aged 15–49 in 601,509 households. The response rates for households and women in 1992–1993 were 96% each;³⁶ the response rates for households and women were 98% and 95%, respectively, in 2005–2006,⁶ and 98% and 97% in 2015–2016.⁷

Because the objective of this study was to examine sterilization regret, the analysis was restricted to women who reported being sterilized at the time of the survey; in addition, women who were married but for whom *gauna*† had not been performed were excluded from the analysis (zero women in 1992–1993 and 2005–2006, and 28 women in 2015–2016). As it is unusual for women in India to undergo sterilization before having children, the few women who reported doing so (38 women in 1992–1993, 27 in 2005–2006 and 213 in 2015–2016) were excluded, resulting in analytic samples of 25,842 women in 1992–1993, 35,105 women in 2005–2006 and 194,429 women in 2015–2016.

Variables

• **Outcome measure.** The dependent variable was sterilization regret. In each survey round, sterilized women were asked “Do you regret that you had the sterilization?” Response options were “yes” and “no.”

• **Independent variables.** On the basis of the existing literature on factors associated with sterilization regret, a number of socioeconomic, demographic, residence-related and quality-of-care variables were examined in the analyses. These included categorical variables for age at sterilization (younger than 25, 25–29, 30 or older), number of years since sterilization (<2, 2–5, 6–10, >10), parity at sterilization (one, 2–3, ≥4), woman's rating of care during and immediately after sterilization (very good, alright, not so good, bad), facility type (public, private, other), sex composition of children (only sons,

*Data from the 1998–1999 survey round were not used because the question on sterilization regret was not asked.

†Gauna is a tradition, particularly in northern states, in which a woman goes to live with her husband after a few years of marriage.

only daughters, both), experience of child loss (no loss, loss before sterilization, loss after sterilization), marital status at interview (currently married, widowed/divorced/separated/deserted), geographic region (North, Central, East, Northeast, West, South), education (none, primary, secondary, more than secondary), caste (scheduled caste, scheduled tribe, other backward class, other) and religion (Hindu, Muslim, Christian, other). In addition, the analyses included binary measures of whether the woman was informed before or at sterilization that she would not be able to have more children after the procedure, urban-rural place of residence and whether the woman received any compensation for sterilization (2015–2016 only).[‡] Wealth quintiles—based on household assets and amenities—were already estimated and provided in the NFHS data sets.

Analysis

Data from the first survey round were only used to examine trends in sterilization regret; for all subsequent analyses, data from the third and fourth rounds were used. First, the 1992–1993 and 2005–2006 samples were pooled to examine whether sterilization regret changed between survey periods. A binary logistic regression model was constructed that had sterilization regret as the dependent variable and time as the independent variable (coded 0 for 1992–1993 and 1 for 2005–2006). Similarly, the 2005–2006 and 2015–2016 samples were pooled, and a logistic regression model was constructed. Next, multivariable binary logistic regression models were constructed to examine the correlates of sterilization regret in 2005–2005 and in 2015–2016. Wald tests were used to examine associations between dependent and independent variables in these models.

To examine the contribution of various factors to the change in sterilization regret between 2005–2005 and 2015–2016, multivariate decomposition was used; the change in sterilization regret between 1992–1993 and 2005–2006 was not decomposed because regret did not change during that period. Multivariate decomposition separates the total change into “endowment” (or “composition”) and “coefficient” (or “rate”). Endowment is the component accounted for by the change in composition of the variable, whereas the coefficient is the component accounted for by the change in the effect of the variable.³⁷ For example, if sterilization regret is the outcome and parity at sterilization is a variable associated with regret, and the change in regret is decomposed over time by parity at sterilization, then the endowment component is the amount contributed by the change in the distribution of women by parity at sterilization and the coefficient component is the amount contributed by the change in the effect of parity on regret. The decomposition procedure relies on two key pieces of information: the prevalence of all selected indicators at both points in time and the coefficients derived from

TABLE 1. Percentage of sterilized ever-married women aged 15–49 reporting sterilization regret, by survey; and percentage-point change between surveys—both according to selected characteristics, Indian National Family Health Survey, 2005–2006 and 2015–2016

Characteristic	2005–2006 (N=35,105)	2015–2016 (N=194,429)	Change
All	4.6	6.9	2.3†
Age at sterilization		*	
<25	5.1	7.4	2.3†
25–29	4.4	6.6	2.2†
≥30	3.9	6.4	2.5†
No. of years since sterilization		*	
<2	3.6	6.5	2.9†
2–5	4.3	7.0	2.7†
6–10	5.1	7.2	2.1†
>10	4.7	6.8	2.1†
Parity at sterilization		*	
1	8.5	11.3	2.8
2–3	4.9	7.1	2.2†
≥4	3.9	5.8	1.9†
Informed before/at sterilization about not being able to have more children after procedure		*	
Yes	4.8	7.4	2.6†
No	4.2	5.2	1.0†
Rating of care during/after sterilization		*	
Very good	4.9	7.8	2.9†
Alright	3.8	5.6	1.8†
Not so good	7.4	9.5	2.1†
Bad	12.0	20.5	8.5
Facility type			
Public	4.5	6.9	2.4†
Private	4.7	6.9	2.2†
Other	6.9	4.4	–2.5
Received compensation[‡]		*	
No	na	7.2	na
Yes	na	6.7	na
Sex composition of children		*	
Only sons	5.6	8.2	2.6†
Only daughters	8.4	10.7	2.3†
Both	4.0	6.0	2.0†
Experienced child loss		*	
No	4.2	6.8	2.6†
Before sterilization	4.9	6.2	1.3†
After sterilization	10.3	12.2	1.9
Currently married[§]			
Yes	4.6	6.9	2.3†
No	4.2	6.6	2.4†
Region		*	
North	3.4	5.5	2.1†
Central	3.9	6.8	2.9†
East	5.0	7.2	2.2†
Northeast	7.5	5.5	–2.0†
West	3.8	4.6	0.8†
South	5.5	8.6	3.1†
Education		*	
None	4.5	6.6	2.1†
Primary	4.2	6.8	2.6†
Secondary	5.0	7.3	2.3†
>secondary	5.0	7.0	2.0†
Caste		*	
Scheduled caste	4.4	6.9	2.5†
Scheduled tribe	4.8	6.7	1.9

[‡]The question on compensation for sterilization was not included in the 2005–2006 survey. The Indian government gives cash compensation for loss of wages to women who accept sterilization; other compensation is also provided for transportation, diet, drugs, dressing, etc. (source: reference 35).

continued

TABLE 1 (continued)

Characteristic	2005–2006 (N=35,105)	2015–2016 (N=194,429)	Change
Other backward class	4.5	7.1	2.6†
Other	4.6	6.4	1.8†
Religion	*	*	
Hindu	4.4	6.8	2.4†
Muslim	6.5	8.6	2.1†
Christian	6.3	7.6	1.3
Other	3.0	4.8	1.8
Wealth quintile		*	
Poorest	4.4	6.6	2.2†
Poorer	4.4	7.1	2.7†
Middle	4.6	7.0	2.4†
Richer	4.7	7.1	2.4†
Richest	4.8	6.6	1.8†
Place of residence			
Urban	4.7	6.9	2.2†
Rural	4.5	6.9	2.4†

*Variable associated with sterilization regret at $p < .05$. †Difference between surveys significant at $p < .05$.

‡Question not asked in 2005–2006. §Excludes women who were married but for whom *gauna* had not been performed. Note: na=not applicable.

multivariable regression models predicting sterilization regret estimated separately at both time points.³⁸

All analyses were conducted using Stata 15.0. Appropriate sampling weights were used in the estimations.

RESULTS

Trends in Sterilization Regret

The prevalence of sterilization regret among ever-married women aged 15–49 in India was 5.5% in 1992–1993, 4.6% in 2005–2006 and 6.9% in 2015–2016. Although sterilization regret did not differ statistically between 1992–1993 and 2005–2006, the increase of 2.3 percentage points between 2005–2006 and 2015–2016 was significant. The increase in sterilization regret between the latter two survey rounds was similar in both urban (from 4.5% to 6.9%) and rural (from 4.7% to 6.9%) areas. Mean age at sterilization was 26 in 2015–2016, which was no change from the previous survey round; mean age at sterilization did not vary by urban-rural residence between any two rounds.

Differentials Between Surveys

In both the third and fourth survey rounds, sterilization regret tended to decrease with increased age at sterilization (Table 1). In 2005–2006, 5.1% of women sterilized before age 25 reported regret, compared with 3.9% of those sterilized at age 30 or older; the figures for 2015–2016 were 7.4% and 6.4%, respectively. Age at sterilization was associated with regret only in the latter survey. Time since sterilization was associated with regret in both rounds, with the highest level of regret being reported among women sterilized 6–10 years prior to survey (5.1% in 2005–2006 and 7.2% in 2015–2016) and the lowest among those sterilized less than two years before (3.6% in 2005–2006 and 6.5% in 2015–2016). In addition, regret declined with increased parity at sterilization. In 2005–2006, 8.5% of women who had one child when they were sterilized

expressed regret, compared with only 3.9% of those who had four or more children; the figures for 2015–2016 were 11.3% and 5.8%, respectively.

Moreover, sterilization regret was associated in both survey rounds with whether women were informed before or at sterilization that they would not be able to have children after the procedure—with greater proportions of women who were informed than of those not informed reporting regret (4.8% vs. 4.2% in 2005–2006 and 7.4% vs. 5.2% in 2015–2016). In both surveys, regret also varied considerably by women's rating of care during and immediately after sterilization: Greater proportions of women who categorized their care as “bad” than of those who categorized it as “very good” expressed regret (12.0% vs. 4.9% in 2005–2006 and 20.5% vs. 7.8% in 2015–2016); women who described their care as being “alright” were the group with the lowest level of reported regret (3.8% in 2005–2006 and 5.6% in 2015–2016). Not receiving compensation for sterilization was associated with higher regret in 2015–2016 (7.2% vs. 6.7%).

Furthermore, sterilization regret was associated with sex composition of women's children: In both surveys, the highest proportion of women reporting regret was among those who had only daughters (8.4% in 2005–2006 and 10.7% in 2015–2016), followed by those who had only sons (5.6% and 8.2%) and then those who had both sons and daughters (4.0% and 6.0%). In both surveys, regret was also associated with women's experience of child loss. The proportion of women expressing regret was substantially higher among those who had lost a child after sterilization (10.3% in 2005–2006 and 12.2% in 2015–2016) than among those who had lost a child before sterilization (4.9% and 6.2%) or those who had not experienced child loss (4.2% and 6.8%).

Finally, sterilization regret varied by several social and demographic characteristics. In 2005–2006, regret ranged from 3.4% in the North to 7.5% in the Northeast; in 2015–2016, regret ranged from 4.6% in the West to 8.6% in the South. In both surveys, regret tended to increase with increased education, and also varied across castes. Moreover, regret varied by religion, with the proportion of women reporting regret highest among Muslim women (6.5% in 2005–2006 and 8.6% in 2015–2016). Wealth was associated with sterilization regret only in the latter survey.

With few exceptions, sterilization regret increased between surveys by 1–3 percentage points for every characteristic. Regret decreased by two percentage points in the Northeast, from 7.5% in 2005–2006 to 5.5% in 2015–2016. In addition, no change was found for women with one child at sterilization, those who rated their sterilization care as “bad,” those who were sterilized at a facility that was neither public nor private, those who experienced a child loss after sterilization, those of scheduled tribes and those who were Christian or a member of “other” religious groups; lack of change may have been because of small sample sizes.

Multivariable Regression Findings

In multivariable analyses, several measures were associated with sterilization regret in both surveys (Table 2). Women

sterilized 6–10 years prior to the survey were more likely than those sterilized less than two years prior to report regret (odds ratios, 1.4 in 2005–2006 and 1.2 in 2015–2016). Parity at sterilization was associated with regret in both survey rounds. Women who were sterilized at parity four or higher were less likely than those sterilized at parity one to express regret (0.5 in 2005–2006 and 0.6 in 2015–2016); in addition, in 2015–2016, those who underwent sterilization at parity 2–3 had decreased odds of expressing regret (0.7). Women who rated their care during and immediately after sterilization as “bad” or “not so good” were more likely than those who reported their care as “very good” to report regret (1.3–2.7); women who rated their care as “alright” had decreased odds of regretting sterilization (0.8 in 2005–2006 and 0.7 in 2015–2016). Compared with women who had only sons, those who had only daughters had elevated odds of expressing regret (1.4 in 2005–2006 and 1.2 in 2015–2016), and those who had children of both sexes had reduced odds of expressing regret (0.8 each). Women who had lost a child after sterilization were more likely than those who had not lost a child to regret sterilization (2.8 in 2005–2006 and 1.9 in 2015–2016); in addition, in 2005–2006, women who had lost a child prior to sterilization had elevated odds of reporting regret (1.5).

In both surveys, geographic region and religion were also associated with sterilization regret in Wald tests. In 2005–2006, compared with women in the South, those in the Northeast were more likely to express regret (odds ratio, 1.8), and those in the North and West were less likely to do so (0.7 and 0.8); in 2015–2016, women of every other region were less likely than those in the South to express regret (0.6–0.9). Muslim women were more likely than Hindu women to regret sterilization (1.5 in 2005–2006 and 1.3 in 2015–2016).

Certain variables, however, were associated with regret only in 2015–2016. Compared with other women, those who were informed before or at sterilization that they would not be able to have more children after the procedure had 40% higher odds of regretting sterilization (odds ratio, 1.4). Also, compared with women sterilized in a public facility, those who underwent the procedure in a private or other type of facility were less likely to express regret (0.9 and 0.6, respectively). Interestingly, women who were not currently married had lower odds than those who were married of reporting regret (0.9). Women who received compensation also had decreased odds of regretting sterilization (0.9).

Decomposition Findings

Of the total change in sterilization regret between surveys, 15% was accounted for by endowment effects (i.e., the change in composition of women; Table 3). Change in the proportion of women informed before or at sterilization that they would not be able to have more children after the procedure contributed the largest increase in regret (0.001350 units or 5.9% of the total change). Change in

TABLE 2. Adjusted odds ratios (and 95% confidence intervals) from binary logistic regression analyses examining women’s likelihood of expressing sterilization regret, by selected characteristics, according to survey

Characteristic	2005–2006	2015–2016
Age at sterilization		
<25 (ref)	1.00	1.00
25–29	0.92 (0.79–1.07)	0.96 (0.90–1.02)
≥30	0.82 (0.67–1.01)	0.93 (0.86–1.01)
No. of years since sterilization		
<2 (ref)	1.00	1.00
2–5	1.17 (0.89–1.54)	1.11 (1.00–1.24)
6–10	1.40 (1.07–1.84)*	1.16 (1.04–1.29)*
>10	1.19 (0.92–1.55)	1.06 (0.96–1.18)
Parity at sterilization		
1 (ref)	1.00	1.00
2–3	0.68 (0.42–1.09)	0.72 (0.62–0.83)*
≥4	0.54 (0.32–0.90)*	0.64 (0.54–0.75)*
Informed before/at sterilization about not being able to have more children after procedure		
No (ref)	1.00	1.00
Yes	1.08 (0.93–1.25)	1.42 (1.32–1.53)*
Rating of care during/after sterilization		
Very good (ref)	1.00	1.00
Alright	0.79 (0.68–0.92)*	0.72 (0.68–0.76)*
Not so good	1.56 (1.17–2.09)*	1.25 (1.10–1.42)*
Bad	2.50 (1.34–4.67)*	2.66 (1.94–3.63)*
Facility type		
Public (ref)	1.00	1.00
Private	0.91 (0.74–1.11)	0.86 (0.78–0.95)*
Other	1.47 (0.85–2.57)	0.57 (0.36–0.90)*
Received compensation		
No (ref)	na	1.00
Yes	na	0.88 (0.82–0.95)*
Sex composition of children		
Only sons (ref)	1.00	1.00
Only daughters	1.36 (1.06–1.75)*	1.21 (1.09–1.35)*
Both	0.79 (0.67–0.93)*	0.76 (0.71–0.81)*
Experienced child loss		
No (ref)	1.00	1.00
Before sterilization	1.46 (1.19–1.78)*	1.04 (0.94–1.14)
After sterilization	2.75 (2.15–3.51)*	1.92 (1.68–2.18)*
Currently married		
Yes (ref)	1.00	1.00
No	0.80 (0.59–1.10)	0.86 (0.76–0.98)*
Region		
South (ref)	1.00	1.00
North	0.70 (0.55–0.89)*	0.69 (0.64–0.76)*
Central	0.86 (0.69–1.07)	0.92 (0.85–0.99)*
East	1.01 (0.81–1.25)	0.90 (0.82–0.98)*
Northeast	1.82 (1.33–2.49)*	0.66 (0.56–0.79)*
West	0.79 (0.63–0.98)*	0.56 (0.50–0.62)*
Education		
None (ref)	1.00	1.00
Primary	0.87 (0.71–1.05)	1.05 (0.97–1.14)
Secondary	1.05 (0.87–1.26)	1.10 (1.02–1.18)*
>secondary	1.05 (0.69–1.59)	1.02 (0.87–1.20)
Caste		
Scheduled caste (ref)	1.00	1.00
Scheduled tribe	1.09 (0.82–1.45)	1.05 (0.95–1.16)
Other backward class	0.97 (0.80–1.18)	0.96 (0.90–1.04)
Other	0.97 (0.79–1.20)	0.98 (0.90–1.08)
Religion		
Hindu (ref)	1.00	1.00
Muslim	1.46 (1.15–1.85)*	1.33 (1.19–1.48)*

continued

TABLE 2 (continued)

Characteristic	2005–2006	2015–2016
Christian	1.06 (0.73–1.55)	0.90 (0.76–1.08)
Other	0.80 (0.51–1.25)	0.90 (0.74–1.09)
Wealth quintile		
Poorest (ref)	1.00	1.00
Poorer	1.02 (0.80–1.31)	1.05 (0.97–1.15)
Middle	1.05 (0.81–1.36)	0.99 (0.90–1.08)
Richer	1.08 (0.84–1.41)	0.97 (0.88–1.08)
Richest	1.18 (0.87–1.61)	0.92 (0.81–1.05)
Place of residence		
Urban (ref)	1.00	1.00
Rural	1.05 (0.89–1.23)	1.03 (0.96–1.11)

* $p < .05$. Notes: ref=reference group. na=not applicable. In 2005–2006, geographic region, parity at sterilization and religion were associated with regret in Wald test at $p < .05$; in 2015–2016, years since sterilization, experience of child loss and religion were associated with regret in Wald test at $p < .05$.

TABLE 3. Results of multivariate decomposition analysis examining the individual contribution of correlates to the change in sterilization regret between 2005–2005 and 2015–2016

Characteristic	Endowment	Coefficient
Age ≥ 30 at sterilization	0.000002	0.000801
>5 years since sterilization	0.000003	-0.004139
Parity at sterilization	0.001122*	0.000160
Informed before/at sterilization about not being able to have more children after procedure	0.001350*	-0.004653*
Rated care during/immediately after sterilization as bad/not so good	-0.000153*	-0.000276
Sterilized at public facility	-0.000027	0.004329
Had sons and daughters/only daughters	0.000258*	-0.000716
Experienced child loss after sterilization	-0.000359*	-0.000639
Not currently married	0.000002*	0.000064
South region	0.000017*	0.001893
Had some education	0.000128	0.001622
Scheduled castes/scheduled tribes/other backward class	0.000043	0.001551
Hindu	0.000044	0.003881
Lowest three wealth quintiles	-0.000021*	0.003804
Rural	-0.000016	0.000377
Constant	na	0.011476
Percentage of total change due to component	14.5	85.5
Total change		0.023*

* $p < .05$. Notes: na=not applicable. Endowment is the component of change accounted for by the change in composition of the variable; coefficient is the component of change accounted for by the change in the effect of the variable.

the composition of women by parity at sterilization also contributed a substantial amount of the change in regret between surveys (0.001122 units or 4.9%). In addition, changes in the proportions of women by sex composition of children, marital status and geographic region also led to an increase in regret. Change in the proportion of women who had experienced child loss after sterilization was associated with the largest decrease in regret between surveys (0.000359 units or 1.6%). Similarly, change in the proportion of women who reported their sterilization care as “bad” or “not so good” was associated with a decrease in regret (0.000153 units or 0.7%). Changes in the composition of women by wealth quintiles was also associated with a decrease in regret.

The vast majority (86%) of the total change in regret between surveys was accounted for by coefficient effects. The change in the effect of women being informed before or at sterilization that they would not be able to have

more children after the procedure was associated with a change in regret. Specifically, holding composition fixed at the 2015–2016 level, the change in the effect of the variable would yield a decrease in regret of 0.004653 units or 20.4%.

DISCUSSION

This analysis—likely the first to examine trends in sterilization regret in India—shows that regret has increased among ever-married women aged 15–49 by 2.3 percentage points between the last two rounds of the NFHS, from 4.6% in 2005–2006 to 6.9% in 2015–2016. By nearly every characteristic studied, greater proportions of women in 2015–2016 than in 2005–2006 reported regret. The variables associated with sterilization regret largely remained unchanged between survey rounds: Only facility type, being informed of not being able to have more children after sterilization and marital status were associated with regret in 2015–2016 but not in 2005–2006. The change in coefficient effects explained a majority of the change in regret (86%) between 2005–2006 and 2015–2016. The change in composition of women by being informed of not being able to have more children after sterilization, parity, sex composition of children, marital status and region contributed to the increase in regret between the two surveys, whereas the change in composition of women by quality of care, experience of child loss after sterilization and wealth decreased the change in regret.

As would be expected, women who rated the quality of their care poorly had increased odds of expressing regret. However, women informed of not being able to have children after sterilization were more likely than those not informed to express regret. The study by Singh et al. using the 2005–2006 NFHS did not find an association between this variable and sterilization regret,¹⁷ likewise, knowing that sterilization ends fertility was not associated with sterilization regret in a previous study in the Dominican Republic.¹⁶ A study among low-income women in São Paulo, Brazil, however, reported a positive association between counseling before sterilization and a broad measure of sterilization dissatisfaction.¹² The reasons for the positive association between being informed that sterilization ends fertility and regret among Indian women in 2015–2016 found in the current study are unclear. Women who reported not being informed may have already been knowledgeable about the procedure and may have gone to the health facility requesting sterilization to cease childbearing. Recall bias may be another possibility, with women—especially older ones—not correctly remembering discussions they had had with providers prior to sterilization. The finding could also be related to how the question was posed to or understood by women. The question in the 2015–2016 NFHS was “Before your sterilization operation, were you told that you would not be able to have any (more) children because of the operation?” This question was translated into several local languages; however, it is not known how the question was actually asked during

the field work or how it was understood by women.³⁹ Moreover, it is not clear whether women understood that a sterilization procedure is considered permanent. More research—particularly qualitative research—is needed to investigate explanations for this finding.

This study employed a more precise measure of child loss and found that, among the 2015–2016 sample, child loss after sterilization—but not before—was associated with sterilization regret. This finding provides additional nuance over those from previous studies in India that found a positive association between child loss (irrespective of whether the loss occurred before or after sterilization) and regret.¹⁷

Previous research has shown that women who are divorced, separated or widowed are more likely than married women to report sterilization regret.^{12,15,23–29} In this study, however, being not currently married was negatively associated with the outcome among women in the 2015–2016 sample; the inconsistency with previous research may be related to apparent recent changes to the institution of marriage in India.³³ Other findings of this study regarding characteristics linked with sterilization regret are mostly consistent with those of previous research. This analysis found increased parity to be negatively associated with regret, as it has been in previous studies in India and other settings.^{16,17,20,22} Also consistent with previous research in India,^{15,17,20} this study found that, compared with women who have only sons, those with only daughters are more likely to regret sterilization. In this study, however, having children of both sexes was negatively associated with regretting sterilization; it has been shown that Indian women desire both sons and daughters,¹⁷ and that they generally believe that sons will take care of their financial needs and daughters will look after them when they are old.⁴⁰

Also consistent with previous research¹⁷ is the finding of the relationship between sterilization regret and geographic region. Among women in the 2015–2016 sample, those in the North, Central, East, Northeast and West regions were less likely than those in the South to regret sterilization; this association held even after adjustment for other socioeconomic, demographic and residence-related characteristics. The finding suggests that women from a low-fertility region⁵ (i.e., the South) are more likely to regret sterilization than those from regions with relatively high fertility. The reasons for this are unclear and warrant further investigation.

To further explain the results of this study, future research must examine Indian women's sterilization decision-making processes and the social contexts in which they decide to undergo sterilization. In addition, a better understanding of the reasons that Indian women accept sterilization is needed. In south India, evidence suggests that young women adopt sterilization at a younger age to achieve the social status—and its benefits, such as more bargaining power, greater involvement in decision making and greater autonomy—that

they otherwise would not achieve until an older age.^{41,42} Women might also undergo sterilization at lower parity and lower age to conform to societal norms: In south India, it is common for women to have children at an early age and with short birth intervals, and then adopt sterilization.⁴² According to a study of U.S. women who had been sterilized, those who reported accepting the method because of encouragement or pressure from family members or health care providers, or because of other reasons, were more likely than those who did so because of not wanting additional children to express regret.⁴³ Studies from Brazil and the Dominican Republic reported similar findings.^{12,16} Another study from Brazil reported that women who had not themselves made the decision to undergo sterilization were more likely than others to express regret;²⁵ women for whom the sterilization was carried out up to the 45th day after childbirth were also more likely than those sterilized later to regret sterilization.

Limitations

An important limitation of this study is that the reasons for sterilization regret could not be analyzed because neither survey round asked women about this. Also, reporting bias related to sterilization regret cannot be ruled out; even so, such bias is likely not substantial as the question on sterilization regret has been asked in the NFHS since the first round in 1992–1993 and the reporting formats have remained the same since then. In addition, marital status at sterilization could not be included in the statistical analysis because of data limitations; for the same reasons, analyses could not examine change in marital status between sterilization and interview.

Conclusions

According to data from 2014–2015, approximately four million female sterilizations are carried out in India per year.⁵ Given this study's finding that the prevalence of sterilization regret in India among married women aged 15–49 was 6.9% in 2015–2016, that means that an estimated 280,000 women per year regret their decision to be sterilized. To reduce sterilization regret, India's family planning program should strive to balance the method mix by promoting the full array of contraceptive methods to all women seeking advice about family planning, and to young women and women of lower parity, in particular. The program should also focus on promoting voluntary and informed choice for a range of effective reversible methods to postpartum women.

According to both the 2005–2006 and 2015–2016 NFHS surveys, substantial proportions of Indian women who reported losing a child after sterilization reported regretting the procedure. Under-five and infant mortality rates in India for the five years preceding the 2015–2016 NFHS were 50 and 41 deaths per 1,000 live births, respectively,⁷ which is very high compared with developed countries, as well as with neighboring countries of a similar

income level.⁴⁴ More needs to be done to reduce infant and under-five mortality in India, which would likely reduce sterilization regret, in turn.

A number of countries in Latin America—where sterilization is widely used^{12,13,25,39,45}—have formulated laws or regulations regarding sterilization. For example, under a Brazilian law passed in 1997, women and men are not allowed to undergo sterilization unless they are older than 25 and have at least two children. In addition, women seeking sterilization have to go through a 60-day counseling period during which they are informed about other modern family planning methods; postpartum sterilization cannot be performed until the 42nd day after delivery, on the basis that women may not be able to clearly figure out their fertility desires in the hospital environment.⁴⁵ In Colombia, Mexico and Peru, sterilization is also subject to legal regulations and requires informed, conscious and willing consent of couples.⁴⁶

In India, sterilization is currently not governed by such laws or regulations, which is beneficial, as subjecting sterilization to legal regulations undermines women's informed choice. However, compared with some Latin American countries, sterilization regret is currently low in India, although findings of this study suggest that it is rising. India may be able to learn from other countries how to have a balanced method mix, to reduce the use of sterilization by promoting effective reversible methods of family planning, as in Bangladesh.⁴⁷ India may also learn how to counsel low-parity couples to delay sterilization. With such strategies in place, regret is likely to decrease.

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RESUMEN

Contexto: La esterilización femenina ha sido el método anticonceptivo dominante en la India desde fines de los años setenta; sin embargo, la evidencia sobre el arrepentimiento por esterilización –incluidas las tendencias y los cambios en los correlatos– es limitada.

Métodos: Se utilizaron datos de las rondas 1992-1993, 2005-2006 y 2015-2016 de la Encuesta Nacional de Salud Familiar de la India para examinar las tendencias en el arrepentimiento por esterilización en mujeres de 15 a 49 años que alguna vez estuvieron casadas. Se realizaron análisis de regresión logística binaria multivariable para examinar los correlatos del arrepentimiento por esterilización en 2005–2006 y 2015–2016; y se usó descomposición multivariada para estimar la contribución de los correlatos al cambio en el arrepentimiento por esterilización entre las distintas encuestas.

Resultados: El arrepentimiento por esterilización en la India aumentó 2.3 puntos porcentuales, de 4.6% en 2005–2006 a 6.9% en 2015–2016. La mayoría de las variables asociadas con el arrepentimiento en 2005–2006 también fueron significativas en 2015–2016: por ejemplo, las mujeres que perdieron un hijo después de la esterilización tuvieron más probabilidades que las que no habían experimentado pérdida de hijos de expresar arrepentimiento (razón de probabilidades, 2.8 en 2005–2006 y 1.9 en 2015–2016). Ciertas características solo fueron significativas en 2015–2016: por ejemplo, las mujeres que fueron informadas de que no podrían tener hijos después de la esterilización tuvieron elevadas probabilidades de expresar arrepentimiento (1.4). El cambio en la composición de las mujeres por paridad y el hecho de estar informadas de que no podrían tener hijos después de la esterilización, contribuyeron de 5 a 6% del aumento del arrepentimiento por esterilización entre las encuestas.

Conclusiones: Los esfuerzos para aumentar el uso de métodos anticonceptivos reversibles, así como reducir la mortalidad materna e infantil, podrían ayudar a reducir el creciente nivel de arrepentimiento por esterilización en la India.

RÉSUMÉ

Contexte: La stérilisation féminine est la méthode contraceptive prédominante en Inde depuis la fin des années 1970. Les données relatives au regret la concernant – y compris en termes de tendances et corrélats changeants – sont cependant limitées.

Méthodes: Les données des cycles 1992–1993, 2005–2006 et 2015–2016 de l'Enquête nationale indienne sur la santé familiale ont servi de base à l'examen des tendances du regret de la décision de stérilisation parmi les femmes de 15 à 49 ans mariées ou l'ayant été. Les corrélats de ce regret en 2005–2006 et 2015–2016 ont été examinés par analyses de régression logistique binaire multivariées, tandis que la contribution des corrélats à l'évolution du regret entre les enquêtes était estimée par décomposition multivariée.

Résultats: Le regret de la décision de stérilisation en Inde a augmenté de 2,3 points de pourcentage, de 4,6% en 2005–2006 à 6,9% en 2015–2016. La plupart des variables associées au regret en 2005–2006 restent significatives en 2015–2016. Par exemple, les femmes qui avaient perdu un enfant après la stérilisation étaient plus susceptibles d'exprimer ce regret que celles qui n'avaient pas subi cette perte (RC, 2,8 en 2005–2006 et 1,9 en 2015–2016). Certaines caractéristiques ne sont significatives qu'en 2015–2016. Notamment, les femmes informées du fait qu'elles ne pourraient plus avoir d'enfants après la stérilisation présentent une plus forte probabilité d'exprimer

un regret (1,4). Le changement suivant que les femmes sont considérées en fonction de leur nombre d'enfants et du fait d'avoir été informées ou non de l'impossibilité d'avoir des enfants après la stérilisation représente pour chacun 5–6% de l'augmentation du regret exprimé entre les enquêtes.

Conclusions: Les efforts visant à accroître la pratique des méthodes contraceptives réversibles et à réduire la mortalité infantile et juvénile peuvent aider à amoindrir le regret sinon en hausse de la décision de stérilisation en Inde.

Acknowledgments

The author thanks Amy Tsui, Fred Arnold, Anrudh Jain, Rajib Acharya and Saggurti Niranjana for their comments. The research was supported by the RASTA initiative of the Population Council, New Delhi, India.

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