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Surgical Sterilization in Brazil's Public Health System Before and After the 2022 Reform of the Family Planning Law: An Interrupted Time Series Analysis

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Abstract

Introduction: Brazil's Law 14,443/2022, in force since March 2023, lowered the minimum age for voluntary surgical sterilization from 25 to 21 years, removed the requirement for spousal consent, and guaranteed sterilization during delivery under specified conditions. This study assessed changes in female and male sterilization in the Brazilian Unified Health System after the reform.

Materials and methods: An ecological interrupted time series study was conducted using monthly counts of tubal ligation and vasectomy from the Brazilian Hospital Information System (January 2015 to December 2025). Rates were calculated per 100,000 women aged 15-49 years and men aged 20-59 years. A negative binomial model with a population offset, a linear trend, and harmonic seasonal terms was fitted to the pre-pandemic period (January 2015 to February 2020) and projected over March 2023 to December 2025 to estimate the number of procedures expected from pre-pandemic trends; the period from March 2020 to February 2023 was excluded because elective surgery was disrupted by the COVID-19 pandemic and the subsequent recovery and because the publication of the law in September 2022 may have prompted anticipation. Results were expressed as observed-to-expected (O/E) ratios with 95% confidence intervals (CIs) obtained by simulation. Three elective procedures (cholecystectomy, inguinal hernia repair, and hysterectomy) served as control series, and alternative counterfactual specifications were tested.

Results: Over the 11-year period, 1,382,600 female sterilizations and 502,473 vasectomies were recorded. The female sterilization rate rose from 151.0 per 100,000 women in 2019 to 519.9 per 100,000 women in 2025. Between March 2023 and December 2025, 761,822 female sterilizations were performed, compared with 370,898 expected (O/E 2.05; 95% CI 1.88-2.26), whereas the control procedures had O/E ratios of 1.09 to 1.20; relative to each control procedure, the female O/E ratio was 1.72 to 1.88. The female O/E ratio ranged from 1.87 to 2.34 across alternative specifications. Vasectomy did not depart detectably from its projected trend (O/E 0.98; 95% CI 0.86-1.13), although this estimate was sensitive to the assumed trend (range 0.89-1.26). The female-to-male sterilization ratio in hospital records increased from 2.03 in 2019 to 3.55 in 2025 (1.41 to 2.64 between 2019 and 2024 when outpatient vasectomies were included), and the proportion of public-system cesarean sections that included tubal ligation rose from 4.7% in 2019 to 17.9% in 2025.

Conclusions: The entry into force of the reform was followed by female sterilization volumes that were approximately twice those projected from pre-pandemic trends, an increase much larger than that observed for other elective procedures, whereas vasectomy did not depart detectably from its projected trajectory, although this estimate depended on the assumed trend. The imbalance between female and male sterilization in the public system widened. Monitoring of counseling quality, regret, and access to vasectomy is warranted.

Categories: Obstetrics/Gynecology, Health Policy, Epidemiology/Public Health
Keywords: brazil, contraception, family planning policy, health policy evaluation, interrupted time series, tubal ligation, unified health system, vasectomy

Introduction

Surgical sterilization has long been a central component of contraceptive practice in Brazil. Until 2023, voluntary sterilization was governed by the original provisions of the Family Planning Law (Law 9,263/1996), which restricted the procedure to people aged at least 25 years or with at least two living children, required a 60-day interval between the request and surgery, prohibited sterilization during delivery except in cases of repeated previous cesarean sections, and required the consent of both spouses for married individuals [1]. These rules were intended to discourage early sterilization [1], but they were also criticized for limiting access to the procedure, particularly for low-income women [2-4].

In September 2022, Law 14,443/2022 amended these provisions [5]. The reform, which took effect 180 days after publication (March 2023), lowered the minimum age to 21 years, revoked the requirement for spousal consent, guaranteed sterilization during delivery when requested at least 60 days in advance and when medical conditions allow, and set a maximum of 30 days for the provision of any contraceptive method [5]. Because the Brazilian Unified Health System (Sistema Único de Saúde (SUS)) is the main provider of these procedures, changes in the volume and profile of sterilizations performed in the SUS could be expected.

Before the reform, three national surveys showed a marked decline in the prevalence of tubal ligation, from 32.2% to 17.3% among women of reproductive age between 2006 and 2019, with a modest increase in vasectomy among male partners [6]. Hospital data from 2013 to 2022, including the pandemic years, showed a stable national trend in vasectomies, with regional and age differences [7]. Vasectomy is more effective and cost-effective than female sterilization and is associated with fewer complications [8], yet in the United States female sterilization remains more than twice as common as vasectomy [8,9]. Abrupt legal changes can alter the use of permanent contraception: after the 2022 United States Supreme Court decision on abortion, both tubal sterilization and vasectomy increased among young adults [10]. Trends also differ between countries: in France, vasectomy has outnumbered tubal ligation since 2021 [11].

A previous study compared national sterilization counts between January 2022 and December 2023 and reported increases in tubal ligation and cesarean sections with tubal ligation after the law took effect, with little change in vasectomy [12]. However, that comparison was limited to the months immediately before and after the reform and did not use a longer pre-intervention series, adjust for seasonality and the post-pandemic recovery of elective surgery, or include control procedures. The primary objective of this study was to assess whether recorded volumes of female and male surgical sterilization in the SUS after the reform took effect in March 2023 differed from those projected from pre-pandemic trends, using an interrupted time series design. Secondary objectives were to describe changes in the proportion of SUS cesarean sections that included tubal ligation and in the ratio of female to male sterilization procedures.

Materials And Methods

Study design

This ecological interrupted time series study examined surgical sterilizations performed in the SUS between January 2015 and December 2025. Reporting followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement and its extension for routinely collected health data (RECORD) [13,14].

Data sources

Monthly counts of procedures were obtained from the Hospital Information System of the SUS (Sistema de Informações Hospitalares (SIH/SUS)) through the TabNet platform of the Department of Informatics of the SUS (DATASUS), using the hospital procedures module categorized by place of hospitalization [15]. The SIH/SUS records all hospitalizations funded by the SUS through the hospital admission authorization form and has been widely used for health services research in Brazil, despite known limitations in coverage and reliability [16]. Approved authorizations were tabulated by month of service and by geographic region, using processing files from July 2014 to July 2026 so that late-processed records were captured. Data were extracted in October and November 2026.

Procedures were identified by their codes in the SUS procedure table, with no restriction on the type of admission: interval tubal ligation (04.09.06.018-6), cesarean section with tubal ligation (04.11.01.004-2), tubal ligation during the same hospitalization as a vaginal delivery (04.09.06.031-3), and vasectomy (04.09.04.024-0). The code for tubal ligation at vaginal delivery was first recorded in March 2024; procedures performed during a vaginal delivery hospitalization before that date may have been recorded as interval tubal ligation. Salpingectomy codes (04.09.06.023-2 and 04.09.06.024-0) were not included because they cover several indications other than contraception, such as ectopic pregnancy. Annual counts of vaginal deliveries (03.10.01.003-9, 03.10.01.004-7, and 03.10.01.005-5) and cesarean sections (04.11.01.002-6, 04.11.01.003-4, and 04.11.01.004-2) were also obtained; hospitalizations coded as tubal ligation at vaginal delivery were added to the vaginal deliveries.

Because vasectomy can also be performed as an outpatient procedure, vasectomies recorded in the SUS Outpatient Information System (Sistema de Informações Ambulatoriais, SIA/SUS) were obtained by month of processing [17]. At the time of extraction, this module contained records up to July 2025, and the series was used until June 2025, the last complete month; no interval tubal ligations were recorded in the SIA/SUS. As control series, monthly counts of hospitalizations for three common surgical procedures unrelated to the reform were obtained from the same hospital module, restricted to admissions whose type of care was recorded as elective: cholecystectomy (04.07.03.002-6 and 04.07.03.003-4; open and laparoscopic), inguinal hernia repair (04.07.04.009-9, 04.07.04.010-2 and 04.07.04.013-7; bilateral, unilateral inguinal or femoral, and laparoscopic), and non-oncological, non-obstetric hysterectomy (04.09.06.010-0, 04.09.06.011-9, 04.09.06.012-7, 04.09.06.013-5, and 04.09.06.015-1; vaginal, with adnexectomy, subtotal, total, and laparoscopic).

Population denominators were the official DATASUS estimates of the resident population by sex, age group, and region for 2015-2025 [18]. Women aged 15-49 years and men aged 20-59 years were used as the reference populations. These age ranges encompass the usual reproductive ages. Because the hospital procedure module does not record patient age, numerators included procedures at all ages, so the rates are reference-population rates rather than age-specific rates. Procedures performed outside these age ranges would slightly inflate the rates but would not materially affect the observed-to-expected (O/E) comparisons, which contrast observed counts with projections from the same series. Each annual estimate was assigned to July of that year, monthly denominators were obtained by linear interpolation between consecutive years, and the 2015 and 2025 estimates were held constant for January to June 2015 and July to December 2025, respectively.

Outcomes

The primary outcomes were the monthly counts and rates of female sterilization (the sum of the three tubal ligation codes) and of vasectomy. Because of the introduction of a new code in 2024, female sterilization was also analyzed in two groups whose definitions were stable over time: cesarean section with tubal ligation and other tubal ligation (interval tubal ligation or tubal ligation at vaginal delivery). Descriptive outcomes were annual rates per 100,000 women or men in the reference age groups for Brazil and its five regions, the female-to-male ratio (the number of female sterilizations divided by the number of vasectomies in hospital records), the proportion of SUS cesarean sections that included tubal ligation, and the proportion of SUS deliveries that were cesarean sections.

Statistical analysis

The intervention date was March 2023, when Law 14,443/2022 took effect [5]. Changes were assessed with a counterfactual approach to interrupted time series analysis, in which a model fitted to pre-intervention data is projected forward to estimate the outcome expected in the absence of the intervention [19,20]. This approach was chosen because the COVID-19 pandemic caused widespread cancellation of elective surgery [21], followed by a recovery period and by the publication of the law in September 2022, which may have prompted anticipation; a segmented model with level and slope changes in March 2023 would therefore depend on how the 36 months between March 2020 and February 2023 were modeled. Additionally, a national program to reduce waiting lists for elective surgery was launched in February 2023 [22]; control series were therefore analyzed to gauge the contribution of this program and of the post-pandemic recovery of elective surgery.

In the main analysis, a negative binomial model (NB2 parameterization), chosen because the counts were overdispersed, was fitted to the pre-pandemic period (January 2015 to February 2020), with the logarithm of the reference population as an offset, a linear term for time (in months), and two pairs of sine and cosine terms with periods of 12 and six months for seasonality. Standard errors were estimated with the Newey-West method with 12 lags, and the pre-pandemic trend was expressed as an annual percentage change. The period from March 2020 to February 2023 was excluded, and the model was projected over the post-intervention period (March 2023 to December 2025, 34 months). The counterfactual therefore assumes that, without the reform, sterilization would have returned after the pandemic and transition period to the trend and seasonal pattern observed before March 2020; sensitivity analyses and comparisons with control procedures examined departures from this assumption. Control series were modeled in the same way without a population offset. The aggregated monthly series had no missing values.

Observed counts were compared with expected counts for each calendar year and for the whole post-intervention period. The excess number of procedures was calculated as the difference between observed and expected counts, and the O/E ratio was calculated by dividing the observed count by the expected count. The same comparison was made for the months between the publication of the law and its entry into force (September 2022 to February 2023) and for the pandemic and transition period (March 2020 to February 2023). Uncertainty was obtained from 10,000 Monte Carlo simulations, each with two steps. First, the model coefficients were drawn from a multivariate normal distribution centered on the estimates, with the Newey-West covariance matrix, to reflect uncertainty in the projected trend and seasonality. Second, month-to-month variation around the projection was added as a first-order autoregressive process on the logarithmic scale, with the lag-1 autocorrelation and variance of the log residuals (the logarithm of the ratio of observed to fitted counts) from the pre-pandemic model, centered so that the expected count was unchanged; this step accounts for overdispersion and for residual autocorrelation, so that consecutive months were not treated as independent. The simulated counts were summed over each period, and the 2.5th and 97.5th percentiles of these sums are reported as the 95% prediction interval (PI) of the expected count, that is, the range of counts compatible with the absence of the reform. Because observed counts were treated as fixed, the 95% confidence interval (CI) of the O/E ratio was obtained by dividing the observed count by the upper and lower limits of the PI. Overdispersion was assessed with the Pearson chi-square statistic of a Poisson model with the same terms, and residual autocorrelation with the Ljung-Box test at 12 lags applied to the Pearson residuals.

Five sensitivity analyses examined how the results depended on the form of the counterfactual: calendar-month indicators instead of harmonic terms; a shorter fitting window (March 2017 to February 2020); a

linear rather than log-linear trend, fitted by ordinary least squares to monthly rates; a model fitted to the full pre-intervention series (January 2015 to February 2023) with indicators for the pandemic (March 2020 to December 2021) and transition (January 2022 to February 2023) periods, set to zero in the projection; and a segmented regression model with level and slope terms for March 2023, fitted to the full series with the same indicators [23]. For vasectomy, an additional analysis combined hospital and outpatient records from January 2015 to June 2025 by adding monthly outpatient counts, tabulated by month of processing, to hospital counts, tabulated by month of service; this may shift some outpatient procedures due to the interval between performance and processing. For comparison, the female O/E ratio was also calculated for the same period (March 2023 to June 2025). To assess whether the general increase in elective surgery after the pandemic, including the waiting-list program, could account for the findings, the O/E ratios for sterilization were also divided by those of each control procedure, which assumes that sterilization would have exceeded its pre-pandemic trend to the same extent as elective surgery in general; intervals for these ratios were obtained from the simulations. Analyses were performed with Python version 3.13 (Python Software Foundation, Wilmington, DE, USA) using the statsmodels library version 0.15.

Ethical considerations

The study used only publicly available, aggregated, and anonymized secondary data. In accordance with Brazilian National Health Council Resolution 510/2016, a research ethics committee review was not required.

Results

Between January 2015 and December 2025, the SIH/SUS recorded 1,382,600 female sterilizations and 502,473 vasectomies (Table *1*). Before the pandemic, both procedures were increasing, and in 2019 the rates reached 151.0 female sterilizations per 100,000 women and 72.4 vasectomies per 100,000 men. Both fell in 2020 and 2021 compared with 2019 and recovered in 2022. After the reform took effect, the female sterilization rate rose to 360.1 per 100,000 in 2023, 512.9 in 2024, and 519.9 in 2025, whereas the vasectomy rate was 123.5, 143.7, and 137.7 per 100,000, respectively. The proportion of SUS deliveries that were cesarean sections increased steadily from 40.5% in 2015 to 48.8% in 2022 and 52.8% in 2025.

Year	Female sterilizations, n	Rate per 100,000 women	Vasectomies, n	Rate per 100,000 men	Female-to-male ratio	Cesarean sections with tubal ligation, % of SUS cesarean sections	Cesarean sections, % of SUS deliveries
2015	61,057	108.9	25,705	45.9	2.38	3.4	40.5
2016	63,332	112.7	26,079	46.2	2.43	3.6	41.3
2017	67,525	120.0	30,725	53.9	2.20	4.0	42.8
2018	77,902	138.3	37,825	65.9	2.06	4.2	44.0
2019	85,150	151.0	41,931	72.4	2.03	4.7	45.2
2020	66,352	117.6	21,468	36.8	3.09	4.9	46.9
2021	71,396	126.4	25,517	43.5	2.80	5.3	47.4
2022	107,683	190.9	52,705	89.4	2.04	6.0	48.8
2023	202,695	360.1	73,082	123.5	2.77	11.3	50.7
2024	288,177	512.9	85,350	143.7	3.38	16.3	52.0
2025	291,331	519.9	82,086	137.7	3.55	17.9	52.8

TABLE 1: Annual surgical sterilizations in the Brazilian Unified Health System, 2015-2025

Female sterilization includes interval tubal ligation, cesarean section with tubal ligation, and tubal ligation at vaginal delivery (codes recorded from March 2024). Rates use women aged 15-49 years and men aged 20-59 years as denominators. The female-to-male ratio is the number of female sterilizations divided by the number of vasectomies. Vasectomy counts, rates, and the female-to-male ratio are based on hospital records; outpatient vasectomies are not included.

Source: Hospital Information System of the SUS (SIH/SUS) and population estimates from the Department of Informatics of the SUS (DATASUS).

SUS: Sistema Único de Saúde (Brazilian Unified Health System).

Before the pandemic, female sterilization increased by 9.0% per year (95% CI 7.5-10.6%). From March 2023

to December 2025, 761,822 female sterilizations were performed, compared with 370,898 expected from the pre-pandemic trend (95% PI 337,155-406,205), an excess of 390,924 procedures (O/E 2.05; 95% CI 1.88-2.26; Table 2, Figure 1). The O/E ratio was 1.80 in 2023 (March to December), 2.23 in 2024, and 2.07 in 2025. On a monthly basis, the O/E ratio rose from 1.12 in February 2023 to 1.40 in March 2023 and approximately 2.0 by August 2023. Between the publication of the law and its entry into force (September 2022 to February 2023), the O/E ratio was 1.14 (95% CI 1.04-1.25).

Outcome	Pre-pandemic trend, % per year (95% CI)	O/E 2023, March-December (95% CI)	O/E 2024 (95% CI)	O/E 2025 (95% CI)	Observed, n	Expected, n (95% PI)	O/E, March 2023-December 2025 (95% CI)
Female sterilization, total	9.0 (7.5-10.6)	1.80 (1.64-1.97)	2.23 (2.03-2.47)	2.07 (1.86-2.32)	761,822	370,898 (337,155-406,205)	2.05 (1.88-2.26)
Cesarean section with tubal ligation	11.9 (10.5-13.4)	1.64 (1.52-1.77)	1.94 (1.79-2.11)	2.00 (1.82-2.20)	400,040	212,171 (195,505-229,882)	1.89 (1.74-2.05)
Other tubal ligation	6.5 (4.5-8.5)	1.95 (1.70-2.24)	2.53 (2.20-2.93)	2.08 (1.77-2.44)	361,782	164,631 (143,817-187,722)	2.20 (1.93-2.52)
Vasectomy, hospital records	13.6 (11.2-16.1)	1.03 (0.91-1.17)	1.05 (0.91-1.21)	0.89 (0.76-1.04)	231,108	235,523 (205,419-270,178)	0.98 (0.86-1.13)
Vasectomy, hospital and outpatient records*	12.1 (10.3-13.9)	0.99 (0.90-1.09)	1.00 (0.90-1.11)	0.86 (0.76-0.97)	242,001	251,300 (228,295-276,503)	0.96 (0.88-1.06)
Cholecystectomy (control)	5.6 (3.5-7.8)	1.17 (1.04-1.32)	1.20 (1.05-1.37)	1.10 (0.95-1.28)	723,350	627,057 (552,205-711,126)	1.15 (1.02-1.31)
Inguinal hernia repair (control)	5.4 (3.0-7.7)	1.10 (0.97-1.26)	1.14 (0.99-1.32)	1.04 (0.89-1.23)	478,966	437,702 (381,025-501,338)	1.09 (0.96-1.26)
Hysterectomy (control)	3.2 (1.2-5.3)	1.21 (1.08-1.37)	1.25 (1.10-1.43)	1.13 (0.98-1.32)	323,766	270,509 (238,485-305,544)	1.20 (1.06-1.36)

TABLE 2: Observed and expected surgical sterilizations after Law 14,443/2022

Expected counts were projected from negative binomial models with linear trend and harmonic seasonal terms fitted to January 2015-February 2020 (March 2020-February 2023 excluded); the female sterilization and vasectomy models included a population offset. Other tubal ligation comprises interval tubal ligation and tubal ligation at vaginal delivery. Control procedures are elective hospitalizations. Intervals were obtained from 10,000 simulations.

*Outpatient records were available until June 2025; for this row, 2025 refers to January-June and the totals to March 2023-June 2025.

O/E: observed-to-expected ratio, CI: confidence interval, PI: prediction interval

The observed counts in both female sterilization categories exceeded the expected counts. Cesarean section with tubal ligation had an O/E ratio of 1.89 (95% CI 1.74-2.05), increasing from 1.64 in 2023 to 1.94 in 2024 and 2.00 in 2025, and other tubal ligation had an O/E ratio of 2.20 (95% CI 1.93-2.52). The code for tubal ligation at vaginal delivery accounted for 15,343 procedures in 2024 and 30,970 in 2025, while interval tubal ligation decreased from 129,374 to 95,416 between these years. Interval tubal ligation did not decrease when the new code was introduced in March 2024 (10,324 procedures in February and 11,778 in April 2024), and the combined series for other tubal ligation showed no decline during that period. The proportion of SUS cesarean sections that included tubal ligation rose from 4.7% in 2019 to 6.0% in 2022, then to 11.3% in 2023, 16.3% in 2024, and 17.9% in 2025 (Table 1).

Vasectomy increased by 13.6% per year before the pandemic (95% CI 11.2-16.1%). The 231,108 vasectomies performed between March 2023 and December 2025 were close to the expected 235,523 (O/E 0.98; 95% CI 0.86-1.13; Figure 1), with annual O/E ratios between 0.89 and 1.05, with all corresponding CIs including 1.

Vasectomies were also at the expected level between September 2022 and February 2023 (O/E 1.00; 95% CI 0.88-1.13).

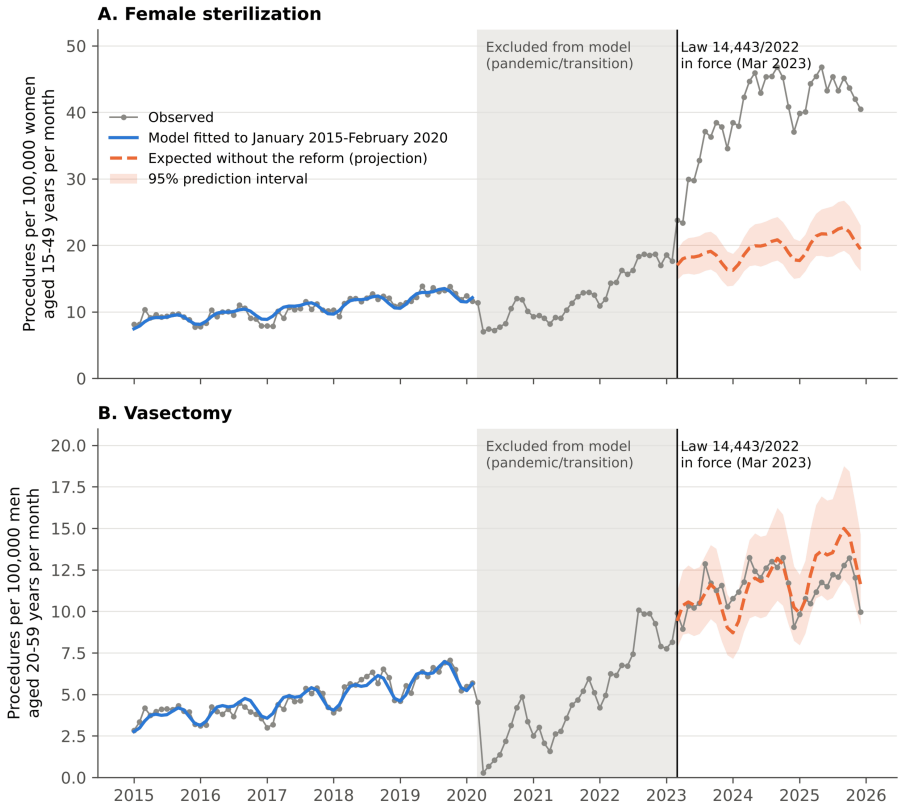


FIGURE 1: Monthly rates of female sterilization and vasectomy in the Brazilian Unified Health System, January 2015 to December 2025

Gray points show observed monthly rates. The solid blue line shows the negative binomial model fitted to January 2015-February 2020; the dashed orange line shows its projection, that is, the rates expected in the absence of the reform, with the 95% PI shaded. The gray area (March 2020 to February 2023) was excluded from the model. The vertical line marks the entry into force of Law 14,443/2022 in March 2023.

PI: prediction interval

The elective control procedures also exceeded their projected volumes, but to a much smaller extent: the O/E ratio was 1.15 (95% CI 1.02-1.31) for cholecystectomy, 1.09 (95% CI 0.96-1.26) for inguinal hernia repair, and 1.20 (95% CI 1.06-1.36) for hysterectomy (Table *2*). Because female sterilization exceeded its projection while vasectomy did not, the balance between female and male procedures shifted: the female-to-male ratio in hospital records, which was 2.03 in 2019 and 2.04 in 2022, reached 3.55 in 2025 (Figure *2*).

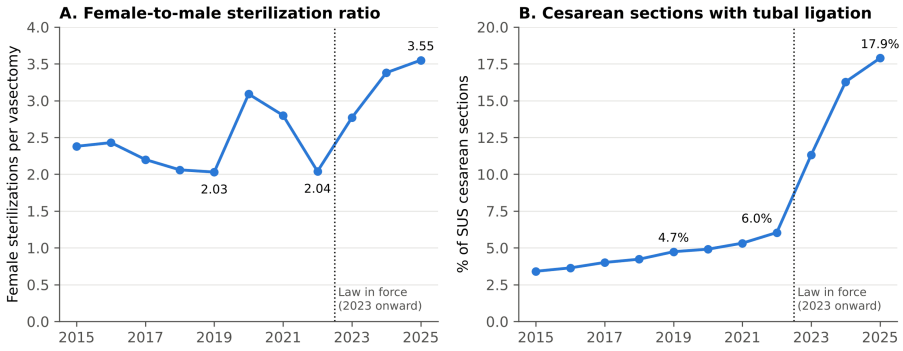


FIGURE 2: Female-to-male sterilization ratio and proportion of cesarean sections with tubal ligation in the Brazilian Unified Health System, 2015-2025

(A) Number of female sterilizations divided by the number of vasectomies in hospital records in each year (outpatient vasectomies not included); the 2020-2021 values reflect the suspension of elective surgery during the COVID-19 pandemic. (B) Percentage of SUS cesarean sections coded as cesarean section with tubal ligation. The dotted line separates the years before and after Law 14,443/2022 entered into force.

COVID-19: coronavirus disease 2019, SUS: Sistema Único de Saúde (Brazilian Unified Health System)

Across the alternative specifications, the O/E ratio for female sterilization ranged from 1.87 to 2.34, with all lower confidence limits at or above 1.76, and remained well above the values for the control procedures (Table 3). When the female O/E ratio was divided by that of each control procedure, which assumes that sterilization exceeded its projection to the same extent as other elective surgery, the ratio was 1.78 (95% CI 1.52-2.09) relative to cholecystectomy, 1.88 (95% CI 1.59-2.22) relative to inguinal hernia repair, and 1.72 (95% CI 1.48-2.01) relative to hysterectomy. For vasectomy, the O/E ratio ranged from 0.89 with the segmented model to 1.26 (95% CI 1.16-1.37) with a linear trend, a value similar to those of the control procedures under the same specification (1.15 to 1.22); relative to cholecystectomy, inguinal hernia repair, and hysterectomy, the vasectomy O/E ratio was 0.85 (95% CI 0.71-1.02), 0.90 (95% CI 0.74-1.09), and 0.82 (95% CI 0.68-0.98), respectively. When hospital and outpatient records were combined, the O/E ratio for vasectomy was 0.96 (95% CI 0.88-1.06) in the main analysis and 1.17 (95% CI 1.10-1.25) with a linear trend; over the same period (March 2023 to June 2025), the female O/E ratio was 2.06 (95% CI 1.89-2.26). Outpatient records added 18,436 vasectomies in 2019 and 23,728 in 2024 (44% and 28% of hospital counts, respectively); combined, the female-to-male ratio increased from 1.41 in 2019 to 2.64 in 2024.

Outcome	Main analysis	Calendar-month indicators	Fitting window March 2017-February 2020	Linear trend	Full pre-intervention series	Segmented regression
Female sterilization	2.05 (1.88-2.26)	2.04 (1.86-2.24)	1.87 (1.76-1.99)	2.34 (2.19-2.51)	2.00 (1.76-2.27)	1.99 (1.76-2.26)
Vasectomy, hospital records	0.98 (0.86-1.13)	0.98 (0.85-1.12)	0.91 (0.81-1.03)	1.26 (1.16-1.37)	0.90 (0.70-1.16)	0.89 (0.69-1.15)
Vasectomy, hospital and outpatient records*	0.96 (0.88-1.06)	0.96 (0.87-1.06)	0.91 (0.83-0.99)	1.17 (1.10-1.25)	0.90 (0.74-1.10)	0.90 (0.73-1.09)
Cholecystectomy (control)	1.15 (1.02-1.31)	1.14 (1.01-1.29)	1.10 (0.97-1.24)	1.22 (1.12-1.35)	1.06 (0.81-1.37)	1.04 (0.80-1.34)
Inguinal hernia repair (control)	1.09 (0.96-1.26)	1.09 (0.95-1.25)	1.00 (0.90-1.11)	1.15 (1.05-1.28)	1.00 (0.76-1.29)	0.98 (0.75-1.28)
Hysterectomy (control)	1.20 (1.06-1.36)	1.18 (1.05-1.34)	1.09 (0.98-1.22)	1.22 (1.11-1.36)	1.08 (0.85-1.37)	1.06 (0.83-1.36)

TABLE 3: O/E ratios for March 2023-December 2025 under alternative counterfactual specifications

Values are O/E ratios (95% CIs). Main analysis: negative binomial model with linear trend and harmonic seasonal terms fitted to January 2015-February 2020. Linear trend: ordinary least squares on monthly rates (monthly counts for control procedures). Full pre-intervention series and segmented regression: models fitted to January 2015-February 2023 (segmented regression, to the full series) with indicators for the pandemic and transition periods set to zero in the projection.

*Totals for March 2023-June 2025

O/E: observed-to-expected, CIs: confidence intervals

All five regions showed a similar pattern (Table 4). Between 2019 and 2025, female sterilization rates increased 2.96- to 3.83-fold, with the largest relative increase in the Northeast, whereas vasectomy rates increased 1.49- to 2.77-fold. The female-to-male ratio increased in every region, nearly doubling in the Southeast (from 1.66 to 3.17), Northeast (from 2.96 to 5.57), and Central-West (from 2.95 to 5.62); the North had the highest ratio in both years (8.66 and 10.13). In the main models, counts were overdispersed relative to a Poisson model (Pearson chi-square divided by degrees of freedom: 7.6-93.8), and the Ljung-Box test indicated residual autocorrelation for all outcomes ($p < 0.05$; lag-1 autocorrelation of log residuals 0.11 to 0.32), which was incorporated in the simulations (Table 5). Calendar-month indicators did not reduce residual autocorrelation compared with harmonic terms.

Indicator	North	Northeast	Southeast	South	Central-West	Brazil
Female sterilization rate, 2019	147.8	136.4	163.6	119.1	196.2	151.0
Female sterilization rate, 2022	220.7	206.0	181.4	133.9	253.7	190.9
Female sterilization rate, 2025	499.0	522.0	539.3	438.7	579.8	519.9
Female sterilization, fold change 2019-2025	3.38	3.83	3.30	3.68	2.96	3.44
Vasectomy rate, 2019	17.3	47.1	93.9	92.0	64.5	72.4
Vasectomy rate, 2022	41.8	69.6	107.9	116.1	61.7	89.4
Vasectomy rate, 2025	47.9	91.8	156.8	244.5	96.2	137.7
Vasectomy, fold change 2019-2025	2.77	1.95	1.67	2.66	1.49	1.90
Female-to-male ratio, 2019	8.66	2.96	1.66	1.20	2.95	2.03
Female-to-male ratio, 2025	10.13	5.57	3.17	1.62	5.62	3.55

TABLE 4: Sterilization rates, fold changes and female-to-male ratios by region, 2019, 2022 and 2025

Regions refer to the place of hospitalization. Female sterilization rates per 100,000 women aged 15-49 years; vasectomy rates per 100,000 men aged 20-59 years. Fold change: 2025 rate divided by 2019 rate. Female-to-male ratio: number of female sterilizations divided by number of vasectomies. Vasectomy rates and the female-to-male ratio are based on hospital records; outpatient vasectomies are not included. Source: Hospital Information System of the SUS (SIH/SUS) and population estimates from the Department of Informatics of the SUS (DATASUS).

SUS: Sistema Único de Saúde (Brazilian Unified Health System)

Outcome	Poisson dispersion (Pearson chi-square/df)	Negative binomial dispersion parameter	Ljung-Box test, 12 lags (p-value)	Lag-1 autocorrelation of log residuals	SD of log residuals
Female sterilization, total	24.0	0.0038	0.012	0.18	0.064
Cesarean section with tubal ligation	7.6	0.0021	0.009	0.20	0.050
Other tubal ligation	29.8	0.0092	0.001	0.32	0.100
Vasectomy, hospital records	17.3	0.0059	<0.001	0.28	0.080
Vasectomy, hospital and outpatient records	19.6	0.0045	0.010	0.11	0.070
Cholecystectomy (control)	93.8	0.0072	<0.001	0.24	0.087
Inguinal hernia repair (control)	69.2	0.0075	<0.001	0.29	0.089
Hysterectomy (control)	48.9	0.0073	<0.001	0.23	0.088

TABLE 5: Diagnostics of the main models

Models fitted to January 2015-February 2020 (62 months) with a linear trend and harmonic seasonal terms. Poisson dispersion: Pearson chi-square divided by the residual degrees of freedom (df) of a Poisson model with the same terms; values above 1 indicate overdispersion. The Ljung-Box test was applied to the Pearson residuals of the negative binomial models; $p < 0.05$ indicates residual autocorrelation. The lag-1 autocorrelation and SD of the log residuals were the parameters of the first-order autoregressive process used in the simulations.

SD: standard deviation

Discussion

In this study, after Law 14,443/2022 entered into force, female sterilization volumes in the SUS were about twice those projected from pre-pandemic trends. After a modest excess in the months between the publication of the law and its entry into force, the excess increased sharply when the reform took effect in March 2023, grew over the following six months, and persisted through 2025; it was several times larger than the increase observed for other elective procedures during the same period. By 2025, the annual rate of female sterilization was more than three times the pre-pandemic level. In contrast, vasectomy did not depart detectably from its projected trajectory, and the gap between female and male sterilization widened. These findings are consistent with the increase in tubal ligation reported in the first year after the reform [12] and extend those findings by showing that the excess persisted through 2025, exceeded the expansion of other elective surgery, and was robust to alternative assumptions about the pre-existing trend.

The timing of the change coincided with the launch of a national program to reduce elective surgery waiting lists [22] and followed the pandemic backlog of elective procedures [21]. Both could have increased sterilizations regardless of the reform. However, cholecystectomy, inguinal hernia repair, and hysterectomy exceeded their projected volumes by only 9% to 20%; for each, the female O/E ratio was 1.72 to 1.88 (lower 95% limits 1.48 to 1.59). The deficit of female sterilizations accumulated between March 2020 and February 2023, approximately 52,000 procedures, was small compared with the excess of approximately 391,000 procedures after the reform. The female results were also consistent across alternative assumptions about the counterfactual trend. These observations indicate that female sterilization increased well beyond the general increase in elective surgery, a pattern consistent with a potential effect of the reform, although time-varying confounding cannot be excluded and an ecological design cannot establish causality.

The magnitude and timing of the change are consistent with the fulfillment of previously unmet demand constrained by the former regulations. Before 2023, the prohibition of sterilization during delivery was a well-documented barrier, and many women who wished to be sterilized after childbirth were unable to obtain the procedure [2]. Medical gatekeeping and administrative barriers further limited access for low-income women [3,4]. The reform removed the prohibition at delivery, lowered the minimum age, and eliminated spousal consent, changes that address barriers reported mainly by women. he nearly threefold increase in the proportion of SUS cesarean sections between 2022 and 2025 that included tubal ligation supports this interpretation. Trends in interval tubal ligation should be interpreted with caution, because its decrease in 2025 coincided with growth in the new code for tubal ligation at vaginal delivery, suggesting a reallocation of records between codes.

Although vasectomy is safer and more effective than female sterilization [8], its use depends on male engagement and on counseling that presents it as an option to couples [24]. In contrast with the stationary trend reported for 2013 to 2022, a period that included the pandemic years [7], vasectomy rates in this study increased steadily between 2015 and 2019 and remained above pre-pandemic levels after the reform. At a Brazilian university hospital, men undergoing vasectomy were mostly married and considered their families complete [25]. Whether vasectomy changed in association with the reform cannot be determined with confidence, because the estimate depended on the assumed shape of the pre-pandemic trend; under the most favorable assumption, the increase was similar to that of other elective procedures. The widening gap resembles the persistent predominance of female sterilization described in the United States [9] and contrasts with France, where vasectomy now exceeds tubal ligation [11]. Unlike the increases in both tubal sterilization and vasectomy observed among young adults after the 2022 Supreme Court decision on abortion in the United States [10], the increase after the Brazilian reform was concentrated in female sterilization, which is consistent with changes in access rules that were more relevant to women than to men.

The increase in sterilization at cesarean delivery has practical and ethical implications. Performing the procedure during a cesarean section avoids a second surgery and anesthesia, which is convenient for women and for the health system. However, regret after sterilization is more frequent among women sterilized at younger ages and shortly after delivery [26], and contemporary data continue to show measurable regret after tubal ligation and salpingectomy, with younger age and sterilization during pregnancy also associated with regret [27]. The law maintains the 60-day interval between the request and the procedure and requires multidisciplinary counseling [5], and administrative data cannot assess compliance with these safeguards. In 2025, about one in six cesarean sections in the SUS included tubal ligation. The proportion of cesarean sections among SUS deliveries was already rising before the reform and continued to rise at a similar pace afterward; individual-level data should be used to examine whether the possibility of concurrent sterilization influences the choice of mode of delivery. The growing interest in opportunistic salpingectomy as a sterilization technique in Brazil [28] may also change how these procedures are performed and coded.

From a policy perspective, these findings indicate that the reform was followed by a large increase in the use of permanent contraception by women in the SUS. Because this study did not measure counseling quality, regret, or whether procedures reflected informed and autonomous choices, it cannot show whether the increase reflects improved access, inadequate counseling, or both. The findings nevertheless support the monitoring of contraceptive counseling, regret and reversal requests, and active strategies to expand the supply and acceptability of vasectomy so that the burden of permanent contraception does not fall

predominantly on women.

Limitations

This study has limitations inherent to its ecological design and to the use of administrative data. First, the SIH/SUS covers only procedures funded by the SUS, so sterilizations performed in the private sector were not captured. Second, the data refer to approved hospital authorizations, which count procedures rather than individuals and are subject to underreporting, coding errors, and changes in billing practices; in particular, the introduction of a code for tubal ligation at vaginal delivery in 2024 shifted records between categories, and the SUS procedure table has no code for tubal ligation during a cesarean section in a high-risk pregnancy; therefore, such procedures may have been undercounted. Salpingectomies performed for contraception were also not captured; however, elective salpingectomies, which include but are not limited to contraceptive procedures, numbered 6,460 in 2019 and 6,489 to 9,331 per year in 2023-2025, equivalent to about 2% to 5% of the female sterilizations recorded in those years. Hence, their exclusion is unlikely to change the main findings. Third, the module used does not provide patients' ages, so it was not possible to determine whether the increase was concentrated among women aged 21-24 years without two living children, who became newly eligible. The data also do not capture counseling quality, regret, or whether sterilizations reflected informed and autonomous choices. Fourth, regional analyses were based on the place of hospitalization rather than residence. Fifth, the expected counts depend on extrapolating pre-pandemic trends across the three excluded years, and their uncertainty intervals assume residual autocorrelation follows a first-order autoregressive process; the female results were robust to alternative specifications and to adjustment for the increase in other elective surgery, but the vasectomy results were not. Sixth, some vasectomies are recorded only in the outpatient system, which was available only until mid-2025 and is tabulated by month of processing; comparisons restricted to the same period with both sources combined led to the same conclusions, but the female-to-male ratio based on hospital records alone overstates the imbalance between the sexes. Finally, the analysis is subject to time-varying confounding: although control series were used, other changes that occurred at the same time as the reform, such as the waiting-list program, the post-pandemic recovery of services, and changes in obstetric care or in the demand for contraception, may have affected sterilization differently from the control procedures, and an ecological design cannot establish causality.

Conclusions

The entry into force of the 2022 reform of the Brazilian Family Planning Law was followed by female sterilization volumes in the SUS that were approximately twice those projected from pre-pandemic trends, an increase substantially greater than that observed for other elective surgeries. The proportion of procedures performed at cesarean delivery also increased. Vasectomy did not depart detectably from its projected trajectory, although this estimate depended on the assumed trend, and the imbalance between female and male sterilization widened. These temporal associations do not establish that the reform caused the changes.

Health services should ensure that the counseling and waiting-period safeguards established by the law are applied, monitor regret and requests for reversal, and actively promote vasectomy as a safe alternative. Future studies with individual-level data should examine the age profile of women undergoing sterilization after the reform, the relationship between concurrent sterilization and the mode of delivery, and the quality of counseling and the frequency of regret.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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Disclosures

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