Determinants of Female Sterilization in Brazil, 2001–2006

Ernesto Friedrich Lima Amaral[1]

Joseph E. Potter[2]

Abstract

This study aims to investigate the determinants of female sterilization in Brazil. Our analysis is innovative because it adds the time of exposure to the risk of sterilization into survival models. We control the models by postpartum duration, age at delivery, parity at delivery, place of delivery, region of residence, color/race, years of schooling, frequency of involvement in religious activities, and religion at the time of interview. We use data from the 2006 Brazilian National Survey on Demography and Health of Women and Children (PNDS). The strongest probability that sterilization might occur was observed among women who gave birth at private hospitals and received support from a health insurance company, between zero and two months after childbirth. These results are an indication of a frustrated demand for female sterilization at public hospitals. Unlike previous studies, our findings suggest color/race and years of schooling do not predict the risk of sterilization.

1. Introduction

The future trends of fertility in countries with rates below the replacement level are an important theme in contemporary demography (Bongaarts 2002). There are a number of reasons why the total fertility rate (TFR) falls to less than 2.1 children per woman (Alves 2004; Bongaarts 2002, 2008; Bongaarts and Sobotka 2012; Demeny 2011; Demeny and McNicoll 2006; Morgan 2003; Rindfuss, Guzzo, and Morgan 2000). Some such reasons include individualism, complex family arrangements, high divorce rates, cohabitation, delayed marriage, fertility postponement, higher proportions of children born outside of wedlock, increasing female labor force participation, increasing levels of schooling, and a greater use of modern contraceptive methods. These changes occur within the context of the second demographic transition (Van de Kaa 1987, 2004; Lesthaeghe 2010; Lesthaeghe and Neidert 2006). In Latin America, most countries have been experiencing a decline in fertility rates. Unlike many African countries that have experienced economic problems and varying mortality trends, there has been no stagnation in fertility decline in these Latin American countries (Bongaarts 2008).

[1] Assistant Professor, Universidade Federal de Minas Gerais (UFMG), Brazil. Email: eflamaral@gmail.com.
[2] Professor, University of Texas at Austin. Email: joe@prc.utexas.edu.

In Brazil, there was an increase in the mean age of fertility from 26.3 years in 2000 to 26.8 years in 2010. Women ranging between 20 to 24 years of age accounted for 27 percent of the fertility in 2010, but this percentage was 29.3 percent in 2000. There is increased fertility participation for women above 30 years of age. The TFR fell from 6.28 children per woman in 1960 to 5.76 in 1970, 4.35 in 1980, 2.85 in 1991, 2.38 in 2000, and 1.90 in 2010 (IBGE 2012). When dividing Brazil into regions, the TFR in 2010 was 2.47 in the North, 2.06 in the Northeast, 1.7 in the Southeast, 1.78 in the South, and 1.92 in the Central-West region. These regional differences had been found in previous studies (Potter, Schmertmann, and Cavenaghi 2002; Potter, Schmertmann, Assunção, and Cavenaghi 2010).

The increased use of modern contraception is a major factor associated with the decline of fertility in Brazil (Berquó, Garcia, and Lago 2008; Leone and Hinde 2005; Perpétuo 1998; Perpétuo and Wajnman 1993, 2003; Perpétuo and Wong 2009). Contraceptive methods are largely concentrated in the use of pills and female sterilization (Janowitz, Higgins, Rodrigues, Arruda, Smith, and Morris 1985; Perpétuo and Wong 2009; Potter 1999; Vieira 2007). The rise in the practice of contraception occurred in a context not associated to public policies on birth control. The government did not intervene in order to reduce fertility, change female reproductive behavior, or increase the use of contraception (Fonseca Sobrinho 1993). Actually, Brazil has inadequate public services for sexual and reproductive health, characterized by excessive "medicalization," the predominance of the private sector, delayed access to contraceptives, inappropriate use of contraceptives, a lack of medical care and reversible methods, a high proportion of unwanted pregnancies, and social inequality effecting access to contraception (Bilac and Rocha 1998; Giffin and Costa 1999; Miranda-Ribeiro and Simão 2009; Vieira 2007). In recent decades, there has been an expansion of modern methods (Amorim, Cavenaghi, and Alves 2008; Cavenaghi and Alves 2009). From 1996 to 2006, there was a change in the distribution of married and cohabiting women between 15–44 years of age by type of contraceptive use. However, female sterilization remains used by 25.9 percent of these women in 2006, compared to 38.5 percent in 1996. Women who use pills rose from 23.1 percent in 1996 to 27.4 percent in 2006. A total of 22.1 percent of women did not use any method in 1996. This rate fell to 18.4 percent in 2006. The use of condoms increased from 4.6 to 13 percent during the period. The percentage of women who were married to men who had obtained a vasectomy rose from 2.8 to 5.1 percent during this 10-year period. The practice of withdrawal decreased from three to 2.1 percent, and women who utilized periodic abstinence fell from 2.9 to one percent between 1996 and 2006. Finally, the use of other methods (IUD, diaphragm, injections, etc.) rose from three to seven percent throughout the same period (Perpétuo and Wong 2009).

In this context that included high rates of female sterilization, the federal government implemented the family planning law in 1997. One of the goals of the law was to enable sterilization in public hospitals, but with restrictions for surgeries during cesarean deliveries, childbirth, and abortion. The law expresses that: “The surgical sterilization of women is forbidden during childbirth or abortion, except for health reasons caused by previous successive cesarean deliveries” (Law #9,263 from January 12, 1996, article 10 vetoed until August 19, 1997). Despite these legal impediments, female sterilization is still held in conjunction with childbirth and cesarean section (Berquó 1993, 1999; Berquó and Cavenaghi 2003; Berquó, Garcia, and Lago 2008; Molina 1999; Perpétuo and Wong 2009).

There are several studies that identify evidence of regret following a female sterilization procedure (Curtis, Mohllajee, and Peterson 2006; Hopkins 2009; Perpétuo and Wong 2009; Vieira 1998, 2007; Vieira and Ford 1996a, 1996b). There is also evidence of a frustrated demand for female sterilization (Caetano and Potter 2004; Lacerda, Miranda-Ribeiro, Caetano, and Machado 2005; Potter, Perpétuo, Berquó, Hopkins, Leal, Formiga, and Souza 2003). Extreme inequality in the access to female sterilization exists between the public and private sectors. A large percentage of unnecessary cesarean deliveries are being utilized as a way for women to obtain access to sterilization. As a result, there are propositions that encouraged updating the family planning law to allow female sterilization after vaginal delivery (Potter, Perpétuo, Berquó, Hopkins, Leal, Formiga, and Souza 2003).

Female sterilization is more prevalent among women at older cohorts, with higher parity, with fewer years of education, with less educated spouses or companions, and among black and indigenous people (Amorim, Cavenaghi, and Alves 2008). Women with high levels of education get sterilized after they reach their ideal number of children as a result of planning for a specific number of offspring through the use of temporary contraceptives. Poorly educated women get sterilized without having used another contraceptive method, after reaching more than the ideal number of children while experiencing shorter birth intervals, demonstrating an increased incidence of regret for the total number of children ever born (Perpétuo and Wong 2009).

The study of female sterilization is important to the area of reproductive health in Brazil, because: (1) 25.9 percent of married or cohabiting women between 15 and 44 years of age were sterilized in 2006; (2) there are legal requirements related to the access of female sterilization; (3) it is an irreversible contraceptive method; (4) the availability of sterilization is associated with type and place of birth; (5) there is evidence of regret after sterilization; (6) there is an indication of a frustrated demand for sterilization; and (7) the public services for sexual and reproductive health are inadequate in the country. The objective of this study is to investigate the determinants of female sterilization in Brazil between 2001 and 2006. This analysis seeks to comprehend the effects of different birth intervals (postpartum duration) on the risk of a woman getting sterilized. Thus, we do not limit our study to a cross-sectional investigation. Estimates are controlled by a series of characteristics of women: age at delivery, parity at delivery, place of delivery, region of residence, color/race, years of schooling, frequency of involvement in religious activities, and religion at the time of interview.

2. Data and methods

Our regression models consider the time of sterilization with data on birth history, similar to models estimated by other studies (Leon and Potter 1989; Godecker, Thomson, and Bumpass 2001; Steele 2003; Leone and Hinde 2004). We consider the time of exposure to the risk of female sterilization, as well as the effects of postpartum duration (in months) in a longitudinal analysis.

We use data from the 2006 Brazilian National Survey on Demography and Health of Women and Children (PNDS). We analyze women between 15–49 years of age at the time of the interview, who had experienced live births beginning in January 2001. Our data come from questionnaires with information on households/individuals (n=56,365), women (n=15,575), history of pregnancies (n=6,833), and history of children born alive (n=27,477). By aggregating variables from different databases, the unit of analysis reports on pregnancies between January 2001 and May 2007, because the histories of pregnancies and children born alive were collected for this specific period.

Information on the contraceptive method that women were currently using includes traditional and modern methods (question 314). There is information on the month and year that the female sterilization took place (question 368). Information that identifies the month and year of a birth (question 256), as well as the duration of the pregnancy (question 259), enable the estimation of the moment of conception. The database about children born alive has information on pregnancy and childbirth (section 4), including place of delivery (question 430) and type of delivery (question 438). Information about the households/individuals, such as date of birth (question 7) and years of schooling (question 110) was also collected from the database. A sterilized woman with multiple pregnancies during the period is marked as sterile only following the last pregnancy. Based on the date of birth of each woman (question 7), date of sterilization (question 368) and date of delivery/childbirth (question 256), it is possible to estimate the age of each women at the time of sterilization, as well as their age at the time of each delivery. The number of children ever born (parity) at the time of each delivery is calculated based on the current parity (question 236) and the birth order (month and year of each delivery).

The date of interview, date of sterilization, and date of delivery/childbirth are transformed into time in months: 1 (January 2001) to 77 (May 2007). The time of conception is the time of delivery minus the duration of pregnancy. The time of the subsequent conception is also estimated. The initial time of exposure to the risk of sterilization equals the time of delivery/childbirth less one unit, in order to include sterilizations that occurred during the month of birth. The final time of exposure to the risk of sterilization equals the time of interview, the time of next conception (for non-sterilized women), or the time of sterilization.

The steps for statistical modeling are the following: (1) establish the sample design (strata and conglomerate) and the expansion factor of women (weight) with the “svyset” command in Stata. The strata are the combination of the five major regions (North, Northeast, Southeast, Central-West, and South) and household situation (urban and rural). The primary sampling unit (PSU) is formed by the census tracts (conglomerate); (2) indicate that this study is based on a survival analysis, with starting and ending times of exposure to the risk of sterilization, as well as note the sterilization event, with the “stset” command. This initial database utilizes pregnancies as the unit of analysis (n=5,889); (3) organize the database with postpartum duration (in months) as the unit of analysis by disaggregating pregnancies into the different times that a woman was at the risk of getting sterilized. Every pregnancy was disaggregated into units of analysis that indicate the exposure of women to a specific postpartum duration. This procedure allows us to check the effects of the time of the exposure of women after delivery/childbirth (postpartum duration) to the event of sterilization. The time of delivery/childbirth (in months) is used to determine the postpartum duration that a woman was exposed to the risk of sterilization: 0–2, 3–12, 13+. The computer software compares the initial time of exposure to the risk of sterilization (postpartum period) with the final time of exposure (already calculated) to define how many times each pregnancy will be disaggregated in the database. The “stsplit” command disaggregates the unit of analysis (pregnancy) into the different times that a woman entered the next postpartum period and was exposed to the risk of sterilization. The initial time of exposure is recalculated, considering the final time of the preceding postpartum period for each woman; (4) indicate, once again, that this study is based on a survival analysis, but now with the ending time of the postpartum period ("stset" command); and (5) estimate survival models (Blossfeld and Rohwer 2002; Blossfeld, Golsch, and Rohwer 2007), in order to understand the effect of postpartum periods and other independent variables on the risk of female sterilization, with the "streg" command. The models are estimated using the exponential distribution.

There are a total of 4,579 women with live births between January 2001 and May 2007. The initial database had a total of 5,889 pregnancies that resulted in live births with valid information for all variables of interest. As explained above, the database was disaggregated into postpartum duration (n=14,549). We kept only one observation for cases of multiple births. Women who did not remember their own date of birth, date of sterilization, or date of delivery/childbirth were also excluded from the analysis. Furthermore, we excluded women who gave birth in health centers, since none of them were sterilized. Women with deliveries at home were also removed from our analysis. Finally, women with one child ever born at the time of delivery were not included in our models, because of the small likelihood of their getting sterilized. Thus, the database with the unit of analysis by postpartum duration was reduced to 7,930 observations, related to 3,397 pregnancies (births), and 2,761 women (cases).

Information on female sterilization (question 314) is used as the dependent variable, considering the month and year of sterilization (question 368). The independent variables used to explain the risk of female sterilization are: (1) postpartum duration in months (0–2, 3–12, 13+); (2) woman's age in years at time of delivery (15–24, 25–29, 30–34, 35–49); (3) parity at delivery (2, 3, 4+), calculated with information about number of children ever born (question 236) and birth order; (4) place of delivery: public hospital (SUS), health insurance ("convênio"), or private hospital (question 430); (5) region of residence (question 4): North, Northeast, Southeast, Central-West, or South; (6) color/race of the woman: white, black, brown ("parda"), yellow ("amarela"), indigenous (question 111); (7) years of schooling: 0–3, 4–7, 8–10, 11+ (question 110); (8) frequency of participating in religious activities: never or don't know, less than once per month, one to three times per month, once per week, more than once per week; and (9) religion at the time of interview: Catholic, Mainline Protestant, Pentecostal Protestant, Spiritualist/Afro-Brazilian/other/don't know, and no religion. Information on region of residence, years of schooling, frequency of participating in religious activities, and religion might change over time. However, the database does not provide for this variation, but only addresses the situation at the time of the interview.

Previous models that evaluated the risk of female sterilization included information about marital status (married, cohabiting/in union, not in union) into the analysis, as these women tend to spend a great proportion of their lives outside of marriage or in less stable unions (Godecker, Thomson, and Bumpass 2001). Other studies also controlled their estimates by the number of unions experienced by women (Leone and Hinde 2004). Furthermore, differentials in the risk of sterilization could take into account the type of delivery (vaginal birth or cesarean section). However, information on marital status (question 501), number of marriages/unions (question 506), and type of delivery (question 438) are not included in our analysis, since they might introduce problems of endogeneity into the regression models. A total of 100 women reported male sterilization as their form of contraception (question 314). However, the date that the vasectomy occurred is not available in the database (question 368). Therefore, our models do not estimate the impact of vasectomy on the risk of female sterilization, despite the significance of male contraception (Oliveira 2003; Oliveira, Bilac, and Muszkat 2009).

3. Results

The pregnancies analyzed in this study refer to the period from January 2001 to May 2007. There were 3,397 pregnancies (births), related to 2,761 women (Table 1). These women were exposed to the risk of sterilization for a total of 88,198 months, resulting in 855 women being sterilized. As expected, the number of women (cases) distributed by postpartum duration diminishes over time, since they are not counted in the subsequent categories when they are no longer exposed to the risk of sterilization. Because of the range of categories used for the postpartum duration (0–2, 3–12, 13+), the number of months of exposure to the risk of sterilization is greater in the 3–12 and 13+ categories. Furthermore, the number of events of sterilization is most concentrated between zero and two months after the delivery (699 events).

>>> Table 1 <<<

In relation to a woman’s age at the time of delivery, younger women present the most number of cases, resulting in a greater number of months where they were exposured to the risk of sterilization. Women between 25–29 years of age were less exposed to these risks than women between 15–24 years of age. However, this 25–29 age group has the greatest number of events of sterilization (280). Women in the 30–34 age group also have a large number of events of sterilization (202), in comparison to their months of exposure to the risk of sterilization (13,245). Women with lower parity have a longer exposure time and more events of sterilization.

The majority of our sample is composed of women who gave birth at public hospitals (SUS), which totaled of 2,262 cases (Table 1). Because of this factor, their time of exposure to the risk of sterilization and the number of events that occurred are much greater than for women who gave birth at other facilities. However, women who delivered their babies at private hospitals present an increased incidence of sterilization (167 events) in relation to their time of exposure (3,832 months).

The distribution of women (cases) by region of residence is very similar throughout the varying areas (Table 1) as a result of the 2006 PNDS sample design. We can identify that women in the Central-West region were exposured to the risk of sterilization for the most months, while their number of events is the smallest among all regions. Women in the North present the most number of events of sterilization.

In terms of the color/race of women, the majority of the sample is composed of brown (1,402) and white (958) women, corresponding to the most number of months of exposure to the risk of sterilization, as well as to the highest number of sterilization events. Information on educational attainment indicates that most women have four to seven years of schooling (1,045), as well as the most number of months of exposure to the risks of sterilization, along with the most number of events. Table 1 also suggests that women with at least 11 years of schooling have the highest number of events of sterilization in relation to their months of exposure. Previous studies (Amorim, Cavenaghi, and Alves 2008; Perpétuo and Wong 2009) suggest that higher levels of female sterilization are associated with color/race (higher incidences among black and indigenous) and with lower levels of educational attainment. However, these analyses did not take into account the number of months women were exposed to the risk of sterilization by color/race and years of schooling. Our study is innovative as a result of the addition of exposure time into the estimates.

Information on frequency of participation in religious activities shows no specific trend when considering months of exposure and events of sterilization. Furthermore, religion at the time of interview indicates that most women in the sample are Catholics (1,777), who experienced the greatest number of months of exposure to the risk of sterilization and the largest number of events of sterilization. Women who claim no religion experience the smallest number of events of sterilization (56) in relation to their months of exposure (7,286).

Table 2 illustrates the exponential function of the coefficients from hazard models that estimate the risk of sterilization, based on the main effects of our independent variables. Model 1 shows that the risk of female sterilization is 91 percent lower [(0.095–1)*100] between three and 12 months following a birth, compared to the period between zero and two months postpartum, when controlling for age at time of delivery, parity at delivery, place of delivery, and region of residence. The risk of sterilization increases with age. For instance, women between 30–34 years of age are 2.9 times more likely to get sterilized than women between 15–24 years of age. Women with three children at the time of a birth, present the highest risk of being sterilized among all parity groups. In relation to place of delivery, women giving birth at public hospitals (SUS) are 79 percent less likely to get sterilized than women at private hospitals. Women giving birth with the support of health insurance ("convênio") are 63 percent less likely to get sterilized than women at private hospitals. The coefficients of region of residence suggest that women living in the North are 1.3 times more likely to get sterilized than those women in the Southeast. The lowest sterilization rates occur in the South, where women are 27 percent less likely to get sterilized than the reference category.

>>> Table 2 <<<

Model 2 in Table 2 adds information on color/race, years of schooling, frequency of participation in religious activities, and religion at the time of interview. The log likelihood of this model did not improve significantly, taking into account the change in the degrees of freedom. Thus, the likelihood ratio chi-squared test does not show a significant improvement in Model 2, compared to Model 1. As a result, the effects of the original independent variables did not change considerably from Model 1 to Model 2. The only effect that lost statistical significance was the one for women with four children or more at the time of delivery, compared to women with two children. In terms of the new variables, the only significant effect was observed for the color/race variable: brown women are 19 percent more likely to get sterilized compared to white women, controlling for the other independent variables.

In order to control for several interactions among our independent variables, two other models were estimated (Table 3). The interactions between age and parity in Model 1 indicate that, among women with two children at the time of delivery, those between 30–34 years of age have the highest risk of getting sterilized, compared to women between 35–49 years of age with three children at the time of delivery. The women with lower risks of sterilization, compared to the reference category, are those between 15–24 years of age with three children at the time of delivery, between 25–29 years of age with three children at the time of delivery, and between 15–24 years of age with four children or more. The coefficients for the other age and parity groups are not statistically significant.

>>> Table 3 <<<

Model 1 in Table 3 also shows higher risks of sterilization for women giving birth with the support of health insurance (“convênio”) or at private hospitals, between zero and two months after the birth, compared to women in public hospitals (SUS) within the same postpartum duration. More specifically, women within 0–2 months postpartum are 22 times more likely to get sterilized if they utilize support from health insurance during their delivery, and 47 times more likely if they are in private hospitals, compared to the reference category.

Another set of variables evaluates the interaction between place and parity at the time of delivery. At public hospitals, women are more likely to get sterilized if they have three children (8.3 times more likely) or four children or more (4.9 times more likely), compared to women with two children at the time of delivery. Women giving birth at private hospitals with two children at the time of delivery are 90 percent less likely to get sterilized, than the reference category.

The last variables of Model 1 in Table 3 refer to the interactions between region of residence and postpartum duration. Women who are residents in the South are less likely to get sterilized than women in the Southeast, within zero to two months after birth (reference category). Women are even less likely to get sterilized in the South, as the categories of postpartum duration increase. The other significant effect is verified for women in the Southeast in the 13+ months postpartum group, which indicates an 80 percent lower chance of getting sterilized than the reference category.

Table 3 also illustrates Model 2, which includes information on color/race, years of schooling, frequency of participation in religious activities, and religion at the time of interview. As observed in Table 2, the log likelihood of the second model did not improve significantly, taking into account the change in the degrees of freedom. Thus the likelihood ratio chi-squared test does not show a significant improvement in Model 2, compared to Model 1. Among the new variables, only brown women reflect a significant effect. As observed in Model 2 of Table 2, these women are 19 percent more likely to get sterilized, compared to white women. Among the old variables, the only effect that lost statistical significance from Model 1 to Model 2 was the one for women living in the South within 3–12 months postpartum, compared to women in the Southeast within 0–2 months postpartum.

Some coefficients increased in magnitude from Model 1 to Model 2 (Table 3). Within 0–2 months postpartum, women giving birth with the support of health insurance became 42 times more likely to get sterilized, compared to women in public hospitals within 0–2 months postpartum. Moreover, women in private hospitals within 0–2 months postpartum are 51 times more likely to get sterilized, compared to the reference category. Finally, women giving birth at public hospitals, with four children or more at the time of delivery, are 8.7 times more likely to get sterilized than women at public hospitals with two children at delivery.

Figure 1 shows the predicted log hazard of sterilization from Model 1 in Table 3 by postpartum duration and place of delivery. Some age and parity groups were selected for this illustration in the Southeast region. The greater changes in female sterilization rates are estimated for women between zero and two months after childbirth, across all age-parity groups and places of birth. For women between zero and two months after a birth, those giving birth at private hospitals are more likely to get sterilized, compared to women giving birth in other places. The chances of getting sterilized at public hospitals are lowest in the 0–2 months postpartum, and the highest occur in the other postpartum duration groups, compared to women who give birth at other facilities. Older women also tend to have higher risks that they will get sterilized, as well as those with higher parity at the time of delivery.

>>> **Figure 1** <<<

4. Final considerations

We verified that there is a higher risk that women will get sterilized between zero and two months after childbirth, despite the regulations of the family planning law (Law #9,263). One could argue that women are being forced to get sterilized. However, models indicate that sterilization is greater among older women, those with higher parity, as well as in areas of elevated fertility rates (North region). Women who gave birth with support of health insurance at private hospitals, between zero and two months following a birth, are observed as being the group with the greatest chance of getting sterilized. This is an indication that these women may not have been able to get sterilized at public hospitals. This frustrated demand for sterilization might be forcing women to search for this irreversible contraceptive method at private institutions. Our findings also suggest that color/race, years of schooling, frequency of participation in religious activities, and religion at the time of interview are not good predictors of the risk of female sterilization, when models take into account the months of exposure to the risk of sterilization.

The government needs to implement family planning programs with appropriate health care, guidance, and access to sexual and reproductive health services for women. Providing alternative contraceptive options to women is necessary, as are appropriate medical follow-ups, which could assist in preventing individual patients from being burdened with financial and emotional trama.

5. References

Alves, J. E. D. 2004. Questões demográficas: fecundidade e gênero. *Textos para Discussão da Escola Nacional de Ciências Estatísticas (ENCE)*, Instituto Brasileiro de Geografia Estatística (IBGE), 9.

Amorim, F. A., Cavenaghi, S. M., Alves, J. E. D. 2008. Mudanças recentes no uso de métodos contraceptivos no Brasil e na Colômbia: com especial menção à esterilização masculina e feminina. In: Wong, L. R. (Org.). *Población y Salud Sexual y Reproductiva en América Latina*. Rio de Janeiro: Asociación Lationamericana de Población (ALAP). Vol. 4. pp. 101-130.

Berquó, E. 1993. Brasil, um caso exemplar a espera de uma açao exemplar: Anticoncepção e partos cirúrgicos. *Estudos Feministas*, 1(2): 366-381.

Berquó, E. 1999. Ainda a questão da esterilização feminina no Brasil. In: Giffin, K., Costa, S. H. (Org.). *Questões da Saúde Reprodutiva*. Rio de Janeiro: Editora Fiocruz. pp. 113-126.

Berquó, E., Cavenaghi, S. 2003. Direitos reprodutivos de mulheres e homens face à nova legislação brasileira sobre esterilização voluntária. *Cadernos de Saúde Pública*, 19(Sup. 2): S441-S453.

Berquó, E., Garcia, S., Lago, T. (Org.). 2008. *PNDS 2006, Pesquisa Nacional de Demografia e Saúde da Criança e da Mulher: Relatório*. Brasília: Ministério da Saúde.

Bilac, E. D., Rocha, M. I. B. (Org.). 1998. *Saúde Reprodutiva na América Latina e no Caribe: Temas e Problemas*. Campinas: Programa Latinoamericano de Actividades en Población (PROLAP), Associação Brasileira de Estudos de População (ABEP) e Núcleo de Estudos de População (NEPO) da Universidade Estadual de Campinas (UNICAMP).

Blossfeld, H. P., Golsch, K., Rohwer, G. 2007. Techniques of Event History Modeling using Stata: New Approaches to Causal Analysis. Mahwah: Lawrence Erlbaum Associates, Inc., Publishers.

Blossfeld, H. P., Rohwer, G. 2002. Techniques of Event History Modeling: New Approaches to Causal Analysis. Second Edition. Mahwah: Lawrence Erlbaum Associates, Inc., Publishers.

Bongaarts, J. 2002. The end of the fertility transition in the developed world. *Population and Development Review*, 28(3): 419-443.

Bongaarts, J. 2008. Fertility transitions in developing dountries: progress or stagnation? *Population Council Working Paper*, 7: 1-19.

Bongaarts, J., Sobotka, T. 2012. A demographic explanation for the recent rise in European fertility. *Population and Development Review*, 38(1): 83-120.

Caetano, A. J., Potter, J. E. 2004. Politics and female sterilization in Northeast Brazil. *Population and Development Review*, 30(1): 79-108.

Cavenaghi, S., Alves, J. E. D. 2009. Fertility and contraception in Latin America: historical trends, recent patterns. In: Cavenaghi, S. (Org.). *Demographic Transformations and Inequalities in Latin America: Historical Trends and Recent Patterns*. Rio de Janeiro: Latin American Population Association (ALAP).

Curtis, K. M., Mohllajee, A. P., Peterson, H. B. 2006. Regret following female sterilization at a young age: a systematic review. *Contraception*, 73: 205-210.

Demeny, P. 2011 Population policy and the demographic transition: performance, prospects, and options. *Population and Development Review,* 37(supplement): 249-274

Demeny, P., McNicoll, G. 2006. The political demography of the world system, 2000-2050. *Population Council Policy Research Division Working Paper*, 213.

Fonseca Sobrinho, D. 1993. *Estado e População: uma História do Planejamento Familiar no Brasil*. Rio de Janeiro: Editora Rosa dos Tempos e Fundo de População das Nações Unidas (FNUAP).

Giffin, K., Costa, S. H. (Org.). 1999. *Questões da Saúde Reprodutiva*. Rio de Janeiro: Editora Fiocruz.

Godecker, A. L., Thomson, E., Bumpass, L. L. 2001. Union status, marital history and female contraceptive sterilization in the United States. *Family Planning Perspectives*, 33(1): 25-41+49.

Hopkins, K. 2009. Getting sterilized in Brazil: stories of success and failure. In: Miranda-Ribeiro, P., Simão, A. B. (Org.). *Qualificando os Números: Estudos sobre Saúde Sexual e Reprodutiva no Brasil*. Belo Horizonte: Associação Brasileira de Estudos Populacionais (ABEP) e Fundo de População das Nações Unidas (UNFPA). pp. 167-183.

IBGE. 2012. *Censo Demográfico 2010: Resultados Gerais da Amostra*. Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística (IBGE).

Janowitz, B., Higgins, J. E., Rodrigues, W., Arruda, J. M., Smith, J. B., Morris, L. 1985. Sterilization in the Northeast of Brazil. *Social Science and Medicine*, 20(3): 215-221.

Lacerda, M. A., Miranda-Ribeiro, P., Caetano, A. J., Machado, C. J. 2005. Mensuração e perfis de demanda insatisfeita por contracepção nos municípios de Belo Horizonte e Recife, 2002. *Revista Brasileira de Estudos de População*, 22(1): 113-129.

Leon, J. G., Potter, J. E. 1989. Modelling the inverse association between breastfeeding and contraceptive use. *Population Studies*, 43(1): 69-93.

Leone, T., Hinde, A. 2005. Sterilization and union instability in Brazil. *Journal of Biosocial Science*, 37(4): 459-469.

Lesthaeghe, R. 2010. The unfolding story of the second demographic transition. *Population and Development Review*, 36(2): 211-251.

Lesthaeghe, R., Neidert, L. 2006. The second demographic transition in the United Sates: exception or textbook example? *Population and Development Review*, 32(4): 669-698.

Miranda-Ribeiro, P., Simão, A. B. (Org.). 2009. *Qualificando os Números: Estudos sobre Saúde Sexual e Reprodutiva no Brasil*. Belo Horizonte: Associação Brasileira de Estudos Populacionais (ABEP) e Fundo de População das Nações Unidas (UNFPA).

Molina, A. 1999. Laqueadura tubária: situação nacional, internacional e efeitos colaterais. In: Giffin, K., Costa, S. H. (Org.). *Questões da Saúde Reprodutiva*. Rio de Janeiro: Editora Fiocruz. pp. 127-145.

Morgan, S.P. 2003. Is low fertility a twenty-first century demographic crisis? *Demography*, 40(4): 589-603.

Oliveira, M. C. 2003. Homens e contracepção: análise estatística de dados qualitativos. *Revista Brasileira de Estudos de População*, 20(1): 63-77.

Oliveira, M. C., Bilac, E. D., Muszkat, M. 2009. Homens e anticoncepção: um estudo sobre duas gerações masculinas das “camadas médias” paulistanas. In: Miranda-Ribeiro, P., Simão, A. B. (Org.). *Qualificando os Números: Estudos sobre Saúde Sexual e Reprodutiva no Brasil*. Belo Horizonte: Associação Brasileira de Estudos Populacionais (ABEP) e Fundo de População das Nações Unidas (UNFPA). pp. 275-311.

Perpétuo, I. H. O. 1998. Contracepção e declínio da fecundidade na Região Nordeste. *Revista Brasileira de Estudos de População*, 15(1): 43-56.

Perpétuo, I. H. O., Wajnman, S. 1993. A esterilização feminina no Brasil: diferenciais por escolaridade e renda. *Revista Brasileira de Estudos de População*, 10(1/2): 25-39.

Perpétuo, I. H. O., Wong, L. L. R. 2009. Desigualdade socioeconômica na utilização de métodos anticoncepcionais no Brasil: uma análise comparativa com base nas PNDS 1996 e 2006. In: Brasil, Ministério da Saúde (Org.). *Pesquisa Nacional de Demografia e Saúde da Criança e da Mulher - PNDS 2006: Dimensões do Processo Reprodutivo e da Saúde da Criança*. Brasília: Ministério da Saúde e Centro Brasileiro de Análise e Planejamento (CEBRAP). pp. 87-104.

Perpétuo, I. H. O.; Wajnman, S. 2003. Socioeconomic correlates of female sterilization in Brazil. In: Cosio-Zavala, M. E. (Org.). *Poverty, Fertility and Family Planning*. Paris: CICRED. pp. 311-333.

Potter, J. E. 1999. The persistence of outmoded contraceptive regimes: the cases of Mexico and Brazil. *Population and Development Review*, 25(4): 703-739.

Potter, J. E., Perpétuo, I. H. O., Berquó, E., Hopkins, K., Leal, O. F., Formiga, M. C. C., Souza, M. R. 2003. Frustrated demand for postpartum female sterilization in Brazil. *Contraception*, 67: 385-390.

Potter, J. E., Schmertmann, C. P., Assunção, R. M., Cavenaghi, S. M. 2010. Mapping the timing, pace, and scale of the fertility transition in Brazil. *Population and Development Review*, 36(2): 283-307.

Potter, J. E., Schmertmann, C. P., Cavenaghi, S. M. 2002. Fertility and development: evidence from Brazil. *Demography*, 39(4): 739-761.

Presidência da República do Brasil. 1996. *Lei nº 9.263, de 12 de janeiro de 1996*. Brasília: Presidência da República, Casa Civil, Subchefia para Assuntos Jurídicos.

Rindfuss, R. R., Guzzo, K., Morgan, S. P. 2000. The changing institutional context of low fertility. *Population Research and Policy Review*, 22(5/6): 411-438.

Steele, F. 2003. A discrete-time multilevel mixture model for event history data with long-term survivors, with an application to an analysis of contraceptive sterilization in Bangladesh. *Lifetime Data Analysis*, 9: 155-174.

Van de Kaa, D. J. 1987. Europe’s second demographic transition. *Population Bulletin*, Washington, 42(2) 1-59.

Van de Kaa, D. J. 2004. Is the second demographic transition a useful research concept: questions and answers. *Viena Yearbook of Population Research*, 2004: 4-10.

Vieira, E. M. 1998. O arrependimento após a esterilização feminina. *Cadernos de Saúde Pública*, 14(Supl. 1): 59-68.

Vieira, E. M. 2007. O arrependimento após a esterilização cirúrgica e o uso das tecnologias reprodutivas. *Revista Brasileira de Ginecologia e Obstetrícia*, 29(5): 225-229.

Vieira, E. M., Ford, N. J. 1996a. Regret after female sterilization among low-income women in São Paulo, Brazil. *International Family Planning Perspectives*, 22(1): 32-40.

Vieira, E. M., Ford, N. J. 1996b. The provision of female sterilization in São Paulo, Brazil: a study among low income women. *Social Science Medicine*, 42(10): 1427-1432.

Table 1. Distribution of pregnancies (births), women (cases), months of exposure, and events of sterilization by variables of interest, Brazil, 2001–2006.

Variables	Pregnancies (births)	Women (cases)	Exposures (months)	Events (sterilization)
Sample size (n)	**3,397**	**2,761**	**88,198**	**855**
Postpartum duration (months)				
0–2	——	2,761	18,370	699
3–12	——	2,171	25,177	87
13+	——	1,760	44,651	69
Age at delivery (years)				
15–24	1,419	1,147	40,301	230
25–29	974	889	24,991	280
30–34	586	541	13,245	202
35–49	418	387	9,661	143
Parity at delivery				
2 children	1,681	1,681	46,556	327
3 children	889	889	21,863	288
4 children or more	827	649	19,779	240
Place of delivery				
Public hospital (SUS)	2,844	2,262	77,196	593
Health insurance (“convênio”)	287	263	7,170	95
Private hospital	266	258	3,832	167
Region of residence				
North	735	560	16,818	216
Northeast	639	505	16,402	158
Southeast	646	548	17,833	154
Central-West	676	576	20,243	123
South	701	572	16,902	204
Color/Race				
White	1,129	958	31,377	266
Black	340	264	8,873	76
Brown	1,754	1,402	43,093	473
Yellow	91	76	2,754	23
Indigenous	83	61	2,101	17
Years of schooling				
0–3	692	503	17,325	168
4–7	1,319	1,045	35,440	301
8–10	699	582	18,668	173
11+	687	631	16,765	213
Frequency to religion activities				
Never or don’t know	596	464	15,583	118
Less than once per month	773	660	20,409	199
One to three times per month	649	518	17,246	152
Once per week	772	627	19,603	209
More than once per week	607	492	15,357	177
Religion at the time of interview				
Catholics	2,185	1,777	56,537	545
Mainline protestants	416	337	10,740	107
Pentecostal protestants	408	332	10,642	111
Spiritualist, Afro-Brazilian, other or don’t know	113	98	2,993	36
No religion	275	217	7,286	56

Source: 2006 Brazilian National Survey on Demography and Health of Women and Children (PNDS).

Table 2. Exponential of coefficients from hazard models to estimate the risk of sterilization (main effects models), Brazil, 2001–2006.

Variables	Model 1	Model 2
Postpartum duration (months)		
0–2	ref.	ref.
3–12	0.095***	0.095***
	(0.011)	(0.011)
13+	0.042***	0.042***
	(0.005)	(0.005)
Age at delivery (years)		
15–24	ref.	ref.
25–29	2.037***	2.029***
	(0.186)	(0.191)
30–34	2.863***	2.847***
	(0.293)	(0.301)
35–49	3.262***	3.288***
	(0.371)	(0.389)
Parity at delivery		
2 children	ref.	ref.
3 children	1.695***	1.677***
	(0.140)	(0.141)
4 children or more	1.210**	1.189
	(0.117)	(0.126)
Place of delivery		
Public hospital (SUS)	0.210***	0.195***
	(0.020)	(0.020)
Health insurance (“convênio”)	0.370***	0.361***
	(0.049)	(0.048)
Private hospital	ref.	ref.
Region of residence		
North	1.289**	1.235*
	(0.140)	(0.139)
Northeast	1.131	1.126
	(0.130)	(0.132)
Southeast	ref.	ref.
South	0.729***	0.765**
	(0.089)	(0.095)
Central-West	1.155	1.145
	(0.127)	(0.127)
Color/Race		
White		ref.
Black		1.186
		(0.160)
Brown		1.190**
		(0.099)
Yellow		1.065
		(0.234)
Indigenous		0.795
		(0.203)

Years of schooling		
0–3		0.972
		(0.097)
4–7		ref.
8–10		1.063
		(0.104)
11+		0.886
		(0.094)
Frequency to religion activities		
Never or don't know		0.818
		(0.101)
Less than once per month		ref.
One to three times per month		0.887
		(0.097)
Once per week		1.020
		(0.104)
More than once per week		1.087
		(0.126)
Religion at the time of interview		
Catholics		ref.
Mainline protestants		1.024
		(0.116)
Pentecostal protestants		0.948
		(0.109)
Spiritualist, Afro-Brazilian, other or don't know		1.150
		(0.205)
No religion		0.913
		(0.140)
Model statistics		
Log likelihood	–2,575.73	–2,566.25
Degrees of freedom	13	28
Likelihood Ratio Chi-Square[1]	1,974.63***	18.95
Number of observations	7,930	7,930

[1] The likelihood ratio chi-square equals the previous model fit [–2 Log L(previous model)] minus the current model fit [–2 Log L(fitted model)]. For the first model, it is the difference of this model's fit to the null model's fit. The negative two times the log-likelihood (–2 Log L) is used in hypothesis tests for nested models and the value in itself is not meaningful. This ratio significance is tested in a chi-square distribution, taking into account the difference between the degrees of freedom (that is, the number of explanatory variables in the current model minus the number of explanatory variables in the previous model). If the chi-square test is significant, it is accessing that the model cannot be reduced any further at a specific significance level.

Note: Standard errors in parentheses. ***Significant at p<0.01; ** Significant at p<0.05; * Significant at p<0.1.

Source: 2006 Brazilian National Survey on Demography and Health of Women and Children (PNDS).

Table 3. Exponential of coefficients from hazard models to estimate the risk of sterilization (interaction models), Brazil, 2001–2006.

Variables	Model 1	Model 2
Age at delivery * Parity at delivery		
Age 15–24, 2 children	ref.	ref.
Age 25–29, 2 children	3.102***	3.119***
	(0.453)	(0.462)
Age 30–34, 2 children	5.551***	5.578***
	(0.882)	(0.904)
Age 35–49, 2 children	4.766***	4.776***
	(0.932)	(0.952)
Age 15–24, 3 children	0.297***	0.298***
	(0.057)	(0.058)
Age 25–29, 3 children	0.501***	0.501***
	(0.095)	(0.096)
Age 30–34, 3 children	0.761	0.769
	(0.157)	(0.159)
Age 35–49, 3 children	dropped	dropped
Age 15–24, 4 children or more	0.528**	0.296
	(0.169)	(0.319)
Age 25–29, 4 children or more	0.668	0.363
	(0.218)	(0.389)
Age 30–34, 4 children or more	0.622	0.339
	(0.189)	(0.364)
Age 35–49, 4 children or more	0.902	0.507
	(0.298)	(0.543)
Place of delivery * Postpartum duration		
Public hospital (SUS), 0–2 months	ref.	ref.
Public hospital (SUS), 3–12 months	0.437	0.398
	(0.450)	(0.411)
Public hospital (SUS), 13+ months	0.159**	0.147**
	(0.120)	(0.111)
Health insurance (“convênio”), 0–2 months	21.970***	41.690***
	(9.724)	(43.190)
Health insurance (“convênio”), 3–12 months	1.825	3.148
	(2.218)	(4.823)
Health insurance (“convênio”), 13+ months	0.574	
	(0.616)	
Private hospital, 0–2 months	46.890***	51.390***
	(11.120)	(12.550)
Private hospital, 3–12 months	dropped	dropped
Private hospital, 13+ months	dropped	dropped
Place of delivery * Parity at delivery		
Public hospital (SUS), 2 children	ref.	ref.
Public hospital (SUS), 3 children	8.284***	8.192***
	(1.645)	(1.648)
Public hospital (SUS), 4 children or more	4.863***	8.676**
	(1.595)	(9.333)
Health insurance (“convênio”), 2 children	0.090***	0.052***
	(0.042)	(0.054)

Health insurance ("convênio"), 3 children	0.648	0.352
	(0.282)	(0.361)
Health insurance ("convênio"), 4 children or more	dropped	dropped
Private hospital, 2 children	0.101***	0.101***
	(0.026)	(0.026)
Private hospital, 3 children	dropped	
Private hospital, 4 children or more	dropped	1.616
		(1.737)
Region of residence * Postpartum duration		
North, 0–2 months	1.207	1.150
	(0.142)	(0.140)
North, 3–12 months	0.330	0.342
	(0.347)	(0.360)
North, 13+ months	0.502	0.515
	(0.397)	(0.410)
Northeast, 0–2 months	0.941	0.929
	(0.123)	(0.123)
Northeast, 3–12 months	0.373	0.403
	(0.393)	(0.426)
Northeast, 13+ months	0.719	0.770
	(0.555)	(0.596)
Southeast, 0–2 months	ref.	ref.
Southeast, 3–12 months	0.231	0.251
	(0.245)	(0.266)
Southeast, 13+ months	0.201**	0.213*
	(0.163)	(0.174)
South, 0–2 months	0.723**	0.749**
	(0.0963)	(0.102)
South, 3–12 months	0.164*	0.189
	(0.173)	(0.201)
South, 13+ months	0.139**	0.158**
	(0.113)	(0.129)
Central-West, 0–2 months	1.026	1.015
	(0.125)	(0.125)
Central-West, 3–12 months	0.389	0.424
	(0.405)	(0.442)
Central-West, 13+ months	0.346	0.371
	(0.269)	(0.288)
Color/Race		
White		ref.
Black		1.172
		(0.159)
Brown		1.194**
		(0.100)
Yellow		1.062
		(0.234)
Indigenous		0.825
		(0.212)
Years of schooling		
0–3		0.999
		(0.100)
4–7		ref.

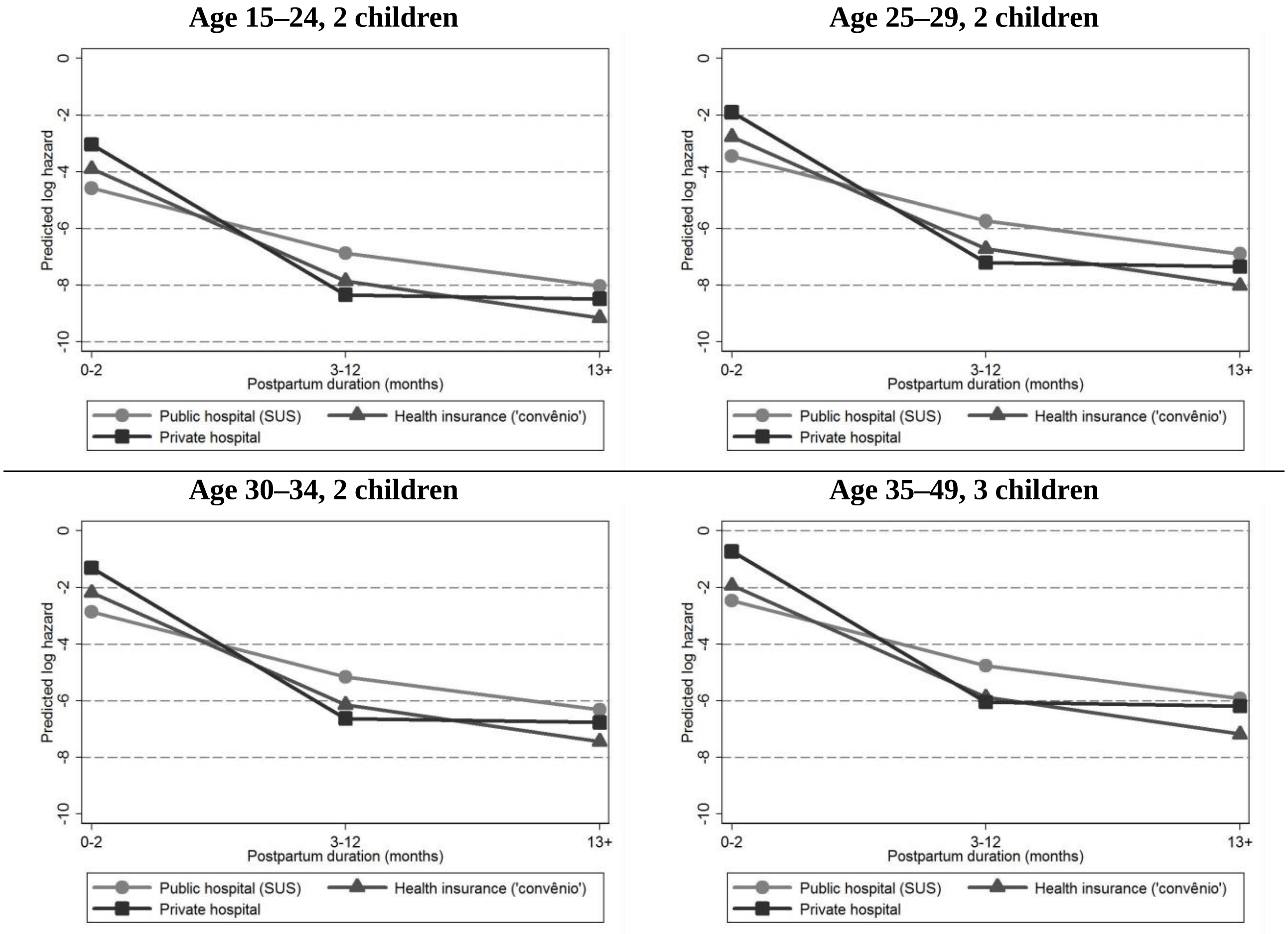
8–10		1.061
		(0.105)
11+		0.865
		(0.093)
Frequency to religion activities		
Never or don't know		0.867
		(0.108)
Less than once per month		ref.
One to three times per month		0.923
		(0.102)
Once per week		1.031
		(0.106)
More than once per week		1.123
		(0.130)
Religion at the time of interview		
Catholics		ref.
Mainline protestants		1.004
		(0.114)
Pentecostal protestants		0.960
		(0.111)
Spiritualist, Afro-Brazilian, other or don't know		1.168
		(0.209)
No religion		0.873
		(0.135)
Model statistics		
Log likelihood	–2,508.35	–2,499.31
Degrees of freedom	35	50
Likelihood Ratio Chi-Square[1]	2,109.38***	18.08
Number of observations	7,930	7,930

[1] The likelihood ratio chi-square equals the previous model fit [–2 Log L(previous model)] minus the current model fit [–2 Log L(fitted model)]. For the first model, it is the difference of this model's fit to the null model's fit. The negative two times the log-likelihood (–2 Log L) is used in hypothesis tests for nested models and the value in itself is not meaningful. This ratio significance is tested in a chi-square distribution, taking into account the difference between the degrees of freedom (that is, the number of explanatory variables in the current model minus the number of explanatory variables in the previous model). If the chi-square test is significant, it is accessing that the model cannot be reduced any further at a specific significance level.

Note: Standard errors in parentheses. ***Significant at $p<0.01$; ** Significant at $p<0.05$; * Significant at $p<0.1$.

Source: 2006 Brazilian National Survey on Demography and Health of Women and Children (PNDS).

Figure 1. Predicted log hazard of sterilization from model 1 in Table 3 by postpartum duration and place of delivery for selected age and parity groups, Brazilian Southeast, 2001−2006.



Source: 2006 Brazilian National Survey on Demography and Health of Women and Children (PNDS).