

Determinants of tubal ligation in Puebla, Mexico

Abstract:

Tubal ligation provides an effective and reliable method by which women can choose to limit the number of children they will bear. However, because of the irreversibility of the procedure and other potential disadvantages, it is important to understand factors associated with women's choice of this method of birth control. Between May 1999 and August 2000, we collected data from 755 women aged 40 to 60 years from a cross-section of neighborhoods of varying socio-economic make-up in Puebla, Mexico, finding a tubal ligation rate of 42.2%. We used multiple logistic regression models to examine demographic, socio-economic and reproductive history characteristics in relation to women's choice of tubal ligation. We repeated regression analyses with participants grouped by age to determine how the timing of availability of tubal ligation related to the decision to undergo the procedure. Our results suggested that younger age, more education, use of some forms of birth control, and increased parity were associated with women's decisions to undergo tubal ligation. The statistically significant difference of greater tubal ligation and lower hysterectomy rates across age groups reflected increased access to tubal ligation in Mexico from the early 1970s, supporting the idea that women's choice of tubal ligation was related to access.

Introduction:

Female sterilization is the most frequently used contraceptive method in the world (Beerthuizen, 2010; Population Reference Bureau, 2008). The closure of the fallopian tubes, tubal ligation (TL), is the main form of female sterilization and is close to 100% effective (Beerthuizen, 2010). TL can involve the destruction of part of the fallopian tubes through chemical scarring, cautery, cutting and removal or, alternately, blockage of the tubes using ligatures, clips or bands (Beerthuizen, 2010; Informed Consent Working Group, 2003).

TL is an effective and reliable method by which women can choose to limit the number of children they will bear (Leite et al., 2004). Post-partum TL by removal of a portion of the fallopian tubes is the most effective method, with a 10-year failure rate of 7.5/1000 procedures, while other methods of TL, mostly used beyond the post-partum period, have somewhat higher failure rates (between 7.5 and 36.5/1000 procedures depending on the method used; Peterson et al., 1996). TL procedures generally involve only one clinical visit, and following the procedure women no longer need to use hormonal or barrier methods for birth control (Peterson et al., 1996).

The prevalence of TL is remarkably high in some countries and contexts; it is the leading modern contraceptive method in South America (34%), Central America (29%), and the Caribbean (22%) for women between 15 and 49 years of age (Population Reference Bureau, 2008). In Brazil, the rate of sterilization is just over 40% among women aged 15-49 years (Population Reference Bureau, 2008; Vieira and Ford, 2004). In the United States 21.7% of women are sterilized (Population Reference Bureau, 2008),

though distinctive demographic patterns of sterilization use are evident. Only 16% of college-educated white women rely on sterilization compared to 50% of white women with less than 12 years of education and 32% of African American college-educated women (Piccinino and Mosher, 1998). In Mexico, the proportion of fertile women using birth control methods rose from 30% in 1976 to almost 71% in 2000 (Tuiran et al., 2002). The percent of fertile women using TL rose from 8.9% in 1976 to 23.5% in 1979 to 36.2% in 1987 to 44.7% in 1997 and 44.0% in 2000 (CONAPO, 2004). The rate of TL was more than twice that of use of the intra-uterine device (IUD), the next most frequently used contraceptive method, used by 21.6% of women in 2000 (CONAPO, 2004).

Clearly, TL is a very popular contraceptive choice, but it also has disadvantages. The most important of these is that the permanency of TL means that women whose desires regarding family size change following the procedure may come to regret their choice (Warren et al., 1988). One study from the United States found that about 6% of women desired a reversal after 5 years (Westhoff and Davis, 2000). In the US and Brazil, women who were younger at the time of the TL and those who were less well-informed about other contraceptive methods were more likely to request a reversal of the TL at a later date (Westhoff and Davis, 2000; Ludermit et al., 2009). Another disadvantage is the potential disruption of blood flow and nerve supply to the ovary, which may bring about a lowered estrogen production by the ovaries (Cattanach, 1985) and may be associated with estrogen-deficiency symptoms.

Because of the irreversibility of the procedure and the potential for regret, especially among younger users, it is important to understand factors related to choice of

TL. This is particularly so in a context in which TL use has dramatically increased over the last three decades.

This study was based on data regarding TL drawn from an investigation of menopause that targeted women aged 40 to 60 years in the city of Puebla, capital of the Mexican state of Puebla (Sievert and Espinosa-Hernandez, 2003; Sievert and Hautaniemi, 2003). The collection of data about TL, and the finding that 42.2% of the women interviewed had undergone a TL, created an ideal opportunity to identify demographic and reproductive variables associated with TL in Puebla, Mexico.

The years during which women in this sample would have been making decisions about family size spanned Mexico's years of demographic transition. In Mexico, this transitional period was characterized by intense population growth between 1930 and 1970, and a deceleration of population growth from 1970 to the present (Tuiran et al., 2002). The use of more effective birth control methods, as well as the wide-spread distribution of such methods by the government, were the primary determinants of the country-wide drop in fertility from 5 children per woman in 1978 to 4 in 1985, 3 in 1993, and an estimated 2.4 in 2002 (Tuiran et al., 2002). Tubal ligation became widely available in the early 1970s. Nearly 12% of the women in this study were aged 15 years when TL became widely available; over 40% reached the mean age at first birth (21 years) after TL was already a practical method of stopping fertility, and none of the women were aged 45 years before TL was a possibility.

Methods:**Sample Selection**

The University of Massachusetts Amherst Institutional Review Board gave ethical approval for the study protocol. From May 1999 through August 2000, we recruited a convenience sample of 755 women from public parks, on the streets outside of their homes, in open markets, at bus stops, in small shops, and in front of large public buildings, such as the Social Security hospital in Puebla, Mexico. We canvassed the city neighborhood by neighborhood to provide a sample that included women from all social classes (Sievert & Hautaniemi, 2003; Sievert, 2006). We targeted women between 40 and 60 years and approached them to request their participation in the study, though we did not exclude women who were older or younger than this age range. We had no additional exclusion criteria. Because we were interested in knowing the rate of hysterectomy and hormone use among the participants, we did not exclude women for history of hysterectomy or use of hormones or other medications. In total we approached approximately 1500 women. Roughly 50% of the women who we approached agreed to participate in the study. Ultimately, 93% of the sample fell within the preferred age range (40 to 60 years), with a mean age of 50.1 years (s.d. 6.3). Some interviews took place on the spot, others at a later appointment. From the larger cross-sectional sample, a subgroup of women also participated in four hours of clinical measurement of hot flashes and open-ended discussion, in addition to answering the questionnaire described below (Sievert et al., 2002). The semi-structured questionnaire asked for age at tubal ligation, and women volunteered additional information about why they had chosen to undergo tubal ligation, with all answers recorded on the questionnaire form. Criteria for inclusion in the

subgroup were not having menstruated for 12 months and not having taken any form of hormone therapy in the prior 12 months.

Of the 755 women recruited, 337 met these criteria. All 337 women who met the criteria were invited to participate in the hot flash measurement and in-depth discussion component. The 67 women who ultimately participated were those who met the inclusion criteria and who were available during the afternoon hours on the specific days when the authors had access to the laboratory for hot flash measurement, during the period that one of the authors (Sievert) was in Puebla. No one was turned away if she met the criteria, except because of lack of availability during the scheduled laboratory hours. Content analyses of open-ended responses were carried out for questions related to tubal ligation. All study participants gave signed, written informed consent prior to administration of the questionnaire by the interviewer.

Measures Used

The questionnaire, developed and piloted with a group of 15 women aged 40-60 years in Puebla, was constructed in Spanish, specifically for the Puebla research site. Interviews included questions about characteristics found in other studies to be related to a woman's decision to undergo TL (Adesiyun, 2007; Carvalho et al., 2004; Chen et al., 2008; Gilliam et al., 2008; Landry, 1990; Leite et al., 2004; Martin and Wu, 2000; Westhoff and Davis, 2000). Demographic questions included age, marital status, years of education, and occupation. We did not employ standardized instruments for any of the questions in this study of TL. Reproductive data included number of children born (parity), age at first and last birth, history of birth control and hysterectomy. We asked women if they had undergone *ligamento de trompas* (TL) or hysterectomy, and at what

age, as well as whether they had ever used contraceptive pills, contraceptive injections, an intrauterine device (IUD), condom, or natural family planning, and for how long. We also asked women “with whom have you talked about menopause?” followed by the choices: doctor, mother, friends, and spouse. Although we asked the question with reference to menopause, women’s responses may indicate whether a woman had a network of people with whom she could discuss health and reproduction.

Statistical Analyses

To explore which characteristics were independently related to a woman undergoing TL, we first looked at bivariate relationships between TL and demographics, reproductive history, contraception use, and health confidants, assessing relationships using chi square tests for categorical variables and Student’s t-tests for continuous variables. We then estimated multiple logistic regression models of these characteristics, with the dependent variable being whether a woman had undergone TL.¹ We entered variables into the multivariable models if they were associated with TL in the bivariate analysis at the $p < .05$ level, with the exception of education. Education is such a prominent feature in the literature of TL that we included it in all models, even though it did not have a statistically significant unadjusted association with TL. We included all dummy variables representing various states of a single variable (e.g. marital status) if one of the states was significantly associated with TL. Finally, we examined whether TL was related to when during the woman’s life TL had become available, by repeating the logistic regression analyses with the sample broken into four age groups. We assessed multicollinearity between variables with variance inflation factors and tolerance scores and model fit using the Hosmer-Lemeshow goodness-of-fit test and Bayesian information

¹ All statistical analyses were performed in Stata 11.1.

criterion.

Results

Unadjusted results

Most of the women interviewed were married (67%) and were employed outside the home as saleswomen in small businesses (63%; Table 1). Very few (3%) spoke an indigenous language in addition to Spanish, probably due to the urban setting. Of the 755 women interviewed, 731 women reported whether they had undergone TL. Of the 731 women who answered, 309 (42.2%) said that they had had a TL, similar to the rate for Mexico as a whole. The median and mean age at TL was 33 years (s.d. 5.4; Figure 1).

Figure 1 about here

At the time of interview, women with a history of TL were slightly, but significantly, younger than those who had not undergone the procedure (Table 1). They were also more likely to be married, and less likely to be single or divorced.

Table 1 about here

In general, the sample had a very low rate of formal education. Over half had six years of schooling or less, with an overall mean of 8.1 years of schooling. Education, which can be reasonably assumed to have been completed before women started their families, provides a proxy of socio-economic status prior to TL (Leite et al., 2004). Education was not significantly associated with TL in bivariate analysis, either as a continuous variable, or categorized into groups that reflected completion of the milestones of primary and secondary school.

Reproductive factors would be expected to be very important in the decision to undergo sterilization, and they were in this population. Parity ranged from 0 to 15 children with a mean of 3.6 children, somewhat higher than that for Mexico as a whole (Tuiran et al., 2002). Women who had undergone TL had significantly higher mean parity. Nearly half of all women with 3 or 4 children had undergone TL, and the procedure was reported by significantly more women with 3 to 7 children than for those with either fewer or more children. An earlier age at first birth was also significantly associated with TL. Of the different forms of contraception, only those women who had used oral contraceptives were significantly more likely to have had a TL. However, of the women who responded to questions about contraceptive use, half (50%) reported never having used any form of modern contraception, and women who had had TL were, overall, more likely to have used contraception. Finally, a significantly larger percentage of women who had undergone TL had spoken with husbands or friends about menopause. In summary, those women who had undergone TL were, on average, younger at the time of interview, younger when they had their first live birth, gave birth to more children, were users of modern birth control, and perhaps more open about reproductive issues.

This picture was more complex because several of the factors were correlated, particularly with age. For the remainder of the analyses, we divided women into four age groups corresponding with TL being available at different times in their lives: late 20s or older (born before c. 1945 and aged 55 years or older at the time of interview); mid 20s (born between 1945 and 1950 and aged 50 to 54 years at interview); early 20s (born between 1950 and 1954 and aged 45-49 years at interview); and mid-teens or younger (born after 1954 and younger than 45 years at interview). While the majority of women

in all age groups were married, a greater proportion of younger than older women were in civil unions, and a greater proportion of women in the oldest group than in younger groups were widowed ($p=0.002$, chi square test). Surprisingly, years of education did not vary significantly across age groups. The number of children increased with women's age at interview. Women younger than 45 years of age averaged 3.2 children, women aged 45-49 years and those aged 50-54 years averaged 3.5 children, and the oldest women (aged 55 years and older) averaged 4.0 children ($p=.003$ in multiple-sample test of means). This pattern provided assurance that the surveyed women represented the fertility transition in Mexico. The oldest group began the reproductive phase of their lives while Mexico's population was still growing and family size was still large.

Mean age at first birth differed significantly among the age groups ($p=.002$) with the age highest among women over 55 years (23.8 years) and lowest among women under 45 years (21.8). Age at last birth was lowest for the youngest group (29.4) and highest for the oldest group (33.6), differing significantly across age groups ($p<.000$). Age at TL was also highly positively correlated with age at last birth ($r=.71$, $p<0.001$, see Figure 2) as would be expected if TL was carried out during the postpartum period. The sub-group of 67 participants, who participated in lengthy open-ended discussions reported that sterilizations were most often carried out during the immediate post-partum period (Sievert et al. 2002).

Finally, women aged 55 years and older at the time of interview, and thus born before circa 1945, were more likely to have undergone TL at an older age (mean age at TL=36.6 years), compared to women aged 50-54 years (mean age at TL=31.9 years), women aged 45-49.9 years (mean age at TL=33.2 years), and women younger than 45

years (mean age at TL=30.6 years) ($p<0.001$), no doubt related to the time that the procedure became widely available relative to when they were considering pregnancy.

Figure 2 goes about here.

Older women were also more likely to have had a hysterectomy, obviating the need for TL. Women younger than 45 years of age were significantly less likely to have undergone a hysterectomy (14%,) compared to women aged 45-49.9 years (24%), women aged 50-54.9 years (26%), and women aged 55 years and older (28%, chi-square $p = .005$). The oldest women (on the left end of the x-axis of Figure 3) were slightly more likely to have undergone TL than hysterectomy, but one was nearly as likely as the other, with hysterectomy at 27% and TL at 32%. The trends were for younger women to have been less likely to have undergone a hysterectomy and more likely to have undergone TL, with a peak in TL frequency (50%) among women aged 45-49 years. The decline in the percentage with TL for the youngest women was at least in part due to truncation – the youngest women in this age group (17 women were younger than 39.5 years) may yet elect TL or hysterectomy at a later age.

Figure 3 goes about here

Adjusted results

We estimated a series of multiple logistic regression models of demographic and reproductive characteristics related to undergoing TL (Table 2). The baseline model included only indicator variables for the age groups described above and parity (Model 1 in Table 2). As in the bivariate results, all younger groups were more likely to have had a TL than the oldest group, with the strongest association among women aged 45-49 years.

The association of parity with TL showed non-linearity, as in the bivariate comparison. The odds of TL increased with parity to peak at five to seven births, compared to women with fewer than two live births. Model 2 included other characteristics that pre-dated TL: the use of non-permanent contraceptives, and education.² The age and parity associations remained, with increased magnitude. A statistically significant relationship was observed between the use of birth control pills and TL, with women who had ever used birth control pills more likely to have undergone TL than women who had never used the pill (adjusted OR (aOR) = 1.68, 95% CI 1.16-2.44). Women who had practiced natural birth control were significantly less likely to have had a TL (aOR = 0.60, 95% CI 0.37-0.97) than those who had not practiced natural birth control. In addition, a significant association of education with TL was observed with more years of education increasing the odds of TL, even when controlling for age (6-12 years: aOR = 1.67, 95% CI 1.07-2.60; 12+ years: aOR = 2.93, 95% CI 1.49-5.76). In the final model (Model 3), we added marital status and with whom a woman had discussed menopause. Women who were married at the time of interview were more likely to have undergone TL than women in other marital status groups (single: aOR = 0.53, 95% CI 0.28-1.04; civil union: aOR = 0.88, 95% CI 0.34-2.27; divorced: aOR = 0.45, 95% CI 0.21-0.97; widowed: aOR = 0.67, 95% CI 0.39-1.17). This was statistically significant only for divorced women (aOR = 0.45, 95% CI 0.21-0.97). This finding was difficult to interpret because it did not reflect marital status at the time the TL decision was made. Women who had undergone TL may have been less likely to later divorce, or divorced women may have had less need of sterilization. We included the questions about talking to a doctor, mother, husband or

² Age at first birth was not included in the model; missing values reduced the number of cases with a bias against younger women, and the effect was not significant.

friends about menopause in this final model because they may have reflected the resources a woman used generally to make health or reproductive decisions. Talking to a doctor or one's mother about menopause had no statistical association with TL; however, talking to friends was positively associated with TL (aOR = 1.44, 95% CI 1.00-2.08) and talking to one's husband had a weak positive association (aOR = 1.49, 95% CI 0.98-2.28). Each model explained more of the variation in TL, as evidenced by increasing pseudo- R^2 , and better model fit, as evidenced by falling Bayesian information criteria scores and non-significant Hosmer-Lemeshow fit statistics. Post-estimation tests showed no significant collinearity, with variance inflation factors ranging from 1.05 to 3.02, and tolerance scores ranging from .33 to .91. Interactions between age group and all other variables in the model were included at each stage (Model 1 – Model 3). None were statistically significant, and the adjusted associations remained.

We also modeled the four age groups separately to explore whether demographic and reproductive characteristics were related differently to TL based on women's age when TL became available (Table 3). Of all demographic and reproductive characteristics, parity was most consistently associated with TL across all age groups. For all age groups likelihood of TL increased with increasing parity (2, 3-4, 5-7 or 8+ children versus 0 or 1 child). The peaking of likelihood of TL at a parity of between five and seven children was consistent across all age groups. The strength of the associations differed somewhat by age group. For women aged 50 to 54 years parity of 2 was not significantly different from parity 0 or 1. For the oldest women (55+ years) the association was only statistically significant for parity groups 3 to 4 (aOR = 4.46, 95% CI 1.06-18.71) and 5 to 7 (aOR = 9.71, 95% CI 2.25-41.85). With regard to prior use of birth

control when models were stratified by age group, the only statistically significant associations with TL occurred among the youngest women. For women under 45 years, those who had used an IUD were less likely to have undergone TL (aOR = 0.43, 95% CI 0.19-0.94), as were women who had used natural birth control (aOR = 0.28, 95% CI 0.10-0.79). The association of educational level with TL also varied by age group. For women under 45 years, having between 6 and 12 years of education increased the likelihood of having undergone TL (aOR = 4.55, 95% CI 1.34-15.53), compared with having less than 6 years of education. For women between 50 and 54 years having more than 6 years or more than 12 years of education both increased the likelihood of having undergone TL (aOR = 3.50, 95% CI 1.21-10.14 and aOR = 6.88, 95% CI 1.08-43.94, respectively), compared with having less than 6 years of education. When looking at the sample by age groups, we found no statistically significant association with marital status. Having spoken to friends about menopause significantly increased the likelihood of TL only for women aged 50-54 years (aOR = 3.20, 95% CI 1.32-7.74), but not for any other age group. These results suggested that parity was the most strongly related factor in the choice of TL across groups of women who were different ages when TL became available to them.

Table 3 goes about here

Discussion:

Tubal ligation is currently the most popular method of contraception around the world (Population Reference Bureau, 2008). In Mexico, the use of TL has increased among women aged 15-49 years from only 8.9% in 1979 to 44% in 2000 (CONAPO,

1999; CONAPO, 2004), while use of other, reversible, means of contraception has declined (Miranda, 2006). Similar trends have been seen in other parts of Latin America and the Caribbean (Leite et al., 2004), with a TL prevalence of up to 50% in some countries (Population Reference Bureau, 2008). Our results echoed this trend of increasing use of TL during the span of years represented by these participants. Whether poor and marginalized women are truly making a voluntary and informed choice to undergo TL has been questioned widely (Warren et al., 1988), with some arguing that lack of access and availability of other reliable methods of contraception has spawned a “veritable sterilization industry” (Carvalho et al., 2004:1566). It is important to understand what factors led women to choose permanent, largely irreversible, contraception.

Several important issues should be considered regarding this study. First, this study was originally a study of menopause, and questions about TL were designed to shed light on the menopausal experience, rather than factors related to TL being the primary focus. Further, non-standard questionnaires were used to assess demographic, socioeconomic, and reproductive history, including characteristics related to TL, which may have resulted in misclassification and limits the ability to compare results to studies that used standard instruments; however, the study instruments were informed by a review of the literature and were piloted among fifteen women within the Puebla community.

Third, the data collection was retrospective in nature, so that the exact timing of age at TL depended on recall. In this sample, women were an average of 16 years beyond their reported age at TL. The high correlation between age at TL and age at last

childbirth ($r=.712$, $p<.01$) indicated a good degree of accuracy in recall, given that during in-depth interviews a sub-group of participants reported that sterilizations were most often carried out during the immediate post-partum period (Sievert et al. 2002). Some points below the line in Figure 2 suggest either (a) an error in recall of age at TL, (b) an error in recall of age at last birth, or (c) a pregnancy that occurred after TL.

Fourth, the city of Puebla is not representative of all of Mexico. It is an urban center and, even though women from very low socioeconomic levels participated in the study, access to health-care resources in Mexico is greater in cities than in rural areas where social, cultural and geographic obstacles reduce access to reproductive options (Salinas et al., 2010). Mexico is a country of diverse regions, as demonstrated by the pattern of fertility change. The drop in fertility in Mexico began in 1967-1970 in the northern states and in the Federal District (Mexico City) and did not reach the state of Puebla until 1978 (Tuiran et al., 2002). A study of TL in Puebla thus may not be generalizable across the entire country.

In this sample from Puebla, women who had had TL were younger than those who had not. Older women did not have access to TL until they were further along in their reproductive experiences. Additionally, the relationship with age may be due to a number of different unobserved factors, including less willingness to use contraceptives for religious reasons, or changing norms for family size between oldest and youngest women. Women with a prior history of contraception may have been more receptive to TL.

Women who had had a TL also had more years of education. Similar findings related to educational attainment have been noted in various developing country contexts

(Adesiyun, 2007), particularly in the Latin American region. For example, Leite and colleagues (2004) found a consistent pattern across four Latin American/Caribbean countries wherein women with schooling above the secondary level were at least twice as likely to have undergone a sterilization compared with their counterparts with no formal schooling. In this study, education was used as a proxy for socioeconomic status, with women who received more years of education also being the women who had greater access to resources and reproductive health options. This contrasts with findings from the US and Canada, where less educated women experience a much greater chance of having undergone TL (Martin and Wu, 2000; Westhoff and Davis, 2000).

Women who had had a TL were more likely to have had two or more children, although this varied by age with this association observed among young women. Most women who had had TL had between five and seven children, fewer of them had eight or more children. Looking at various Latin American countries, Leite and colleagues (2004) found it common for sterilization risk to peak at a certain parity, rather than to show a linear increase with parity. Because having surpassed her own ideal level of fertility increases a woman's risk of TL in Mexico (Zuñiga-Herrera, 2004), seeing a peak at parity of 5 to 7 suggests that while fertility overall may drop, some women may still desire larger families. At the same time, in countries where TL occurs frequently, the peak of TL risk comes at lower parities (Leite et al., 2004), suggesting that those women who do decide to undergo TL may be more comfortable doing so sooner in a context in which TL is frequent and familiar.

Because higher parity was also associated with lower educational status, it is possible that the cultural norm for fertility changed more slowly among segments of the

population with less exposure to education. This is supported by data from Mexico which show that as fertility norms changed, the number of children desired remained higher for women with no schooling than for women with even a minimal amount of schooling (Zuñiga-Herrera, 2004). These data showed that the number of children desired decreased for both women without schooling and for women with at least a primary school education. However, the number of children desired, and the number of children actually living remained higher for women without education than for women with some education (3.99 and 7.49 vs. 3.33 and 5.25, respectively).

One aspect that determines a woman's willingness to undergo TL is her awareness of other family planning methods (Landry, 1990). In Puebla, we did not ask women about their knowledge of contraceptives, but did ask about their use of four widely-used contraceptive methods. The low frequency of contraceptive use prior to TL among women surveyed does not necessarily indicate a lack of knowledge about birth control, since Puebla's residents are staunchly Catholic, famous for their faithfulness. Many women, particularly in the age group targeted (40 to 60 years), refrained from contraceptive use for religious reasons. Religious adherence may explain some degree of avoidance of other contraceptives among women who later used TL. Women who at some point committed to using a "natural" method of fertility control were operating in line with church doctrine. These women may have been generally reluctant to pursue TL because it was not in line with the teachings of the church. In contrast, women who had used the oral contraceptive pill were willing to use contraception, but because the pill had a relatively high failure rate under standard use, they may not have felt as protected as they needed or wanted to be. TL offered a permanent and more reliable solution for

contraceptive needs. This is supported by the fact that in countries such as Canada and Scotland, TL use has actually begun to decrease sharply, in favor of other permanent or long-lasting contraceptive options, such as male sterilization (Martin and Wu 2000) and the progesterone-impregnated intrauterine system (Chen et al., 2008).

In Brazil, Carvalho and colleagues (2004) also found that women tended to opt for TL on the basis of information they received from family and friends, not from their doctors, while in the US it was found that doctors behaved as gate-keepers for TL and had a large degree of influence over women's decisions regarding the procedure (Gilliam et al., 2008). We have no information about who the women in our study talked to about TL, but tentatively suggest that the people women talked to about menopause may reflect in general the people they would talk to about other reproductive and health issues, including TL. The finding in this study that older women who talked with their friends about their menopause were more likely to have undergone TL echoes the findings of a Scottish study that found that women who had discussed TL with friends and family tended to have a positive impression of sterilization, and to pursue it, while those who spoke with their doctor about TL tended to come away with a more negative view (Chen et al., 2008).

Conclusions:

The results of this study contribute to our understanding of the determinants of TL in a country that underwent a demographic transition during the reproductive lives of the women interviewed. Our results suggest that women's socio-demographic characteristics and their preferences regarding family size were related to their choice. However,

perhaps more crucially, it appears that increased access to TL is reflected in the statistically significant increase in TL and decrease in hysterectomy across age groups in this study. The results of this study also indicate a high degree of accuracy in recall of age at TL because of the relationship between TL and the timing of last birth. Although the generalizability of this study was limited, it contributes some pieces to the puzzle of what motivates change in practices related to women's health across age groups.

References Cited

- Adesiyun, A. G. 2007. Female sterilization by tubal ligation: A re-appraisal of factors influencing decision making in a tropical setting. *Arch Gynecol Obstet* 275(4):241-4.
- Beerthuizen, R. 2010. State-of-the-art of non-hormonal methods of contraception: V. Female sterilization. *Eur J of Contracept Reprod Health Care*. 15(2):124-135.
- Carvalho, L. E. C., J. G. Cecatti, M. J. D. Osis, and M. H. Sousa. 2004. Ideal number of children as a risk factor for tubal ligation. *Cad Saúde Pública* 20(6):1565-74.
- Cattanach, J. 1985. Oestrogen deficiency after tubal ligation. *Lancet*. 1(8433):847-9
- Chen, Z. E., A. Glasier, and P. Warner. 2008. Why are rates of sterilization in decline? A pilot study designed to explore reasons for declining female sterilization in Scotland. *Contraception* 78(4):309-14.
- CONAPO. 2004. Capítulo cinco. Salud, derechos reproductivos y salud reproductiva. In *Informe de ejecución del programa de acción de la conferencia internacional sobre la población y el desarrollo 1994-2003*. Consejo Nacional de Población, México, D.F.
- CONAPO. 1999. Veinticinco años de planificación familiar en México. In *Situación Demográfica de México 1999*. Consejo Nacional de Población, México, D.F. On-line publication, www.conapo.gob.mx
- Fine, J. P., and R. J. Gray. 1999. A proportional hazards model for the subdistribution of a competing risk. *J Am Stat Assoc* 94(446):496-509.
- Gilliam, M., S. D. Davis, A. Berlin, and N. B. Zite. 2008. A qualitative study of barriers to postpartum sterilization and women's attitudes toward unfulfilled sterilization requests. *Contraception* 77(1):44-9.
- Informed Consent Working Group. 2003. Quinacrine sterilization (QS): informed consent. *Int J Gynaecol Obstet*. 83(suppl 2):S147-S159.
- Landry, E. 1990. How and why women choose sterilization: Results from six follow-up surveys. *Stud Fam Plann* 21: 143-51.
- Leite, I. D. C., N. Gupta, and R. D. Rodrigues. 2004. Female sterilization in Latin America: Cross-national perspectives. *J Biosoc Sci* 36(6):683-98.
- Ludermir, A.B., K. M. D. Machado, A. M. da Costa, S. V. Alves, and T. V. B. de Araujo. 2009. Tubal ligation regret and related risk factors: Findings from a case-control study in Pernambuco state, Brazil. *Cad Saúde Pública* 25(6):1361-8.

Martin, K. and W. Zheng. 2000. Contraceptive use in Canada: 1984-1995. *Fam Plann Perspect* 32: 65-73.

Miranda, A. 2006. Are young cohorts of women delaying first birth in Mexico? *J Popul Econ* 19(1):55-70.

Peterson, H. B., Z. Xia, J. M. Hughes, L. S. Wilcox, L. R. Tylor, and J. Trussel. 1996. The risk of pregnancy after tubal sterilization: findings from the U.S. Collaborative Review of Sterilization. *Am J Obstet Gynecol* 174:1161-8.

Piccinino, L.J., and W. D. Mosher. 1998. Trends in contraceptive use in the United States: 1982-1995. *Fam Plann Perspect* 30(1):4-10, 46.

Population Reference Bureau. 2008. *World population data sheet*. Washington, DC: USAID.

Salinas, J. J. , S. A. Snih, K. Markides, and L. A. Ray. 2010. The Rural–Urban Divide: Health Services Utilization Among Older Mexicans in Mexico. *Journal of Rural Health* (26)4:333-41.

Sievert, L. L. 2006. *Menopause: A Biocultural perspective*. Rutgers University Press: New Brunswick, NJ.

Sievert, L. L. and G. Espinosa-Hernandez. 2003. Attitudes toward menopause in relation to symptom experience in Puebla, Mexico. *Women Health* 38(2):93-106.

Sievert, L. L. and S. I. Hautaniemi. 2003. Age at menopause in Puebla, Mexico. *Hum Biol* 75(2):205-26.

Sievert, L. L., R. R. Freedman, J. Zarain Garcia, J. L. Foster, M. C. Romano, C. Longcope, and C. Franz. 2002. Measurement of hot flashes by sternal skin conductance and subjective hot flash report in Puebla, Mexico. *Menopause* 9(5):367-76.

Tuirán, R., V. Partida, O. Mojarro, and E. Zúniga. 2002. Tendencias y perspectivas de la fecundidad. In *The Demographic Situation of Mexico, 2002*. Consejo Nacional de Población (CONAPO), on-line publication. www.conapo.gob.mx

Ventura, S. J., S. M. Taffel, W. D. Mosher, J. B. Wilson, and S. Henshaw. 1995. Trends in pregnancies and pregnancy rates: estimates for the United States, 1980-1992. *Mon Vital Stat Rep* 43(11-S).

Vieira, E. M. and N. J. Ford. 2004. Provision of female sterilization in Ribeirão Preto, São Paulo, Brazil. *Cad Saúde Pública* 20: 1201-10.

Warren, C.W., R. S. Monteith, J. T. Johnson and M. W. Oberle. 1988. Tubal sterilization: Questioning the decision. *Popul Stud* 42: 407-18.

Westhoff, C., and A. Davis. 2000. Tubal sterilization: Focus on the US experience. *Fertil Steril* 73(5):913-22.

Wyshak, G. 2004. Menopausal symptoms and psychological distress in women with and without tubal sterilization. *Psychosomatics*. 45:403-13.

Zuniga-Herrera, E. 1993. Cambios en el nivel de la fecundidad deseada en las mujeres mexicanas, 1976-1986. *Rev Mex Sociol* 55(1):83-96.