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Living in the American South and the Likelihood of Having a Tubal Sterilization

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This research uses a nationally representative sample of 7,643 American women from the public-and restricted-use National Survey of Family Growth, Cycle 6 data files and logistic regressions to model for the first time the relationship between having a tubal sterilization and southern region of residence. This research finds a disparity in reproductive health for southern women; women living in the South face about 1.5 greater odds of being sterilized compared with women from other regions, all else being equal. When other potential main and moderating effects are included in the model, rural women are found to have twice greater odds as urban women and Protestant women have 1.5 times greater odds than Catholics of having a tubal sterilization, net of other effects.

Since the 1970s, increasing numbers of American women have had a tubal ligation procedure, also known as tubal sterilization surgery (MacKay et al. 2001). As a result, data over the period 1982 to 2008 show that tubal sterilization is the second most common method of contraception for American women, used slightly less often than the pill (Mosher and Jones 2010). Further contextualizing this, tubal sterilization appears to be even more common among women living in the southern region of the United States than in other regions (Chandra 1998; MacKay et al. 2001; Schwartz et al. 1989; Taffel and Placek 1987). These patterns are unsettling because this procedure largely ends a woman's ability to have children even though less permanent forms of contraception are widely available. While a tubal sterilization provides women a safe, assured method of birth control and a reversal procedure is available, success rates vary, and a reversal is considered an elective procedure which is not usually covered by insurance, so most tubal sterilizations render a woman permanently infertile.

Research indicates that infertility - including voluntary forms of infertility such as tubal sterilization - is associated with higher psychological distress, compared to that undergone by fertile women (McQuillan et al. 2003). The infertility literature indicates that relinquishing fertility intentions is related to emotional distress (White and McQuillan 2006), and that infertility is harmful for women's overall well-being, sense of control, and identity (Williams 1997). Specific

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to the tubal sterilization procedure, a few studies document a desire for reversal (Borrero et al. 2008; Chandra 1998, and Hillis et al. 1999) and many studies document regret after having a tubal sterilization (Curtis, Mohllajee, and Peterson 2006, Henshaw and Singh 1986, Jamieson et al. 2002, Marcil-Gratton 1988, Remez 1991). One study (Hillis et al. 1999) estimates a woman's cumulative probability of expressing regret after a tubal sterilization over her life course as 12.7 percent. However, regret is not distributed evenly, as the probability of regret is found to be more elevated 7 to 14 years after a tubal sterilization than in the first five years (Jamieson et al. 2002) and among black women compared with white women (Borrero et al. 2008). In addition to the regret and desire for reversal, evidence suggests negative effects on sexual functioning for women who have a tubal sterilization; specifically, those with tubal ligations are more likely to report stress interfering with sex to report seeing a physician about sexual problems in the pre-vious 12 months, compared with women without tubal ligations (Warehime, Bass, and Pedulla 2007). Taken together, these studies highlight three areas of concern - desire for reversal, regret, and negative sexual functioning - as possible adverse consequences of this difficult-to-reverse form of birth control.

Because of the potential for adverse side effects for a substantial proportion of women, and the reality that tubal sterilizations are not distributed evenly, tubal sterilization should be understood as a health disparity issue. Tubal sterilization is more prevalent among black and Hispanic women (Bass and Warehime 2009; Borrero, Moore et al. 2010), women with less education (Bass and Warehime 2009; Metoyer 2009) and lower income (Bass and Warehime 2009; Mosher 1990), rural women (Bass and Warehime 2009) and women with a lower level of health care access (Bass and Warehime 2009; Borrero et al. 2007; Lopez 1993; 2008; Metoyer 2009). To explain the racial disparity between tubal sterilization rates for black and white women, researchers (Borrero, Abebe et al. 2010) find that patient-level factors, such as misinformation about ster-ilization and limited awareness of contraceptive alternatives among black women, explain the higher likelihood of black women to have a tubal sterilization. Borrero et al. (2010b) conclude that experience with an unintended pregnancy explains the racial disparity in tubal steriliza-tion between minority and white women; black and Hispanic women are found to be more likely to have a tubal ligation, but once unintended pregnancy is included, this relationship is less pronounced for black women and no longer significant for Hispanic women. Also, among women over age 30 at the time of tubal sterilization, black women are found to be more likely to want a reversal than their white counterparts (Borrero et al. 2008). Moreover, tubal steril-ization can be viewed as a health disparity issue, because it is a long-lasting method that is difficult to reverse. Likewise, Metoyer (2009) finds that women from disadvantaged groups - namely African Americans, Hispanics, and those with lower incomes - tend to use contra-ceptive methods, such as tubal sterilization, intrauterine devices, and the Depo Provera shot, that have more enduring side effects and require more reliance upon medical professionals. In contrast, she finds that white women and those with higher incomes are more likely to use vasectomy and more temporary contraceptive methods, like the pill. Related to this, Borrero et al. (2009) find that Hispanic and black women are more likely than white women to receive birth control counseling, and Hispanic women are more likely to receive sterilization counseling, compared with white women. Altogether then, women's reproductive health and specifically, whether women have a tubal sterilization, seems to be patterned by a lower level of social advantage more generally - such as ethnic minority group status and lower socioeconomic status - in society.

A separate line of research documents that the South has a markedly lower level of health care access, quality, and outcomes compared with other regions of the United States (Cantor et al. 2007). While women living in the South have a higher incidence of tubal sterilization (Chandra 1998; Schwartz et al. 1989; Taffel and Placek 1987), no research to date has examined this relationship within a multivariate framework to evaluate whether southern women are more likely to opt for a tubal sterilization surgery, net of other related factors - such as lower income and living in a rural area - that are also associated with having a tubal sterilization. This lower level of health advantage in the South coupled with the association between living in the South and having a tubal sterilization suggest the possibility of a *place effect* (as described by Agnew and Duncan 1989; Blank 2004; Cotter 2003, Lobao 1994), because women in the South may have access to fewer contraceptive options or navigate a larger milieu of lower health care quality. This research therefore draws on prior research (Asthana 1996; Dyck 2003; Ellaway, Macintyre, and Keams 2001; Keams 1993; Keams and Moon 2002; Moss and Al-Hindi 2007) positing that the intersection of place and health can usefully inform local contexts of health inequality as well as social process.

This study uses a sample of 7,643 women from the National Survey of Family Growth, Cycle 6 (NSFG 2002) to test for a relationship between southern residence and the likelihood of having a tubal sterilization, while holding other factors (e.g., income and education) known to be associated with tubal sterilization constant in the analysis. Therefore, this research examines tubal sterilization as an inequality issue which may manifest itself as a place effect that patterns a lower level of reproductive health access to women who reside in the southern region of the United States. This analysis merges a restricted-use contextual variable - region of residence - with the public-use NSFG data in order to consider southern region as a predictor of tubal sterilization/or *the first time* in a multivariate framework. This relationship between region of residence and tubal sterilization has been noted in the literature as a bivariate association for decades, but it has not been tested in a multivariate framework. This research will also test for other possible intervening effects, namely rural residence and Protestant religious affiliation, that may be related both to living in the South and having a tubal sterilization surgery.

Disparity in Health by Residing in the South

While much research has documented key health disparities in the United States (e.g., Adler and Newman 2002; Braveman et al. 2004; Costello, et al. 2003; Schnittker and McLeod 2005), relatively few studies have focused on women's reproductive health. This research examines one health procedure, the tubal sterilization, as it may represent a social disparity in health by region of residence. Similar to Braveman et al. (2004:2,139), the concept of *social disparity in health* refers to the determinants of health that are "systematically associated with different levels of underlying social advantage or position in a social hierarchy." Medical researchers and practitioners are aware of the potential for regret after a tubal sterilization (see the review of 19 papers on sterilization timing and regret in Curtis et al. 2006) and are beginning to connect this regret to changes in marital status over the life course (Doyle et al. 2008). At the same time, infertility researchers (Greil, Slauson-Blevins, and McQuillan 2010) theorize how infertility is shaped by social contexts. This study likewise takes a sociological approach to understand how tubal sterilization may be influenced by one social context, the experience of living in the South, which has previously been associated with other social disadvantages. Two bodies of scholarly work inform this analysis: 1) research and theorizing on having a tubal sterilization, and 2) research on reproductive health as it may be patterned by region of residence. Each will be discussed in turn.

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Factors Associated with Having a Tubal Ligation

Research indicates that many factors shape a woman's likelihood to have a tubal sterilization procedure. Women with less education (Bass and Warehime 2009; Metoyer 2009) and lower incomes (Bass and Warehime 2009; Mosher 1990) pattern a higher likelihood of having a tubal ligation. Research also finds that rural women are more likely than urban women (Bass and Warehime 2009) and women with Medicaid insurance are more likely than women with private or government health insurance (Borrero et al. 2007) to have a tubal sterilization. Protestants are found to be most likely to have a tubal sterilization compared with those of other religious affiliations (Borrero et al. 2007). Further, older women (Dryfoos 1982; MacKay et al. 2001), black and Hispanic women (Bass and Warehime 2009; Borrero et al. 2009; Borrero, Abebe et al. 2010; MacKay et al. 2001), and women who are currently or ever-married (Chandra 1998; Godecker, Thomson, and Bumpass 2001; Mosher 1990) all are associated with an increased likelihood of having a tubal sterilization. These overall patterns do not work the same way for all racial-ethnic groups, as most white and Hispanic women were married when they had the operation, but only 36 percent of black women were married at the time of the operation (Godecker and Bumpass 2001). Therefore, understanding what is associated with having a tubal sterilization requires the consideration of several possibly interrelated factors such as racial-ethnic group and marital status.

Lopez (1993; 2008) asserts that women with a lower level of health care access are more likely to have a tubal sterilization. To explain why Puerto Rican women have a higher rate of tubal sterilization compared to other groups of women in New York City, she contends, "By focusing on individual choice, we overlook that choices are primed by larger institutional structures and ideological messages" (Lopez 2008:305). Therefore, it is necessary to view these ethnically homogenous, Hispanic women as sharing a history of patriarchy wherein they have lower status and say within their families and culture. In addition to having lower status culturally, these women face constrained choice in their available contraceptive options due to their social milieu characterized by lower income, a lower level of health care access, and even a medical misunderstanding about the difference between getting one's tubes tied on the one hand and cut on the other. About one-half surveyed by Lopez thought that getting one's tubes tied is a different procedure than getting them cut, whereas the medical community uses these terms interchangeably to describe the same tubal ligation procedure, a form of sterilization which is difficult to reverse. In Lopez's research, the decision to have a tubal sterilization is not found to be an informed one, and this compromised position is further undermined by patriarchal norms and the economics of contraception.

A related line of research suggests that health care providers' perceptions and interactions with low-income patients may shape whether women have a tubal sterilization. Lopez (2008:313) observes, "There is ... the attitude among health care providers that it is better to recommend mechanical and surgical forms of fertility control to the poor because they do not

have sufficient initiative or responsibility for controlling their fertility." Further exacerbating the lower social status of low-income women, one study (Poland et al. 2005) finds that when people perceive the authority of health care providers as legitimate, they, in turn, contribute to their own subordination through a process of lopsided interactions. Another study (Ginsburg and Rapp 1995) documents a culture of "stratified reproduction" wherein reproduction is heavily influenced by social and cultural boundaries, which in turn, increase reproductive control for some women and reduce it for others by social status. It is well documented that certain groups of American women patterned by minority racial-ethnic group status and low income have been encouraged or pressured to have a tubal sterilization by health care professionals in recent history (Roberts 1997; Schoen 2005; Stern 2005; Torpy 2000). Social status and specific ideas about appropriate health care for low-income individuals therefore may create a context of constrained choice, and result in a higher likelihood of tubal sterilization for certain groups of women in society.

Region of Residence and Women's Reproductive Health

Region of residence should be examined as a possible *place effect* that patterns the likelihood of having a tubal sterilization. Research (MacKay et al. 2001:164) finds, "[R]egional differences in overall tubal sterilization rates continued in a pattern similar to those reported in the 1970s and 1980s, with the South having the highest rates." Chandra (1998) echoes this finding of markedly higher levels of sterilization in the South in bivariate analysis, as southern women are most likely to report having a tubal ligation procedure compared with women living in other regions. However, to date, regional differences in tubal sterilization rates have not been examined using multivariate research methods. At the same time, research on the relevance of *place* within current sociological research (Lobao 1994) includes region as a macro level of analysis, and argues for macro-micro linkages through place effects on individuals. Similarly, Skinner (2001) argues that the structural characteristics of the region and characteristics of a population by region can affect disparities in patient outcomes.

Additionally, Chandra and Skinner (2003) illustrate the usefulness of aggregating data to identify region-specific effects that may reflect a variety of unmeasured, confounding variables. Specifically, they document that there are disparities in treatment patterns (i.e., whether patients obtain the appropriate treatment) by region that are masked as an individual-level race effect that result in patterned lower health outcomes by region regardless of race. Because tubal sterilization rates have continued to be highest in the South since the 1970s, this research posits that the southern region should be examined as a likely place effect that structures access to reproductive health care and health outcomes.

Theorizing from medical geography on the intersection of place and health further informs this analysis by considering the interaction of structure, or the local context of health, with agency, or the individuals who reside within a given geography (e.g., Kearns 1993; Kearns and Moon 2002). Kearns (1993) examines two geographies of health and finds that place matters because of the perceptions that individuals hold vis-a-vis their local environment and the health institutions within it. Agnew and Duncan (1989) aptly denote this intersection as the *power of place* as they highlight the contribution of geographical place to understand both social science and history. Research (Ellaway et al. 2001) finds that in addition to individual-level characteristics, place - or the perception of where one lives - matters for mental health outcomes across those living in

two divergent neighborhoods of Glasgow, Scotland. Adding to this, feminist research (Asthana 1996; Dyck 2003; Moss and Al-Hindi 2007) considers how locale can be a useful framework for understanding both women's health and their empowerment. Taken together, these studies suggest that place matters.

A study using in-depth interview data finds that tubal sterilizations occur so frequently that they have become known as "Mississippi appendectomies" for women on Medicaid by the medical community in the South, as women would have a tubal sterilization at the time of childbirth while they are covered by Medicaid. This same study (Sered and Fenandopulle 2005:51) notes, "When we asked these women why they had their tubes tied, very few of their answers led us to believe that it had been a truly informed choice." Statistics indicate that one-half of all female sterilizations are performed within 72 hours post-partum (Westoff and Davis 2000). In these particular cases, level of reproductive health care seems to be shaped in part by income level. Because the overall income level of the South is historically lower compared with other regions, income could be masking a region effect, yet southern region has not yet been included in multivariate research on this subject. It is therefore important to test the Sered and Fenandopulle (2005) qualitative research findings with a nationally representative sample to consider a possible place effect of southern region of residence, as women residing in the South may opt for this procedure at a higher rate due to a contextual factor (living in the South where they may experience a lower level of health advantage) and not only personal-level factors (income, insurance type). Context, poverty and lack of awareness may come together to paint a picture of disparity in health that is associated with living in the South, which may, in turn, affect women's reproductive health options.

Additionally, a southern place effect may be influenced by the *rural* character of the South. Across regions, the South distinguishes itself as being the most rural, 31.7 percent, compared with the Midwest (28.3 percent), Northeast (21.2 percent) and West (13.7 percent); the southern region also distinguishes itself from other regions because it accounts for almost one-half (49.4 percent) of poor, rural individuals nationally (United States Department of Agriculture 1996). Recent research (Bass and Warehime 2009) using nationally representative data finds an important rural component associated with tubal sterilizations, as women in rural areas are nearly twice as likely to have a tubal ligation as their urban counterparts, and this relationship is independent of lower income and Medicaid health insurance being associated with a higher likelihood of having a tubal ligation. In addition to including income and health insurance type, research on a possible southern place effect should also control for rural residence as a main effect and consider that there may be a moderating effect of rural on any southern association with having a tubal sterilization.

Because the South has a high level of Protestant influence (Pew Research Center 2007), as 46 percent of all Protestants live in the South, and other research (Borrero et al. 2007; Chandra 1998) has established that Protestants are most likely to have a tubal sterilization compared with other or no religious affiliation, a southern place effect may be shaped by type of *religious affiliation*, specifically Protestant. Prior research (Grasmick, Wilcox, and Bird 2007) using a southern sample finds a strong, positive direct effect of adherence to a fundamentalist Protestant doctrine on support for the patriarchal family, but no direct effect of personal religiosity (i.e., the frequency of attending religious services). This research suggests that there may be a larger normative effect shaped by Protestantism at play in the South, which may work differently at the individual level, depending on the research question at hand. In this way, traditional attitudes aligned with Protestant ideology may be an underlying contextual factor particular to the southern region

and associated with having a tubal sterilization. Research on a southern place effect on having a tubal sterilization should consider the direct and moderating influences of religious affiliation to understand these relationships clearly.

Tubal Sterilization as a Health Disparity

Using the social health disparities framework, this research examines whether having a tubal sterilization is related to an underlying indicator of social disadvantage, i.e., living in the South. As discussed earlier, the term *social disparity in health* is used to explain a lower level of health that is related "systematically" to an underlying disadvantage or a lower position in a social hierarchy (Braveman et al. 2004). Therefore, living in the South represents a context of relative disadvantage and this may be associated with lower income and lower reproductive health access and quality, which may in turn shape the higher likelihood of southern women to have a tubal sterilization. Nearly 25 percent of women with an unreversed tubal sterilization in 1995 reported a desire (i.e., on their or their partner's part) to reverse the operation (Chandra 1998), yet with lower incomes it is less likely that this group of women would be able to afford this "optional" tubal sterilization reversal surgery. In tandem with this, not only are women with lower incomes more likely to have a tubal sterilization, they are also more likely to experience the dissolving of a relationship, i.e., divorce (Cherlin 1992). Fertility intent is likely to change with a relationship transition such as a divorce or remarriage as individuals live their lives. This is an issue of concern because lower income women are the ones most likely to have a tubal sterilization surgery; at the same time, they are least likely to be able to reverse it and most likely to experience a relationship transition that may change their desire to be surgically sterilized.

This research provides an examination of one health procedure, the tubal sterilization, as it may represent a health disparity. Because many women use tubal sterilization as their form of contraception, and living in the South may serve as a marker of access to and quality of reproductive health care services, this research investigates the possible link across having a tubal sterilization and southern place of residence. This research addresses the following questions: What are the characteristics of women who report having a tubal sterilization by region, rural or urban residence, and religious affiliation? Does southern place of residence independently affect the likelihood of having a tubal sterilization? Are there moderating effects of rural residence and Protestant religion on the relationship between southern residence and having a tubal sterilization?

Hypotheses

Guided by prior theorizing and findings on the intersection of place and health (Asthana 1996; Dyck 2003; Ellaway et al. 2001; Kearns 1993; Kearns and Moon 2002; Moss and Al-Hindi 2007) and specifically on tubal sterilization (Lopez 1993, 2008; Sered and Fernandez 2005), this research expects that women living in the South will be more likely to report having a tubal sterilization compared to women living outside the South, all else being equal. Based on prior research (Bass and Warehime 2009; Borrero et al. 2007; Chandra 1998), this research also expects to find positive, independent effects of rural residence and Protestant religious denomination on the likelihood of having a tubal sterilization in addition to the southern effect, net of other

interrelated factors. Finally, this research expects that there may be moderating effects of rural residence and Protestant religious denomination on the relationship between living in the South and having a tubal sterilization.

DATA AND METHODOLOGY

Sample

This research uses data from the National Survey of Family Growth, Cycle 6 (NSFG 2002) to examine the relationship between having a tubal sterilization and the place effect of living in the South. Using a random sample of American women, 15 to 44 years old, the NSFG completed interviews with 7,643 respondents using face-to-face and self-administered questionnaires (United States Department of Health and Human Services 2004). Blacks and Hispanics were oversampled and weighted to represent the racial composition of the United States. Table 1 describes the sample presenting a proportion and number of cases, as well as showing the bivariate relationships between each variable of interest and women who report having a tubal sterilization. Weighted percentages of the effective sample size of 7,643 respondents are used in Table 1, and weighted data with downsized variances are used for the logistic regressions presented in Table 2.

Variables

The dependent variable in this analysis is *whether or not a woman reported having a tubal sterilization*. This variable is dichotomous with the responses of "yes" or "no," necessitating the logistic regression procedure to test for relationships with the dichotomous dependent variable, having a tubal sterilization or not. As shown in Table 1, the mean number of respondents who reported having had a tubal sterilization is 0.162 (16 percent).

Using Aneshensel's (2002) concept of the focal relationship, *southern region of residence* is the focal variable in this analysis, and is used to evaluate the relationship between women having a tubal sterilization and residing in the South. Southern region of residence is measured in two ways. First, *South*, *Northeast*, *Northwest*, and *West* are included as categorical variables, and *South* is the reference group for the first two logistic regression models. Next, *South* and *Non-South* are included as a dummy variable, and *Non-South* is the reference group in the next three logistic regression models. Table 1 indicates that 37.3 percent of sample respondents live in the South. Because those selected into the sample have a random chance of living in the southern region compared with other regions, there is no clustering of the data at the southern region level, and therefore no need to use multi-level analysis when testing for a southern region relationship. *Rural residence* and *religious affiliation* are additional independent variables in this analysis.

As conceptualized by others (Probst et al. 2004), rural residence status is used as a dummy variable. Rural area includes non-urban and non-suburban areas, and accounts for 15 percent of the sample as presented in Table 1. The *urban area* category serves as the reference group in the logistic regression analysis. Similar to other research using the NSFG (Chandra 1998), religious affiliation is measured with a categorical variable, namely *Catholic*, *Protestant*, and *Other or no religion*, with Catholic used as the reference category. Table 1 shows that the sample is comprised

TABLE 1
 Characteristics of Women in Sample and Those Who Report Having a Tubal Sterilization

<i>Variables</i>	<i>Sample Characteristics</i>		<i>Have Tubal Sterilization</i>
	<i>Proportion</i>	<i>#of Cases</i>	<i>Percent</i>
Dependent variable			
Tubal ligation or sterilization		7,643	16.2%
Independent variables			
Region of residence			
South	0.373	1,205	19.3%**
Northeast	0.158	2,848	13.6
Midwest	0.229	1,751	16.2
West	0.241	1,840	12.9
Rural residence	0.149	1,139	20.8%**
Urban residence	0.851	6,504	14.4
Religious affiliation			
Protestant	0.500	3,822	19.0%**
Catholic	0.296	2,262	14.2
Other or no religion	0.204	1,559	11.8
Control variables			
Age	M=29.5		M=35.9
14-24 years	0.329	2,513	1.4%**
25-29 years	0.170	1,296	10.6
30-34 years	0.177	1,355	19.6
35-39 years	0.166	1,270	27.8
40-44 years	0.158	1,209	31.1
Race and ethnicity			
White	0.542	4,143	12.9%**
Black	0.200	1,529	20.5
Hispanic	0.208	1,590	18.0
Other racial ethnic group	0.050	382	8.3
Marital status			
Married	0.403	3,080	20.6%**
Cohabiting	0.096	734	15.2
Ever married	0.116	887	31.0
Never married	0.385	2,943	5.0
Parity			
0 births	0.423	3,233	1.1%**
1 to 2 births	0.408	3,118	17.6
3 or more births	0.169	1,292	46.1
Ever unwanted pregnancy	0.201	1,536	33.5%**
No unwanted pregnancy	0.799	6,107	10.7
Education level			
No high school diploma	0.223	1,703	15.9%**
High school diploma	0.284	2,171	21.4
Some college	0.285	2,177	14.5
Bachelor's degree	0.153	1,171	7.6
Master's degree	0.055	421	6.2

(Continued)

TABLE 1
(Continued)

<i>Sample Characteristics</i>		<i>Have Tubal Sterilization</i>	
<i>Variables</i>	<i>Proportion</i>	<i>#of Cases</i>	<i>Percent</i>
Income level			
Less than \$12,499	0.168	1,287	18.4%**
\$12,500-\$29,999	0.287	2,193	17.7
\$30,000--\$49,999	0.225	1,722	15.0
\$50,000-74,999	0.168	1,281	12.2
\$75,000 or more	0.152	1,160	11.0
Insurance coverage			
Private insurance	0.633	4,815	12.9%**
Medicaid	0.128	789	20.8
Government provided	0.068	520	17.7
No insurance	0.171	1,307	18.8

Source: National Survey of Family Growth, Cycle 6, public-use data and National Institutes for Health (NIH) Research Data Center (RDC) contextual data. The effective sample size is 7,643 respondents.

**(X^2) $p < .01$ The chi-square statistic is used to test for bivariate categorical relationships.

of 50 percent Protestant, 29.6 percent Catholic, and 20.4 percent Other or no religion. This analysis is interested in the independent and moderating effects of being Protestant on having a tubal sterilization.

Social and demographic control variables include age, race and ethnicity, marital status, parity, and an unwanted pregnancy. The mean *age* for all females in the sample is 29.5 years. Age is recoded into five age categories for Table 1, and for the logistic regressions, age is a continuous variable with responses ranging from 15 to 44 years old. A categorical race and ethnicity variable is used, namely *White*, *Hispanic*, *Black*, and *Other*. The white racial-ethnic category is the reference group in the logistic regression analysis. *Marital status* is measured with the categorical variable *currently married*, *currently cohabitating*, *ever married* (consisting of divorced, separated, or widowed individuals), and *never married*. The currently married category is the reference group in the logistic regression models. *Parity* is measured with a categorical variable indicating the number of pregnancies a woman has had: *0 pregnancies*; *1 to 2 pregnancies*; and *3 or more pregnancies*. Prior research (Chandra 1998) suggests that higher parity is associated with a higher rate of surgical sterilization and tubal sterilization. The *0 unwanted pregnancies* category is the reference group in the logistic regression analysis. *Ever unwanted pregnancy* is a dummy variable indicating having or not having an unwanted pregnancy.

Socioeconomic level is measured with the variables of education, income, and insurance type. *Education level* is presented as a categorical variable in Table 1, but is left as a continuous variable to indicate the actual number of years of education respondents reported for the logistic regression models. *Income* is a 14-level ordinal variable recording income, which ranges from 1 for those with family income less than \$5,000, to 14 for those with family income of \$75,000 or more. Income is recoded and presented as a categorical variable in Table 1, and is treated as continuous in the logistic regression models. *Insurance type* is measured as a categorical variable, namely *private health insurance*, *Medicaid*, *government or military insurance*, and *no health insurance*. Private health insurance is the reference group for the logistic regression models.

TABLE 2
Odds of a Woman Having a Tubal Sterilization

<i>Characteristics</i>	<i>Model 1</i>	<i>Model 2</i>		<i>Model 3</i>	<i>Model 4</i>		<i>Model 5</i>	
	<i>Odds Ratio</i>	<i>SE</i>	<i>Odds Ratio</i>	<i>SE</i>	<i>Odds Ratio</i>	<i>SE</i>	<i>Odds Ratio</i>	<i>SE</i>
Region of residence								
South	R		R					
Northeast	0.66***	(.12)	0.72***	(.12)				
Northwest	0.81**	(.11)	0.70***	(.14)				
West	0.62***	(.14)	0.62***	(.15)				
Region of residence								
South					1.44***	(.09)	1.48***	(.09)
Noh-South					R		R	
Rural residence								
Rural area			1.98***	(.14)			2.00***	(.14)
Urban area			R				R	
Religion								
Catholic			R				R	
Protestant			1.61***	(.15)			1.59***	(.15)
Other or no religion			1.35**	(.16)			1.34*	(.16)
Interactions								
South*Rural							0.72	(.26)
South*Protestant							1.19	(.24)
South*Other or no religion							0.51*	(.31)
Age			1.12***	(.01)			1.12***	(.01)
Race and ethnicity								
White			R				R	
Hispanic			1.35*	(.17)			1.30	(.17)
Black			1.27*	(.14)			1.28*	(.14)
Other			0.76	(.28)			0.74	(.27)
Marital Status								
Currently married			R				R	
Cohabiting			1.08	(.17)			1.09	(.17)
Ever married			1.50***	(.16)			1.50***	(.15)
Never married			0.58***	(.17)			0.59***	(.16)

TABLE 2
(Continued)

Model 1

	Mode/2		Model 3		Mode/4		Mode/5	
Characteristics	Odds Ratio	SE	Odds Ratio	SE	Odds Ratio	SE	Odds Ratio	SE
--								
Parity								
0 births			R				R	
1 to 2 births			8.27***	(.26)			8.32***	(.25)
3 or more births			18.61***	(.28)			18.71***	(.28)
Ever unwanted pregnancy			1.79***	(.12)			1.78***	(.12)
Education level			0.70***	(.05)			0.70***	(.05)
Income level			0.99***	(.00)			0.99***	(.00)
Insurance status								
Medicaid insurance			1.36**	(.15)			1.36**	(.14)
Private health insurance			R				R	
Government health insurance			1.36	(.21)			1.34	(.21)
No health insurance			1.19	(.15)			1.19	(.14)
Degrees of freedom		3		21	I			19
Wald model fit statistic	19.09***		1,077.08***		16.76***		1,039.54***	
Number of cases	7,643		7,643		7,643		7,643	

Source: Logistic regression models using National Survey of Family Growth, Cycle 6, public-use data and National Institutes for Health (NIH) Research Data Center (RDC) contextual data. Data are weighted with downsized variances. Cross weights are applied to attain a stratified sample and the SAS survey logistic procedure is used in this analysis. The difference in Wald model fit chi-square statistics, degrees of freedom, and a chi-square distribution table are used to assess improvement in model fit from the smaller "nested" model to the next larger model (i.e., at the $p < .01$ level). The model fit improves from Model 1 to Model 2, and again across Model 3, 4 and 5.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Plan of Analysis

To answer the research questions, Table 1 presents the bivariate relationships between having a tubal sterilization and key explanatory variables. Table 2 presents logistic regressions to evaluate the relationships between having a tubal sterilization and key explanatory variables while holding constant other interrelated variables. The use of logistic regressions in this analysis allows for the testing of relationships with the dichotomous dependent variable, having a tubal sterilization or not.

Based on prior research, this study first assesses whether southern residence is related to having a tubal sterilization, and then evaluates whether this relationship holds once rural residence and Protestant religion are included in the model. Southern residence is considered along with the independent effects of rural residence and Protestant religious affiliation, while controlling for other demographic and socioeconomic variables known to be associated with having a tubal sterilization, such as age, race and ethnicity, marital status, parity, unwanted pregnancy, education, income level, and type of insurance coverage. This full model allows us to rule out spuriousness if the focal relationship remains once all independent and control variables are included. The final regression model considers the possible intervening effects of rural residence and Protestant religion on the relationship between southern region of residence and having a tubal sterilization.

RESULTS

Bivariate Results

The results in Table 1 indicate that 16 percent of all women 15 to 44 years old report that they have had a tubal sterilization surgery. When examining region of residence, southern women are most likely, 19 percent, to report having a tubal sterilization surgery, compared with 16 percent of women living in the Midwest, 14 percent in the Northeast, and 13 percent in West. This pattern agrees with prior bivariate findings (Chandra 1998; MacKay et al. 2001; Schwartz et al. 1989; Taffel and Placek 1987) that the South has the highest proportion of women who are surgically sterile. Next, Table 1 indicates that more rural women, 21 percent, report having a tubal sterilization compared with 14 percent of urban women. Religion also patterns whether women report having a tubal sterilization in Table 1; 19 percent of Protestants, 14 percent of Catholics, and 12 percent of those with Other or no religion have a tubal sterilization. This finding agrees with and updates prior NSFG findings (Chandra 1998), which report that Protestant women have the highest rate of tubal sterilizations across religious groups.

Additionally, Table 1 reports the bivariate relationships between women who report having a tubal sterilization and the control variables of interest in this analysis. First, it is noteworthy that women who report a tubal sterilization are on average 6.4 years older than women in the general sample, 35.9 compared with 29.5 years. Agreeing with prior findings on tubal sterilization, the bivariate analysis shows that older women, black and Hispanic women, ever married women, and women with higher parity are more likely to have a tubal sterilization. Among women who have had an unwanted pregnancy, 34 percent have a tubal sterilization, compared with just 11 percent among those who have not experienced an unwanted pregnancy. Next, women who report having a tubal sterilization appear to have less education and lower income on average, compared with

women in general. Also, as education and income increase, women are less likely to have a tubal sterilization. Finally, women using Medicaid, government-provided, or no insurance are more likely to have a tubal sterilization, compared with those who have private insurance. Next, all of these bivariate relationships will be examined in a logistic regression framework to test whether they hold, all else being equal.

Logistic Regression Results

Logistic regressions are used to test this study's hypotheses in Table 2. The odds ratio can be interpreted as the log odds that an event such as having a tubal sterilization may occur. An odds ratio farther from 1 indicates that a larger effect exists, and an odds ratio greater than 1 indicates an increase in odds, while an odds ratio less than 1 indicates a decrease in odds in the dependent variable (Menard 1995). For example, an odds ratio of 1.5 means that the odds are 1.5 greater that an event - a woman will report having a tubal sterilization - will occur than not occur.

Model 1 of Table 2 provides initial support for the hypothesized southern place effect, presenting the focal variable, southern region of residence, as the reference category, and indicating that the log odds are less for those living in the Northeast, Northwest, and West to report having a tubal sterilization than those living in the South. Model 2 includes the independent variables of rural residence and religious affiliation, and the control variables of age, race and ethnicity, marital status, parity, unwanted pregnancy, educational level, income level and type of health insurance. This model indicates that women living in the South are more likely to have a tubal sterilization, net of other possible relationships. Women from the Northeast have a 28 percent lower likelihood, women from the Northwest a 30 percent lower likelihood, and women from the West a 38 percent lower likelihood than women in the South to report having a tubal sterilization.

In Model 3 of Table 2 the focal variable - southern region of residence - is associated with a higher likelihood of a woman having a tubal sterilization. Providing additional support for the first hypothesized place effect, women residing in the South have about one-and-one-half greater odds of having a tubal sterilization, compared with women living outside the South. When rural residence, religious affiliation and the control variables are included in Model 4 of Table 2, southern region of residence, rural residence, and Protestant religious affiliation are significant in similar directions and magnitudes as Model 2. These findings support the second hypothesis regarding the likely independent effects of these variables; in addition to southern region of residence, rural residence and Protestant religious affiliation are associated with an increased likelihood of having a tubal sterilization, all else being equal.

Model 5 of Table 2 regresses having a tubal sterilization on three interactions - living in the South and rural residence, living in the South and Protestant religious affiliation, and living in the South and Other or no religious affiliation - and includes their independent effects and the control variables. These results provide no support for the third hypothesis that rural residence and Protestant religious affiliation moderate the southern effect on the likelihood of having a tubal sterilization; the interactions of South-and-rural and South-and-Protestant are not significant. Surprisingly, however, the interaction of South-and-Other-or-no-religion is significant, but runs in the opposite direction of the independent effects of living in the South and having Other or no religion. Those from the South who report Other or no religion are one-half as likely as

Catholics outside the South to have a tubal sterilization. Once the moderating effect of southern individuals with Other or no religion is added to Model 5, the independent effects of South and Other or no religion increase in magnitude.

Overall, Model 5 shows that women living in the South have roughly a 1.5 times greater likelihood of having a tubal sterilization compared to women living outside the South, net of other effects. Additionally, rural women have over twice greater odds as urban women, and Protestant women have about 1.5 greater odds than Catholics, to have a tubal sterilization. These findings indicate that southern residence is a key variable to include, because there is a relationship between living in the South and having a tubal sterilization which is independent of the other relationships. Agreeing with prior research on tubal sterilization using the NSFG and other data sources (Bass and Warehime 2009; Borrero, Abebe et al. 2010; 2010b; 2007; Chandra 1998; Godecker et al. 2001; MacKay et al. 2001; Metoyer 2009; Warehime et al. 2007) and speaking to the validity of these data for this analysis, Model 5 also shows that women at older ages, black women compared with white women, ever-married women compared with married women, women with more births, women who have had an unwanted pregnancy, women with less education and lower income levels, and women on Medicaid are more likely to have a tubal sterilization.

The Wald model fit statistics - Wald chi-square and degrees of freedom - at the bottom of each model tests the null hypothesis that the coefficients of interest are simultaneously equal to zero. Each model is significantly improved by the addition of the variables considered over a null model. Additionally, comparing across the first two nested models in Table 2, Model 2 is a better fit than Model 1, and there is improvement in the model fit for the nested models of Model 3 to Model 5, with Model 5 being the best fit of the data, hence rejecting the hypotheses that each of the smaller models are the "true" models. The difference in Wald model fit chi-square statistics, degrees of freedom, and a chi-square distribution table are used to assess improvement in model fit from the smaller "nested model" to the next larger model (i.e., at the $p < .01$ level). Finally, while these statistics provide evidence that the results are trustworthy, the model building process in this analysis is foremost informed by theory and other empirical findings on what predicts whether a woman has a tubal sterilization.

DISCUSSION

Using data from the NSFG restricted-use and public-use data files, this research examined the hypothesis that there is a southern region place effect associated with the likelihood to have a tubal sterilization. Supporting the first hypothesis, this research finds that the likelihood of having a tubal sterilization is influenced by *southern place* of residence, net of other effects. This is an important finding, and it is the first time that southern place of residence has been included in a multivariate analysis explaining tubal sterilization. Women living in the South face a markedly higher likelihood - an over 1.5 times greater likelihood - of having a tubal sterilization compared to women living in other regions. As a result, this study provides new information on the regional geographic patterning of the likelihood of American women having a tubal sterilization, a largely permanent form of birth control.

Providing support for the second hypothesis, southern region continues to be a significant predictor at the same time that rural women and Protestant women are more likely to report

having a tubal sterilization compared to urban and Catholic women, respectively. While causality is limited due to the cross-sectional nature of the data, there is no evidence that these associations are spurious. These relationships remain and are substantial even when controlling for likely selection effects. Southern place of residence stands as a marker of inequality that explains a greater likelihood that women will have a tubal sterilization.

Adding to and expanding prior theorizing and research on place and other aspects of women's health (Dyck 2003; Ellaway et al. 2001; Kearns 1993; Kearns and Moon 2002; Moss and Al-Hindi 2007), this research highlights the importance of residing in the South as a macro-level, place-effect variable to explain the reproductive health disparity of having a tubal sterilization. While previous research has connected the higher rate of tubal sterilization in the South with higher parity for southern women (Chandra 1998; Schwartz et al. 1989; Taffel and Placek 1987), this research documents the relationship between southern residence and having a tubal within a multivariate framework and shows that a southern region effect remains even when controlling for the higher parity of individual women who live in the South. In this way, this research provides validation and extends the results of the earlier parity finding. This study also provides a direct quantitative test of the "Mississippi appendectomies" detailed by Sered and Fernandopulle (2005) using a nationally representative data set, the NSFG survey data. This research extends the qualitative Mississippi appendectomy finding with evidence that the tubal sterilization procedure represents a health disparity for southern women more generally.

This southern finding means that it is not only the composition of southern individuals (i.e., having personal characteristics such as less education, lower income, or higher parity), but it could be a southern context of more limited health choices (i.e., lower access and knowledge of alternative reproductive health options) that defines women's reproductive health. After clearing the hurdles of having health insurance and income, which is less likely for those living in the South, there is another significant barrier related to a disadvantaged southern place of residence that thwarts the likelihood of receiving a full set of contraceptive options. For example, interviews conducted by Sered and Fernandopulle (2005) indicate that women with tubal sterilizations in Mississippi are constrained monetarily - being covered by Medicaid rather than a private health insurance plan - and seem to have had a tubal sterilization without complete information. More measures of attitudes and knowledge of tubal sterilization and awareness of contraceptive alternatives - similar to those used in the Borerro et al. (2010a) study of patient-level factors - are needed in the NSFG instrument to test whether this higher level of tubal sterilization for southern women can be attributed to a lower level of reproductive health care for women in general who live in the South.

As an alternative to this place effect translating into a lower access to reproductive health care, there could also be a southern cultural difference (e.g., an overall greater patriarchal tendency net of other effects) which is not captured within the NSFG data resource. Somewhat dated research indicates that gender role attitudes tend to be more conservative in the South; southerners are found to hold more conservative attitudes on questions about women in politics and women employed outside the home (Rice and Coates 1995). These conservative attitudes regarding expectations for women may spill over into the reproductive realm. Perhaps women are seen as holding the responsibility for contraception, and tubal sterilization offers women more certainty and no accommodation on the part of the male. However, this research is reticent to suggest that an underlying, unmeasured cultural trait of the South provides the explanation for this southern region effect without valid measures of patriarchy within the NSFG instrument to confirm this. More research and additional measures are needed to disentangle the underlying reasons for this regional effect.

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There is no support for the third hypothesis regarding the moderating effects of rural and Protestant religious denomination for southern women who opt to have a tubal sterilization. It is not rural or Protestant women in the South that drive the southern region effect. The interactions indicate that there are separate and independent effects of southern region, rural residence, and Protestant religious denomination; southern women, rural women, and Protestant women are more likely than their counterparts to have a tubal sterilization. As a result, this study extends prior research findings that have noted the importance of living in a rural area (Bass and Warehime 2009) and Protestant religion (Chandra 1998) on the likelihood of having a tubal sterilization. Much like Lopez found Hispanic women have comparatively higher tubal sterilization rates due to a larger Hispanic culture of patriarchy (i.e., social constraints and expectations) and a structural context of being poor with less education, this research finds that women living in the South may also be viewed as opting for the tubal sterilization within a larger context of confining social expectations and a structural context of limited alternatives due to southern residence, yet this southern effect is not moderated by rural residence and Protestant religious influences.

Agreeing with Chandra (1998), the bivariate results of this analysis use more recent NSFG data to update the finding that Protestant women are more likely than Catholic women to have a tubal sterilization. There is a moderating effect of Other or no religion on the southern effect, which runs in a counter direction. While the independent effects of living in the South and reporting Other or no religion are associated with a higher likelihood of having a tubal sterilization, the interaction of South and Other or no religion is associated with a lower likelihood (i.e., the odds being one-half as likely) of having a tubal sterilization. Because the Other or no religious category is relatively small and more heterogeneous than the other religious denomination categories, future research beyond the scope of this analysis is needed to disentangle this relationship across living the South, the composition of the Other or no religion category, and the likelihood to have a tubal sterilization.

The inclusion of other likely predictor and control variables agrees with prior research on tubal sterilization using the NSFG and other data sources (Bass and Warehime 2009; Borrero, Abebe et al. 2010; 2010b; 2007; Chandra 1998; Godecker et al. 2001; MacKay et al. 2001; Metoyer 2009; Warehime et al. 2007) and adds validity to these data for this type of analysis. Specifically, this research agrees with prior research holding that older women, black women compared with white women, ever-married women compared with married women, women with higher parity (i.e., more births), women who have had an unwanted pregnancy, women with less education and lower income levels, and women on Medicaid are more likely to have a tubal sterilization. Considered together, these relationships agree with prior studies (Bass and Warehime 2009; Borrero, Abebe et al. 2010; Borrero, Moore et al. 2010; 2007; Ginsburg and Rapp 1995;

Lopez 2008; Metoyer 2009; Poland et al. 2005; Roberts 1997; Schoen 2005; Stern 2005; Torpy 2000) that connect social status and a lower level of health care and therefore outcomes. The lower health outcome of having a tubal sterilization disproportionately affects women who are least likely to act upon a desire for reversal due to their low income. In this way, social milieu, social status, personal resources, and specific ideas about appropriate health care for low-income individuals come together and translate into a social disparity in health (i.e., as originally conceptualized by Braveman et al. 2004), for the southern women who have a tubal sterilization in this analysis.

However, this study and prior studies provide useful direction for medical and public health professionals. While Greil et al. (2010) assert the need to consider how social considerations largely shape and construct infertility, Borrero, Abebe et al. (2010) have already evidenced a connection between the misinformation and limited awareness of contraceptive alternatives among black women and their likelihood to have a tubal sterilization, compared with white women. If southern women are considered as an analogously disadvantaged group as black women, but defined by region of residence, the medical and public health community in the South could be addressing any lack of knowledge about alternatives to sterilization for southern women.

Finally, while the findings from this research are compelling, this analysis is also limited to the extent that the NSFG survey instrument does not ask where the respondent lived at the time of the tubal sterilization. The southern residency measure is current residence at the time of the interview. Specific to this set of research questions, it would be useful also to know at what age the respondent had the tubal sterilization, as well as rural or urban residence, type of health insurance coverage, and marital status at the time of the tubal sterilization to understand any underlying relationships and the longitudinal dynamics at play. In addition to *current* socioeconomic and demographic information, there is a need to ask respondents detailed *retrospective* and *longitudinal* socioeconomic and demographic information in order to identify the underlying relationships between region of residence and opting to have the tubal sterilization procedure.

CONCLUSIONS

The major contribution of this study is that for the first time in a multivariate analysis a merged, regional variable - living in the South - from the NSFG restricted-use contextual data file is used to examine and specify that there is a relationship between *living in the American South* and the likelihood of having a tubal sterilization, net of other effects. The social context of living in the South predicts a higher likelihood of tubal sterilization for women, even when other interrelated factors such as income and educational level are held constant. This research illustrates that the

U.S. health care system is experienced differently by southern women, who receive a disproportionately higher number of today's tubal sterilization procedures. This relationship highlights how it is that where one lives can shape a woman's contraceptive experiences and expectations, as well as serve as a geographic marker of lower reproductive health care services. Future studies should consider southern region of residence as a variable of interest in studies of health care disparities in the United States, and continue to explore why this is the case. This study has tested for moderating rural and religious affiliation effects, but has not found that these attenuate the effect of living in the South.

By considering main and moderating effects of other likely predictor variables, this analysis highlights how this disadvantage in reproductive health care takes place for women living in the South quite independently of other social factors (i.e., living in a rural area, having Protestant religious affiliation) and other areas of economic and social disadvantage (e.g., such as lower income, less education, and minority racial-ethnic group status) that these women may experience. This difference in reproductive health care for southern women is systematic and associated with a lower level of social advantage in society. Policymakers and medical practitioners should be made aware that there is a disparity in reproductive health for women living in the American South, and sensible policy and practice should address this issue.

ABOUT THE AUTHOR

Loretta Bass focuses on stratification issues and works in West Africa, the United States, and France. Her current work examines the integration of African immigrant children and their mothers in France; the relationship between inequality in health as it affects child and family well-being in the United States; and child labor and trafficking in Africa. She has published in *Population Research and Policy Review*, *Current Sociology*, *Sociological Inquiry*, the *International Journal of Sociology and Social Policy*, the *Sociological Studies of Children and Youth*, the *Journal of Reproductive Health*, *Political Behavior*, *Anthropology of Work Review*, and the *Journal of Sociology and Social Work*. Her research has been supported by grants from the Howard Foundation, the U.S. Agency for International Development, the U.S. Census Bureau in cooperation with the Joint Center for Poverty Research at Northwestern/University of Chicago, the Rutgers' University Center for Children Fellows Program, and from the University of Oklahoma.

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