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Rural-Urban Differences in Tubal Ligation Incidence in Georgia

By

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Master of Public Health

Epidemiology

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Rural-Urban Differences in Tubal Ligation Incidence in Georgia

By

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B.Sc., University of Northern British Columbia, 2012

Thesis Committee Chair: Dr. Penelope Howards, PhD

An abstract of

A thesis submitted to the Faculty of the

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Abstract

Rural-Urban Differences in Tubal Ligation Incidence in Georgia

By Curtis Travers

Rural-urban health disparities are apparent in family planning and contraception availability, affecting over 50 million people in America. Tubal ligations are a very effective form of contraception; however, their permanency can result in regret and requests for reversals to restore fertility. Using data from the FUCHSIA Women's Study, we examined the differences in tubal ligation incidence between large metropolitan, small metropolitan, and rural counties among 2160 women aged 22-45 in the state of Georgia. County of residence was categorized using the National Center for Health Statistics Urban-Rural Classification Scheme. We estimated the effect of residence on tubal ligation using Cox regression. Women without a tubal ligation were censored at age of hysterectomy, age of double oophorectomy, or current age. After adjustment for covariates, women residing in rural counties had nearly twice the incidence rate of tubal ligations compared with women in large metropolitan counties (Hazard Ratio = 1.8, 95% Confidence Interval = 1.3, 2.5). No differences were observed between small metropolitan and large metropolitan counties. Rural women were also less likely to have used hormonal contraception or long acting reversible contraception (LARC) prior to their tubal ligation and were less likely to experience regret. The American College of Obstetricians recommends increased availability and usage of LARC as alternatives to tubal ligations. Our results suggest this message is less likely to reach residents of rural counties.

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TABLE OF CONTENTS

CHAPTER 1

Importance of Family Planning Research

Family planning and contraception use are important issues in women's health**.** Contraception gives women empowerment, control of child-birthing, and provides health and social benefits to mothers and their children. Goals related to family planning have been included in Healthy People 2020 with a target of reducing the proportion of unintended pregnancies to 44%, down from 49% in 2006 (1, 2). Unintended pregnancies are related to risky behaviors by the mother and health risks for the developing fetus including low birth weight, smoking during pregnancy, and late or no prenatal care (3). The current rate of unintended pregnancy in the United States has not changed significantly over the past 20 years and remains close to 50%; much higher than other developed nations (4). Rates have decreased somewhat in higher income women, however the rate of unintended pregnancies are increasing in low income women. In addition, unwanted births in women aged 15-24 nearly doubled between 1995 and 2002 (4).

Highly related to unintended pregnancy rates is contraception method and usage. Women have the option of many birth control methods ranging from temporary, relatively non-invasive methods, such as condoms, to permanent surgical procedures such as tubal ligations. A woman's pregnancy history, age, primary care physician, insurance status, marital status, education, income, and geographical location all may affect her contraceptive choice and options (5). With so many factors affecting contraceptive choice, disparities exist in contraception utilization across the population, and women may not be getting the method of birth control they want or need. Factors related to this disparity include poor physician knowledge and weak counseling practice prior to

method choice. A better understanding of family planning practices and awareness of disparities that exist in contraception access and knowledge are key to improving outcomes.

Physician Contraception Knowledge and Attitudes

Women may have some knowledge of different forms of contraception, but they can be served better with education and counseling on the variety of methods available to them. Primary care physicians (PCP) are often the first point of contact with a medical professional for patients, and it is these physicians that provide information to women requiring contraception. Therefore, it is necessary that PCPs are up to date on current practices, knowledgeable of all methods of contraception available, and able to provide the most appropriate form of contraception to each patient. However, many physicians fail to keep up with current scientific literature and medical recommendations. An online survey sent to 550 PCPs practicing in Pennsylvania, Rhode Island, and Oregon showed many PCPs underestimated the current rate of unintended pregnancies. When asked to estimate the unintended pregnancy rate in the United States, 54% of PCPs underestimated the rate by an average of 23 percentage points (6). Physicians were also more likely to underestimate the risk of pregnancy without contraception and typical-use failure rates of condoms and oral contraceptive pills (6). Of the 550 PCPs surveyed, only 172 completed the survey which resulted in low power for detecting differences among the physicians that underestimated these rates. Despite this low follow-up, the results suggest that improved education of PCPs on contraceptive counseling is needed.

Another study of 524 health care providers including physicians, nurse practitioners, and physician assistants looked at providers' knowledge of contraception and patient eligibility for specific types of contraceptives (7). Providers were asked questions relating to intrauterine, emergency, and hormonal contraception. Nearly 40% of providers had incorrect knowledge of the risk of pelvic inflammatory disease in relation to intrauterine contraception. In addition, 36% of providers incorrectly believed that women with migraine with aura could be prescribed combined hormonal contraceptives without side effects (7). Older providers and providers who did not perform intrauterine contraception (IUC) insertions were more likely to answer questions about contraception incorrectly compared with providers less than 36 years old and providers who did perform insertions (7). This study further highlights the gap in knowledge of current family planning methods and recommendations among health care providers. Improved medical education is required to ensure that women are not restricted or unnecessarily deemed ineligible for specific contraceptives. Strong evidence that many US health providers possess poor knowledge about intrauterine contraception may contribute to the relatively low use of long acting reversible contraception (LARC) in the United States compared with European countries (6, 7). Low use of LARCs may result in high unintended pregnancy and sterilization rates in the United States.

Even if providers have strong knowledge of contraception, their attitude towards certain contraceptives may affect the availability to the patient. Attitudes regarding newer forms of contraception, specifically IUC, is variable with some providers reluctant to recommend IUC or unaware of the benefits of this contraceptive method. Rubin et al. investigated this issue through a survey of knowledge, attitudes, and practice of IUC

provision among 3500 American family physicians (8). This study was subject to low participation with a response rate of only 25% and 869 valid surveys (8). Physicians who inserted IUC were significantly more knowledgeable of IUC with an adjusted odds ratio (OR) of 1.85 (95% Confidence Interval (CI) = 1.32, 2.60) (8). Most physicians were comfortable discussing IUC and believed them to be safe; however, physicians who insert IUC were significantly more likely to be comfortable discussing IUC (OR = 2.35, 95% CI = 1.30, 4.27). Further, physicians who insert IUC were nearly 3 times more likely to believe their patients would be receptive to discussing IUC (8). They also believed IUC to be more effective than physicians who did not insert IUC and were more likely to recommend IUC. Physicians who insert IUC were more likely to be female and have inserted IUC during residency (8). Despite attitudes and knowledge differing between physicians who insert IUC in their practice and those that did not, most physicians believed IUC to be safe and many had been trained on insertion during residency. Therefore, what may be preventing IUC being offered to patients is the application of overly restrictive eligibility criteria which differ from current recommendations. This may result in many women being directed to tubal ligations despite the fact that they may be served better by LARCs.

Attitudes towards LARCs differ according to urban and rural status of the provider. Individuals living in rural areas are at a health care disadvantage as they often have to travel longer distances to receive care and may not have access to certain forms of care. Vaaler et al. investigated this issue in Texas, exploring whether providers' attitudes towards LARCs differed by urban-rural status (9). Surveys were emailed to 224 providers with 43% responding, a relatively high response rate for studies of physicians.

Results showed that 97% of providers would recommend IUC to clients, however the urban and rural providers' differed in their eligibility criteria and considerations when recommending different forms of contraception. Rural providers recommended LARCs to a narrower age range than their urban counterparts and were more likely to consider affordability and feasibility for the practice to obtain contraception when recommending different forms of contraception (9). For hormone implants, rural providers were significantly less likely to recommend implants and had less favorable attitudes toward them. Only 60% of rural providers would recommend hormone implants to their patients compared with 90% of urban providers (9). This study adds to the evidence showing the lack of knowledge regarding newer forms of contraception, specifically LARC, among health care providers. Incomplete knowledge of current contraception and failure to keep up with recommendations has a direct effect on patients health. Regarding contraception, if providers are using out-of-date recommendations, women may not be receiving the appropriate form of contraception for their needs. This can lead to higher rates of unintended pregnancy and early sterilization.

History and Trends of Tubal Ligations

Tubal ligations provide women a permanent contraception option with very low rates of failure, which only requires one medical appointment. These procedures have been performed for over 100 years with the first performed in 1880 in Toledo, Ohio. Since then, they have become one of the most popular methods of contraception in the United States and the world (10). Despite its current popularity, the process was not widely accepted at first and was not available nationally until 1972 (10). At which time

there was a dramatic increase in tubal ligation rates. At the beginning of the decade, there were approximately 200,000 tubal ligations performed per year. By the end of the decade this number had more than tripled with a peak of 702,000 procedures performed in 1977 (11). During this time, the procedure had become more efficient. When it became widely available in 1970, the average length of stay in hospitals for all tubal ligation procedures was 6.5 nights, but over the next 8 years, this decreased to 4.0 nights (10).

Since the 1970's, there has been a decrease in the number of procedures which coincides with the increased variety of contraceptive methods available to women. From 1995 to 2006, the number of procedures in the US decreased from 687,000 to 643,000 per year despite a 4% population growth in women from 15-44 (11). However, despite this decrease in the number of sterilizations performed each year, it is still a common method of contraception. Currently in the United States, an average of 640,000 women undergo tubal ligations each year, and it is the fifth most common operation performed (11). Estimates from the National Survey on Family Growth place sterilization as the second most popular form of contraception in the US and the most common contraception method among married women and women over the age of 30 (12, 13). Data from the Behavioral Risk Factor Surveilance System suggest it is the third most commonly used form of contraception (14). As of 2008, 10.3 million American women aged 15-44 were currently sterilized for contraception (13). This represents 17% of the female population of this age and 27% of those women using contraception. Tubal ligations are not just a popular form of contraception in the US, but also worldwide. Globally, tubal sterilization is the most commonly used method of contraception in women with approximately 180 million women of reproductive age (15-44) being sterilized (10).

Tubal Ligation Procedures

Since 1972 when tubal sterilizations became nationally available in the US, the sterilization techniques available have increased. Women are offered a number of sterilization procedures, which are closely related to when the woman chooses to have the operation performed. Tubal ligations may either be performed postpartum or as a procedure not associated with pregnancy, which is termed an interval procedure (10). Approximately half of all sterilizations performed in the United States occur postpartum during the same hospitalization for the pregnancy delivery (10). Postpartum and interval tubal ligations may be performed by laparotomy, laparoscopy, or hysteroscopy. Most postpartum procedures are performed using laparotomy, whereas interval procedures commonly utilize laparoscopy. Hysteroscopy methods are the least common (10). After incision, the doctor has a number of options by which to occlude the ovaries. These include partial salpingectomy, electrocoagulation, and mechanical occlusion techniques including silicone rubber bands, spring clips, titanium clips, or microinserts (10). Partial salpingectomy is the most common method where a loop of fallopian tube is created, ligated, and resected. Electrocoagulation uses two electrodes and a stream of electricity to form a blockage of the tubes (10). The rubber band method is performed by retracting the fallopian tube into an applicator and then placing a rubber band at the base of the loop. The spring clip method utilizes a clip that is applied to the tube perpendicular to the long axis of the tube (10). This method has been shown to be the safest at time of surgery, but has the highest risk of failure (13).

Prevalence of Regret

Although sterilization has low failure rates and is a permanent solution to birth control, there are side-effects due to the permanency of this procedure. Reversal is a difficult, invasive procedure that is often not covered by insurance and is not 100% effective. In fact, the reported success rates of reversal can range from a low of 20% to a maximum of 70% (13). Therefore, there is often regret associated with tubal sterilization. The prevalence of regret is, in fact, quite high among sterilized women in the United States with reports indicating that up to 30% of women experience regret after sterilization (13). The most common reason for regret is the desire to have more children, however a change in marital status is also a common reason (13).

Not all women have the same risk of regret. Regret has been reported to be associated with young age, non-white race, having a postpartum procedure, and a change in marital or partner status (13, 15). A systematic review of the literature on tubal sterilization regret has shown a strong association between the age of women at time of procedure and risk of regret. A study of women in Puerto Rico reported a 10% increase in the risk of regret for every year decrease in age at the time of the procedure (15). Further, a prospective cohort study of over 11,000 American women over 14 years showed a 20.3% risk of regret in women age 30 and younger compared with a much lower incidence of regret of 5.9% among women older than 30 (15). In addition to regret, younger women are more likely to request a reversal procedure with 14% of women who were sterilized prior to age 30 requesting reversal compared with only 6% among those women sterilized after age 30 (15).

A lack of counseling may be the root cause of unnecessary sterilization and resulting regret. A survey study of women from 2002 to 2008 showed that many women are not aware of the advantages and disadvantages of tubal ligations (16). For instance, 45% of women thought that sterilization reversal could easily restore fertility, 35% thought their fallopian tubes would grow back together after 5 years, and 25% were not aware of other non-permanent methods of contraception that have proven to be as effective as sterilization (16). These figures were even greater among black women after adjusting for socioeconomic status. This shows that counseling is extremely important when a woman considers sterilization because many women, especially young women below the age of 30, would be better served by other contraceptive methods.

Long Acting Reversible Contraception Trends and Advantages

Long-term reversible options offer contraceptive alternatives to traditional short-term options such as oral contraceptives and permanent options such as tubal sterilization. LARC includes intrauterine devices (IUD) and hormonal implants. The advantage of LARCs compared with other reversible methods is that they require very little follow-up by the user. When compared with sterilization, it offers the user a reversible method with a short time to recovering fertility after discontinuation.

LARCs have significant advantages over sterilization and other forms of contraception. Perhaps most importantly, LARCs have tremendous effectiveness. They have the lowest 1 year risk of unintended pregnancy compared with other forms of contraception. With typical use, the risk of unintended pregnancy is 0.05% with implant use and 0.2% with levonorgestrel releasing IUD use (4). In contrast, the failure rates for

typical oral contraceptive use is 9% and for sterilization is 0.5%. In addition to efficacy, LARCs have been shown to be the most cost effective method of contraception with a 5 year cost savings of approximately $14,000 compared with using no method (17). This was calculated using the average cost of an unintended pregnancy and the number of unintended pregnancies avoided over 5 years. In contrast, tubal ligations have a 5 year cost savings just below $12,000 (17). LARCs also have been shown to have higher continuation rates than other methods. A study of 4,167 women aged 14-45 showed a 1 year continuation rate of 86% for LARCs compared with only 55% continuation in other short acting methods (18). Other advantages include independence from user action, no requirement for frequent doctor or pharmacy visits for resupply, and no cost once placed (4).

From 1995-2010, LARC use in metropolitan areas has increased from 1% to 5.5% among women aged 15-44 using contraception, and LARC use has increased in non-metropolitan areas from 0.6% to 5.3% (5). As of 2010, IUD use was 3.5% among all women aged 15-44 (5). Despite this increase, LARC use is lower in the United States than in Europe (19). The United States has much higher rates of unintended pregnancy than Europe with rates in the United States close to 50% compared with approximately 33% in Europe (4). In the United States, expanding access to LARCs for young women has been declared a national priority in order to decrease the rate of unintended pregnancy (4). It would also be expected to decrease the number of tubal ligations performed and increase the age at tubal ligation. Increased LARC usage would greatly improve family planning and associated health outcomes, especially among young

women who are the greatest risk for regret and for negative outcomes associated with tubal ligations.

Currently there are three LARC methods available in the United States. The single-rod etongestrel implant was approved by the FDA in 2007 for contraceptive use for up to 3 years. There are also 2 IUC available: the copper T380A approved for use for up to 10 years and the levonorgestrel releasing IUD approved for use for up to 5 years (4). The implant is placed in the upper arm and releases hormones to act as birth control (20). All LARC methods can be placed during a single clinic visit and are fast-acting. The IUDs begin acting immediately, and the implant acts within 48 hours (20).

Although sterilization remains an effective form of contraception it has been surpassed by other methods, specifically LARCs. Their advantages have been well documented, and the American College of Obstetricians and Gynecologists (ACOG) now recommends their use over sterilization for many women (4). Specifically, ACOG states that LARCs are the most effective reversible method for preventing unintended pregnancy, rapid repeat pregnancy, and abortion (18). Currently, women with a history of unintended pregnancy are much more likely to undergo sterilization, but they should be made aware of LARCs and their advantages. In all women, including those considering sterilization, LARCs should be offered as first-line contraceptive methods and should be encouraged as options for most women (4).

Factors Affecting Tubal Ligation Rates

Despite these recommendations, some groups of women appear to undergo sterilization procedures when using LARCs would be more beneficial. Black and

Hispanic women are more likely to use sterilization as a form of contraception compared with white women (13). A survey of 13,000 women from the National Health Statistics Report showed that 37% of both black and Hispanic women aged 15-44 were sterilized for contraception compared with only 24% of white women (5). A recent study by Borrero et al. investigated these racial differences further, looking at the role of patient-level factors underlying this racial discrepancy (16). Using a self-administered questionnaire provided to 193 women who had undergone tubal sterilization, the authors investigated the reasons behind choosing sterilization, a women's knowledge of sterilization and alternatives, and the people who influenced choosing sterilization. Black women who had undergone sterilization had a higher prevalence of a previous unintended pregnancy (80% vs. 54.5%), greater likelihood of sterilized family members (OR = 2.39, 95% CI = 1.25, 4.53), less knowledge of tubal sterilization (OR = 0.44, 95% CI = 0.22, 0.91), and decreased likelihood of having heard of IUC (OR = 0.11, 95% CI = 0.02, 0.83) compared with sterilized white women (16). Black women were also more likely to be single at the time of sterilization (31.2% vs. 9.5%) (16). These results suggest inadequate prior counseling on tubal sterilization and LARCs among black women.

A number of other factors have also been reported to be associated with tubal ligation use including lower education status, being married, increased parity, poverty, history of unintended pregnancy, rural residence, and having public or no insurance (5, 13). The National Health Statistics Report explores some of these factors further. Increases in income correspond to decreases in tubal ligation rates with 43% of women below 150% of the federal poverty line being sterilized and only 14% of women above 400% of the federal poverty line being sterilized (5). The association between higher

income and better insurance may partially explain these numbers because women with higher income may be able to pay the initial costs of LARCs, whereas poorer women may not have insurance coverage for LARCs but may have coverage for tubal ligation. In one study, formerly married women had the highest prevalence of sterilization at 56% compared with 30% of currently married women and 10% of never married women (5). This difference may partially be explained by age. Younger women are more likely to have never been married, and formerly married women may have finished having children and been looking for permanent options of sterilization. However, the relationship between age and marital status was not investigated in this report. Among young formerly married women, tubal ligation may not be the best course of treatment because they may wish to have children later with a new partner. Another predictor of tubal ligation is rural residence. From 1995 to 2010 the proportion of women in non-metropolitan areas with a tubal ligation has increased from 32.6% to 34.7% in the United States. During this same time span, in metropolitan areas, this proportion decreased from 27.7% to 23.5% (5). Thus, tubal ligation rates are decreasing in metropolitan areas and increasing in non-metropolitan areas. A number of underlying factors may explain this association further, but these factors have yet to be thoroughly investigated.

To decrease tubal ligation rates and remove barriers to LARC use, ACOG has recommended increased educational and hands-on training opportunities for clinicians in implant and IUD insertion (4). Further, to improve the familiarity with LARCs, the Food and Drug Administration (FDA) now requires health care providers to participate in manufacturer-sponsored training for implants (4). These recommendations are expected to increase LARC use, increase age at sterilization, and decrease rates of unintended

pregnancy. To further overcome barriers to LARC use, ACOG recommends a strong counseling system on contraceptive options, encouraging LARCs for all appropriate candidates, adopting same-day insertion protocols, avoiding unnecessary delays, support efforts to lower up-front costs, and coverage of all contraceptive methods by all insurance plans (4). Strong counseling on both the cost and efficacy benefits of LARCs is likely to have the greatest benefits on LARC use (4). Implementing this knowledge and system in all clinical practices is key to overcoming barriers to LARC use, decreasing unintended pregnancies, and minimizing regret of sterilization.

Rural-Urban Health Disparities Background

With the documented gaps in family planning knowledge among practitioners, rural urban differences in this knowledge, and the disparities revolving around sterilization versus LARC use, questions regarding rural urban disparities related to sterilization and contraception remain. Improving health in rural areas has been a long standing issue. In the United States, 50 million people live in rural areas equating to 16% of the US population. However, only 9% of physicians practice in these area (21). Residents in rural areas are not located uniformly across the United States with three quarters of rural residents living in the Midwest or South regions. The South has 22.3 million people living in rural areas, the most of any region (22). This equates to nearly 20% of all southern residents. In 2011, 28.1% of Southern residents were obese, but 31.0% of rural residents are obese compared with 27.4% of urban residents (22). Rural residents are also more likely to smoke and be physically inactive than their urban counterparts. These differences in risk factors lead to differences in chronic health

conditions. In a 2011 survey of PCPs, rural physicians were more likely to perceive negative health in their communities than urban physicians. A large proportion of physicians in the rural South reported hypertension (84%), teen pregnancy (38%), and diabetes (93%) to be major health problems affecting their communities. These proportions are much greater than those for urban physicians (71%, 27%, and 82%, respectively) (22). Even after adjustment for age, the prevalence of hypertension and arthritis is 5% and 6% higher, respectively, in non-metropolitan areas compared with metropolitan areas (22).

Rural residents also differ from urban residents with respect to insurance coverage. In rural areas, 31% of the population uses Medicare or Medicaid as their primary source of coverage while only 25% of the urban population utilizes public insurance (22). Once again, this disparity is even greater in the South. Being enrolled in a public health insurance plan has disadvantages. Although these plans cover most services, many health care providers do not accept Medicare or Medicaid plans thus limiting an individual's access to care. In the context of family planning, southern residents may not have access to providers who provide LARCs or may have access to providers who only provide LARCs based on strict eligibility criteria. As a result, women may be more likely to undergo tubal ligations.

There is a deficit of physicians in the South with only 87.2 PCPs per 100,000 population, the least of any region in the United States (22). However, in rural areas there are even fewer physicians and nurses per capita (21). Nationally, the density of PCPs in rural areas is less than urban. In the South, this disparity is large with only 57.7 PCPs per 100,000 residents in rural areas compared with an urban density of 94.4 PCPs per

100,000 (22). Because of the deficit of physicians, rural communities depend on small clinics and health centers where non-physician health professionals, such as nurse practitioners, see a high proportion of the patients. There is also a deficit of specialists in rural areas. Specialists represent 44% of all physicians in urban areas, whereas they embody only 31% of rural physicians (22). This difference is especially high in family planning and reproductive services where there are 55% fewer obstetricians and gynecologists (OB/GYNs) in rural areas than in urban areas (22). This results in rural residents being more likely to have transportation barriers to specialty services. Fifty-one percent of rural patients are referred more than 20 miles away for specialty services compared with only 6% of urban patients, and only 33% of rural patients are referred to specialty practices within their city. Furthermore, rural patients report an average distance of approximately 60 miles between their PCP's office and their specialist (22). Lack of access and transportation barriers represent significant hindrances to receiving the recommended standard of care which can lead to health disparities between rural and urban populations. In terms of specialty care, it has been shown that rural residents are diagnosed at later stages of cancer, do not receive recommended radiation therapy as often, and are more likely to undergo mastectomies (23-25).

Not only do rural counties have poorer health outcomes, but they also have a poorer quality of care. A national consumer survey found that one quarter of rural residents viewed their local care as fair or poor compared with only 12% of urban residents (22). Fewer rural residents viewed their care as excellent than urban residents (19% vs. 31%, respectively). In addition to rural patients having poorer views of the quality of their care, but physicians also view care in rural areas to be of lower quality

than urban areas. Only 21% of rural PCPs described the quality of care from their local hospital as excellent, whereas 15% viewed it as fair or poor. This compares to 33% of urban PCPs describing it as excellent and 10% as fair or poor (22). A national study by United Health Group attempted to understand these differences in a quantitative sense. Rural and urban doctors were compared with each other within regions on a number of performance indices. Performance of rural physicians was below urban performance in 75% of the regions with the greatest discrepancies being found in Southern regions (22). The greatest disparity was seen in cancer screening with a 20% gap in performance between the lowest performing rural areas and the average for urban areas (22). The difference in proportion of patients receiving evidence based care for more common conditions such as hypertension and migraines was much smaller. Differences in practices related to family planning were not reported despite evidence for poorer reproductive health in rural areas (26, 27).

Rural Health Disparities in Contraception

Counseling, education, and access are important factors in family planning and contraception. With the apparent disparities between rural and urban health outcomes, such as unplanned pregnancy, it is important to learn how education and healthcare may need to be adjusted to respond to these disparities. Despite the variety of birth control methods available, there have been few population based research studies that compare the choices of rural and urban adults. Tobar et al. performed the largest study looking at this issue using data from the 2004 BRFSS (14). Contraceptive choices of adults age 18-55 were compared considering rural-urban status, race, household income, gender,

education, and marital status. Rural and urban counties were categorized based on 2003 Rural-Urban Continuum codes. Their results showed 64% of rural respondents were using some form of contraception compared with a national average of 62%. Among urban respondents, the top three forms of contraception were non-injectable hormones, condoms, and female sterilization (29.0%, 24.6%, and 18% of those using contraception, respectively). This compares with the top three choices in rural respondents of female sterilization, non-injectable hormones, and male sterilization (27.7%, 27.3%, and 17.4% of those using contraception, respectively) (14). These differences are unlikely to be due to sex because urban and rural respondents had a similar proportion of females (43.2% and 40.2%, respectively). One of the reasons suggested for these differences in contraceptive practices is the lack of healthcare access in rural areas. For adults who have completed their reproductive goals, the lack of access to alternative forms of contraception may lead them to seek out sterilization as a permanent, low follow-up, form of contraception. This is goes against recommendations by ACOG, and may lead to a high incidence of regret (15, 28).

Although tubal ligation remains one of the most used forms of contraception, despite recommendations for increased usage of LARCs and the clear differences in rural and urban contraception practices, there have been few epidemiological studies that have examined tubal ligation specifically in urban and areas. Lunde et al. used data from the National Survey of Family Growth interviews to specifically look at differences in tubal ligation of rural versus urban women in the United States (29). The study restricted analyses to women who did not want to become pregnant, and excluded infertile women, women who were surgically sterile for noncontraceptive reasons, and women who had

not had sexual intercourse within the past 3 months. In addition, analyses were restricted to women age 20-34 years old, based on preliminary results that suggested this age group was less likely to wish to have their tubal ligation reversed than women aged 35 years or older (29). Rural and urban residence was classified using United States Office of Management and Budget standards, with suburban and urban areas combined for analysis. After exclusions, 4685 women who were at risk for unintended pregnancy were available for analysis (696 rural, 3989 urban). Rural residents were of similar age, had similar parity, and had similar history of unintended pregnancy to urban residents, but they were also poorer, had less education, and were more likely to be white (29).

Bivariate analysis showed that 22.75% of rural residents were sterilized compared with 12.69% of urban residents. Sterilization was also associated with being older, being non-white race, having lower income, having public or no insurance, having less education, being currently married or divorce, having higher parity, and having a history of unintended pregnancy (29). Stratified bivariate analyses were performed to determine variables of greatest disparity. Women under 30, below the poverty line, on public insurance, without a high school degree, divorced, without children, and without a history of unintended pregnancy had the greatest disparities between urban and rural residence regarding sterilization (29). Of note was that increased education decreased this disparity drastically, so much so that in women with more than a high school degree, there was no difference seen in the prevalence of sterilization between rural and urban women. Educated rural women would likely be more aware of their contraception options, specifically LARCs.

Results were further analyzed using logistic regression controlling for race and ethnicity, income, insurance, education, parity, history of unintended pregnancy, and relationship status. Potential interaction between location and education was also evaluated. Rural residents without a high school degree were more likely to be sterilized than all residents (both rural and urban combined) with more than a high school degree (OR = 8.34, 95% CI = 4.45, 15.61) (29). Rural residence with a high school degree, urban residence without a high school degree, and urban residence with a high school degree were all associated with increased odds of tubal ligation compared with all women with more than a high school degree (OR = 3.26, 1.95, 1.76, respectively). Older age, lower income, parity, and history of unintended pregnancy remained statistically significant predictors of sterilization after adjustment. Lunde et al. suggest that limited access to alternative methods of contraception in rural areas result in women choosing to undergo tubal ligations. This is supported by work from Chandra et al. that shows rural women are less likely to access family planning (30). Another proposed explanation of this disparity is cultural differences in childbearing and marriage, with rural women having children and completing their families at a younger age than urban women. This explanation is not supported by Lunde et al., because rural and urban women were of similar ages, had a similar number of children, and had a similar pattern of relationship status. Cultural differences due to race were controlled for in the multivariate model.

The work performed by Lunde et al. provides a better understanding of the apparent disparity in sterilization between urban and rural environments. A strength of this study is that it is a large, nationally representative sample of women. However, there are a number of limitations. Women were categorized as urban or rural based on current

residence, but it is possible that a women's current residence is not the same as where she had her sterilization performed. Other variables associated with sterilization such as income, insurance, and parity are also based on current status, which may differ from the status at the time of the procedure. This represents possible misclassification. In addition, logistic regression does not take into account the time of event. Current age was included in the analysis as a confounder, but it does not account for age at sterilization. Older women have been at risk of having a tubal ligation for a longer period of time and therefore are more likely to have had a tubal ligation performed. Inclusion of age in the model adjusts for potential differences in current age of urban and rural women, but it does not indicate if women are being sterilized at different ages in rural and urban locations. With the differences in physician education and knowledge of LARCs in rural versus urban environments, rural women may be offered tubal ligations at younger ages than urban women.

Contribution of Research

This work builds on the existing literature examining the difference in tubal ligation incidence between rural and urban women. While Lunde et al.'s study evaluated this disparity on a national scale, this work will focus on Georgia, a region that has been shown to have large disparities in rural health. The data come from the FUCHSIA Women's Study, which enrolled over 2600 women aged 22-45 years old. Women completed a computer assisted telephone interview and were asked a variety of questions relating to their overall and reproductive health. Approximately half of the participants are young adult cancer survivors, which will provide insight into disparities related to

tubal ligation among women who have received extensive health care for cancer and therefore might be different from women who have less contact with health care providers. The dataset also contains information on the age of tubal ligation and the reason for the procedure. Through survival analysis using age as the time scale, we are able to assess whether rural women are getting tubal ligations performed at a younger age. Furthermore, the dataset contains sufficient sample size to analyze small metropolitan counties separately from large metropolitan counties, giving us a greater insight to the disparities across regions. Results from this study will further characterize the differences in tubal ligation incidence between urban and rural women. This will provide information that can be used to develop guidelines to address the rural-urban disparities observed in contraception availability and usage.

CHAPTER 2

URBAN-RURAL DIFFERENCES IN TUBAL LIGATION INCIDENCE IN GEORGIA

CURTIS TRAVERS

ABSTRACT

Rural-urban health disparities are apparent in family planning and contraception availability, affecting over 50 million people in America. Tubal ligations are a very effective form of contraception; however, their permanency can result in regret and requests for reversals to restore fertility. Using data from the FUCHSIA Women's Study, we examined the differences in tubal ligation incidence between large metropolitan, small metropolitan, and rural counties among 2160 women aged 22-45 in the state of Georgia. County of residence was categorized using the National Center for Health Statistics Urban-Rural Classification Scheme. We estimated the effect of residence on tubal ligation using Cox regression. Women without a tubal ligation were censored at age of hysterectomy, age of double oophorectomy, or current age. After adjustment for covariates, women residing in rural counties had nearly twice the incidence rate of tubal ligations compared with women in large metropolitan counties (Hazard Ratio = 1.8, 95% Confidence Interval = 1.3, 2.5). No differences were observed between small metropolitan and large metropolitan counties. Rural women were also less likely to have used hormonal contraception or long acting reversible contraception (LARC) prior to their tubal ligation and were less likely to experience regret. The American College of Obstetricians recommends increased availability and usage of LARC as alternatives to tubal ligations. Our results suggest this message is less likely to reach residents of rural counties.

INTRODUCTION

Rural residents are at a health care disadvantage compared to their suburban and urban counterparts. Approximately 50 million Americans live in rural counties, which is about 20% of the United States population. However, only 9% of American physicians practice in these areas (21). In addition to a lower physician to patient ratio than urban areas, rural residents also have poorer health outcomes and more risk factors for disease such as diabetes, hypertension, and obesity (22). There is a substantial rural-urban disparity in family planning and reproductive services with 55% fewer obstetrician-gynecologists (OB/GYN) in rural areas than in urban areas, and 10.1 million women living in a county without an OB/GYN (22, 27).

These disparities in reproductive services affect availability of contraceptive options. Tubal ligation is the most common permanent contraceptive option available to women (10). An average of 640,000 procedures are performed each year in the United States, and it is the second most used form of contraception in the United States and the most common among women over the age of 30 (11, 13). Despite its effectiveness, tubal ligation may not be the most appropriate option for many women. The permanency of this procedure can result in women having regret and wishing to undergo the invasive, often ineffective reversal (10, 13, 15). Women who are sterilized at young ages are at the greatest risk for regret (15). Long acting reversible contraception (LARC) offers significant advantages over tubal ligation providing a reversible option that offers birth control lasting for up to 10 years (28). Their usage has increased from 1% to 5.5% from 1995 to 2010 in the United States. This increased usage and acceptance has coincided with a decrease in ligation rates in Europe; however, this has not been observed in the

United States (4). The American College of Obstetricians and Gynecologists (ACOG) advocates LARCs as an appropriate alternative to tubal ligations for nearly all women, especially in women who are under the age of 30, and support increased usage and availability of LARCs (4). One advantage of LARCs is that they can prevent regret and unnecessary reversal surgery in young women who might otherwise opt for tubal ligation.

It has been reported that the prevalence of tubal ligation is greater in rural areas than in urban areas (14). In this manuscript, we assess whether the rate of tubal ligation procedures differs between non-metropolitan, small metropolitan, and large metropolitan counties in the state of Georgia. We utilize survival analysis to determine not only if rural women are having these procedures more often than urban women, but also whether age at tubal ligation differs. This is important because of the association of regret with young age at procedure and because it improves our understanding of the differences in usage of tubal ligations in rural versus urban areas.

METHODS

This study uses data from the FUCHSIA Women's Study; a study of cancer survivors and women without a history of cancer residing in Georgia. Women were required to be between the ages of 22-45 years, have a working telephone number, and have the ability to complete an interview in English. Among cancer survivors, they had to be diagnosed with their first primary cancer between the ages of 20 and 35 years and agree to medical record abstraction for their cancer treatment history. Eligible cancer survivors were identified in collaboration with the Georgia Cancer Registry. Potentially eligible women without a history of cancer were obtained from marketing lists frequency matched to cancer survivors on age and residence. Women were invited to participate in the study by

telephone. Interested women consented orally before completing a computer assisted telephone interview.

The primary exposure for this study was rural versus urban county of residence at the time of interview. Counties were coded according to the 2006 National Center for Health Statistics (NCHS) Urban-Rural Classification Scheme. This scheme categorizes counties into levels of noncore, micropolitan, small metropolitan, medium metropolitan, large fringe metropolitan, and large central metropolitan areas with categories and definitions chosen specifically for their utility in studying health differences across the urban-rural continuum (31). For this study, noncore and micropolitan counties were classified as rural, small and medium metropolitan were classified as small metropolitan, and large fringe and large central metropolitan were classified as large metropolitan (Appendix A).

During the interview women were asked whether they had a procedure to tie or block their fallopian tubes. Women who reported having this procedure were then asked at what age and why they had the procedure. Women who reported having a tubal ligation to prevent pregnancy were classified as having the outcome.

The interview also contained information on a number of covariates including hysterectomy, oophorectomy, birth control methods used, income, education, insurance status, relationship history, pregnancy history, and desire for future children. Pregnancy history was used to determine parity and whether the woman had an unintended pregnancy. Birth control methods used were used to create indicators for ever using hormonal contraception and ever using LARC, which included hormonal implants and intrauterine devices (IUD). Insurance status was categorized as employer based, self-

insured, public (which included Medicaid, Medicare, and military insurance), or none. Hormonal contraception included the pill, patch, Nuvaring, mini-Pill, or Depo Provera.

We fit cox proportional hazards regression using age as the time scale to determine if differences in the rate of tubal ligations existed between rural and urban women. We used generalized estimating equations to account for clustering of women within counties. Time of the event was defined as the age of tubal ligation. Women who had a tubal ligation for reasons other than to prevent pregnancy were censored at the age of their tubal ligation. We also censored women who did not have a tubal ligation at the age of their hysterectomy, oophorectomy, or current age. Potential confounders included race, ever used hormonal contraception (other than LARC), ever used LARC, household income, current insurance status, education, parity, history of unintended pregnancy, and history of cancer. Covariates, other than race and age, whose exclusion changed the main effect by less than 10% were dropped from the final model. The main model included cancer survivors and women without a history of cancer, but additional models were fit stratifying on cancer status.

We performed subanalysis of the women who had received a tubal ligation to determine factors associated with never using hormonal contraception or LARC prior to having a tubal ligation. Predictors assessed in a logistic model included urbanness of county, race, history of unintended pregnancy, parity, current type of health insurance, household income, current insurance status, education, parity, and marital status at the time of tubal ligation.

RESULTS

Of 2636 women interviewed, 272 were excluded because they did not provide information on incidence of tubal ligation, and 204 were excluded because they did not provide a county of residence (n = 2) or lived outside of Georgia (n = 202). After exclusions 2160 women were eligible for analysis with 1548 residing in large metropolitan counties, 372 in small metropolitan counties, and 240 in rural counties. In our study population, 13% of women had a tubal ligation performed to prevent pregnancy at an average age of 30 years. Women from rural counties were more likely to have undergone a tubal ligation (Table 1, Figure 1). Almost 22% of rural participants had a tubal ligation compared with 14% of small metropolitan women and 11% of large metropolitan women. Rural women were also more likely to be non-Hispanic white, to be less educated, to have lower household income, and to have more children than women from large and small metropolitan counties. Women from small metropolitan counties were the most likely to have had an unintended pregnancy and to be on public health insurance. There were no meaningful differences between urban and rural women in their current age, history of LARC or hormonal contraception usage, or relationship status.

The unadjusted odds of having a tubal ligation performed was 1.4 times greater in black women compared to white women (95% Confidence Interval (CI) = 1.1, 1.8) (Table 2). Women that had ever used LARC or hormonal contraception had decreased odds of having a tubal ligation performed (Odds Ratio (OR) = 0.61, 95% CI = 0.5, 0.9; OR = 0.66, 95% CI = 0.4, 0.9, respectively). Women with public or no insurance, and with less than college graduate education were also more likely to have had a tubal ligation (Table 2).

Women in rural areas had tubal ligations more often at younger ages than women in small metropolitan and large metropolitan areas (Figure 1). Based on unadjusted Kaplan-Meier plots, at age 30, 15% of rural women, 9% of small metropolitan women, and 5% of large metropolitan women had a tubal ligation. At the oldest observed age (45 years), approximately 31% of rural women, 16% of small metropolitan women, and 14% of large metropolitan women had a tubal ligation. In unadjusted models, rural counties had a hazard ratio (HR) of 2.5 (95% CI = 1.8, 3.5) compared to large metropolitan counties and small metropolitan counties had a hazard ratio of 1.4 (95% CI = 1.0, 2.0) (Table 3).

After adjustment for race, education, household income, insurance type, and parity the effect estimate for small versus large metropolitan counties moved towards the null (HR = 1.1, 95% CI = 0.8, 1.4), but the estimate for rural versus large metropolitan counties remained elevated (HR = 1.8, 95% CI = 1.3, 2.5). Excluding cancer survivors did not change the results (small metropolitan HR = 1.2 (95% CI = 0.9,1.8) rural HR = 2.0 (95% CI = 1.3, 3.1)).

Among women who had a tubal ligation, rural women were less likely than women from large metropolitan counties to have used hormonal contraception or LARC before having a tubal ligation (OR = 1.32, 95% CI = 0.66, 2.66). Young age, non-white race, history of unintended pregnancy, higher parity, no health insurance, low income, and low education were also predictors of no hormonal contraception or LARC use prior to tubal ligation (table not shown). The odds of not using hormonal contraception or LARC in women with household income below $50,000 was 2.9 times greater

(95% CI = 1.6, 5.1) than women with over $50,000 income. The OR comparing no health insurance to employer based health insurance was 2.5 (95% CI = 1.3, 5.0), and black women had 2.2 times the odds of no contraception use (95% CI = 1.2, 3.9) compared with white women.

DISCUSSION

With 12.5% of our study population having undergone a tubal ligation, our estimate is comparable to the national average of 16.5% for women age 15-44 (5). However, lower income is associated with a higher prevalence of tubal ligations (5). Therefore, the lower prevalence of tubal ligations in our study population may be attributable to the relatively high household income in our population. Assuming an average household size of 4, nearly 50% of our study population was living above 300% poverty level. In contrast, Jones et al. evaluated a population with 38% of participants living above 300% poverty level (5).

Decreasing urbanness was associated with a greater proportion of women having a tubal ligation. More than twice as many of our rural women had a tubal ligation compared with women from large metropolitan areas, consistent with previous findings (14, 29). Unlike prior studies, we were able to separate large and small metropolitan counties. A greater proportion of small metropolitan county women were sterilized compared to large metropolitan county women. However, after adjusting for confounders, women from small metropolitan counties were more similar to women from large metropolitan counties than rural women. In contrast, rural women continued to be almost twice as likely to have a tubal ligation as women from large metropolitan counties after adjustment for potential confounders. Insurance coverage and income differ

between rural and urban women and also differ across women with and without a tubal ligation (22, 32). However, adjustment for these variables did not change the results suggesting additional factors contribute to the difference.

Decreased access to long term reversible alternatives to tubal ligations may explain the disparity between rural and metropolitan counties. The availability of specialized obstetric and gynecologic health practices and family planning clinics is lower in rural areas, and the combination of low population density with less availability of health practices results in longer travel times to receive health care (22, 27). These access to care and travel barriers may discourage rural women from choosing short term contraceptive options. Instead they may prefer tubal ligations because it offers them a permanent option, which would reduce the number of trips to a pharmacy to refill contraception. Alternatively, rural women may be less aware of other contraceptive options, such as LARC.

Among women who had a tubal ligation performed, rural women were less likely to have used hormonal contraception or LARC compared with metropolitan women. Current recommendations suggest that LARCs should be the preferred method of contraception over tubal ligations for most women (28, 33). This may indicate rural women are not receiving appropriate counseling about LARCs or are less likely to be offered this option. However, these recommendations are primarily intended to decrease regret about permanent sterilization and they may not be as applicable in a population that has already met their reproductive goals (28, 33).

Our results suggest that rural women are not only having more tubal ligations performed, but that they are also more likely to have these procedures performed at

younger ages. Regret is a common occurrence after ligation and younger age is associated with an increased likelihood to express regret (10, 13, 15). Among women who had a tubal ligation, 18% expected to raise fewer children than they wanted, 16% said they would like to have another biologic child, and 11% said they would be disappointed if they found out they could not get pregnant again. Many women have misconceptions on the feasibility of tubal ligation reversal, believing that reversal could easily restore their fertility (13). This may account for the women who said they would be disappointed if they could not get pregnant again. Rural woman with a tubal ligation had less regret with 14% saying they would raise fewer children than they want, 15% saying they would like to have another biologic child, and 8% saying they would be disappointed if they found out they could not get pregnant again. Despite the increased rate of tubal ligation in rural women, these indirect indicators of regret suggest that most rural women are comfortable with their decision to have a tubal ligation and experience regret less often than urban women who have had a tubal ligation.

A major strength of this study is the inclusion of age at procedure. The use of survival analysis allowed us to determine if women are undergoing tubal ligations at different ages in urban versus rural environments. Age at tubal ligation is an important piece of information because age is associated with prevalence of regret after tubal ligation. Another strength is that our data comes from a population based study, which included information on a number of demographic characteristics, other forms of contraception, and reproductive surgeries. This allowed us to censor individuals at the ages at which they were no longer at risk of receiving a tubal ligation. We also had indirect indicators of current regret after tubal ligation which allowed us to

simultaneously assess the differences in regret in rural versus urban environments. In addition, we categorized county of residence as large metropolitan, small metropolitan, or rural. Women from small metropolitan areas in our study were different from both women living in large metropolitan areas and rural women, and we were able to assess the differences in tubal ligation rate between these areas.

The primary limitation of our study is the use of current county of residence instead of residence at the time of tubal ligation. We assumed that a woman's current county residence was the same as her residence at the time of tubal ligation. However, some women may have had their tubal ligation in a rural county prior to moving to an urban county and were therefore misclassified. This misclassification could result in a bias towards the null, whereas movement from an urban area to a rural area would likely lead to bias away from the null. From 2000 to 2010, the urban population in Georgia increased from 71.6% to 75.1%, suggesting a bias towards the null is more likely (34).

In summary, we found that rural women are at increased risk of having a tubal ligation performed and have these procedures performed at younger ages than their large and small metropolitan counterparts. We expected to see an increased prevalence of regret among rural women who had a tubal ligation; however, these women were less likely to currently express regret. Rural women were also less likely to have used hormonal contraception or LARC before their tubal ligation. ACOG and the Centers for Disease Control and Prevention recommend LARCs as the most effective form of contraception and suggest appropriate counseling on the permanency of tubal ligations and the availability of LARCs as long-term reversible alternatives (4, 33). The difference observed between rural and urban tubal ligation incidence could be driven by differences

in physicians' awareness of these recommendations or by differences in preference of patients. Future studies should evaluate rural patients understanding of their contraception options and evidence based counseling practices at the time of tubal ligations. Recommendations may need to be tailored to reach rural women and increase awareness of alternatives to tubal ligation in rural areas.

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TABLES

Table 1. Baseline characteristics of women aged 22-45 living in the state of Georgia from the FUCHSIA Women's Research Study by metropolitan county status defined by the NCHS Urban-Rural Classification Scheme (N = 2160).

	Large Metropolitan (N = 1548)	Small Metropolitan (N = 372)	Rural (N = 240)	p-value
Tubal Ligation	166 (10.7%)	53 (14.3%)	52 (21.7%)	<0.0001
Current Age				0.1762
22-29	87 (5.6%)	31 (8.3%)	20 (8.3%)	
30-39	847 (54.7%)	192 (51.6%)	133 (55.4%)	
40-45	614 (39.7%)	149 (40.1%)	87 (36.3%)	
Age at procedure				0.3493*
22-29	70 (42.4%)	30 (56.6%)	25 (48.1%)	
30-39	85 (51.5%)	22 (41.5%)	26 (50.0%)	
40-45	10 (6.1%)	1 (1.9%)	1 (1.9%)	
Race				<0.0001*
White	981 (63.4%)	259 (69.6%)	199 (82.9%)	
Black	479 (30.9%)	99 (26.6%)	39 (16.3%)	
Hispanic	63 (4.1%)	6 (1.6%)	2 (0.8%)	
Other	25 (1.6%)	8 (2.2%)	0 (0.0%)	
Type of Contraception Use				
Hormonal Contraception[1]	1245 (80.4%)	282 (75.8%)	182 (75.8%)	0.0596
LARC[2]	283 (18.3%)	59 (15.9%)	40 (16.7%)	0.4965
Neither	262 (16.9%)	81 (21.8%)	51 (13.7%)	
History of Unintended Pregnancy (Yes)	743 (48.0%)	211 (56.7%)	126 (52.5%)	0.0074
Parity[3]				0.0048
Zero	415 (26.8%)	69 (18.6%)	43 (17.9%)	
One	305 (19.7%)	78 (21.0%)	51 (21.2%)	
Two	532 (34.4%)	146 (39.2%)	88 (36.7%)	
≥ Three	295 (19.1%)	79 (21.2%)	58 (24.2%)	
Type of Health Insurance[4]				<0.0001
Employer	1197 (78.0%)	232 (62.5%)	162 (68.1%)	
Self	96 (6.3%)	13 (3.5%)	10 (4.2%)	
Public	107 (7.0%)	70 (18.9%)	27 (11.3%)	
None	135 (8.8%)	56 (15.1%)	39 (16.4%)	
Income[5]				<0.0001
< 25K	159 (10.6%)	78 (21.4%)	55 (23.5%)	
25K – 49K	260 (17.3%)	77 (21.2%)	50 (21.4%)	
50K – 74K	262 (17.4%)	69 (19.0%)	52 (22.2%)	
75K – 100K	285 (18.9%)	66 (18.1%)	38 (16.2%)	
> 100K	539 (35.8%)	74 (20.3%)	39 (16.7%)	
Education[6]				<0.0001*
High School or Less	82 (5.3%)	37 (10.0%)	27 (11.2%)	
Some College	357 (23.1%)	124 (33.3%)	85 (35.4%)	
College Graduate	580 (37.5%)	114 (30.6%)	74 (30.1%)	
Graduate School	527 (34.1%)	97 (26.1%)	54 (22.5%)	
Marital Status at Event				0.5453
Married or Living Together	1167 (75.4%)	288 (77.4%)	181 (77.9%)	
Other	381 (24.6%)	84 (22.6%)	53 (22.1%)	

* Fisher's exact test used
[1] Includes the birth control pill, birth control patch, Nuvaring, the mini-Pill, and Depo Provera
[2] Includes Norplant, Implanon, hormone releasing IUD, and non-hormone releasing IUD
[3] 1 Large Metropolitan missing
[4] 13 Large Metropolitan, 1 Small Metropolitan, and 2 Rural missing
[5] 43 Large Metropolitan, 8 Small Metropolitan, and 6 Rural missing
[6] 2 Large Metropolitan missing

Table 2. Characteristics of women aged 22-45 living in the state of Georgia from the FUCHSIA Women's Research Study by tubal ligation status (N = 2160).

	Tubal Ligation (N = 271)	No Tubal Ligation (N = 1889)
Location		
Large Metropolitan	166 (61.3%)	1382 (73.2%)
Small Metropolitan	53 (19.6%)	319 (16.9%)
Rural	52 (19.2%)	188 (9.9%)
Current Age		
22-29	7 (2.6%)	131 (6.9%)
30-39	126 (46.5%)	1046 (55.4%)
40-45	138 (50.9%)	712 (37.7%)
Race		
White	162 (59.8%)	1277 (67.6%)
Black	92 (39.9%)	525 (27.8%)
Hispanic	13 (4.8%)	58 (3.1%)
Other	4 (1.5%)	29 (1.5%)
Type of Contraceptive Use		
Hormonal Contraception[1]	197 (72.7%)	1512 (80.0%)
LARC[2]	33 (12.2%)	349 (18.5%)
Neither	68 (25.1%)	326 (17.3%)
History of Unintended Pregnancy (Yes)	215 (79.3%)	865 (45.8%)
Parity[3]		
Zero	5 (1.9%)	522 (27.6%)
One	23 (8.5%)	411 (21.8%)
Two	131 (48.5%)	635 (33.6%)
> Three	111 (41.1%)	321 (17.0%)
Type of Health Insurance[4]		
Employer	176 (65.2%)	1415 (75.5%)
Self	12 (4.4%)	107 (5.7%)
Public	37 (13.7%)	167 (8.9%)
None	45 (16.7%)	185 (9.9%)
Income[5]		
< 25K	47 (17.7%)	245 (13.3%)
25K – 49K	51 (19.3%)	336 (18.3%)
50K – 74K	63 (23.8%)	320 (17.4%)
75K – 100K	44 (16.6%)	345 (18.8%)
> 100K	60 (22.6%)	592 (32.2%)
Education[6]		
High School or Less	36 (13.3%)	110 (5.8%)
Some College	98 (36.1%)	468 (24.8%)
College Graduate	70 (25.8%)	698 (37.0%)
Graduate School	67 (24.7%)	611 (32.4%)
Marital Status at Event or Censor		
Married or Living Together	224 (82.7%)	1410 (74.6%)
Other	47 (17.3%)	479 (25.4%)

[1] Includes the birth control pill, birth control patch, Nuvaring, the mini-Pill, and Depo Provera
[2] Includes Norplant, Implanon, hormone releasing IUD, and non-hormone releasing IUD
[3] 1 tubal ligation missing

[4] 1 tubal ligation and 15 censored missing
[5] 6 tubal ligation and 51 censored missing
[6] 2 censored missing

Table 3. Crude and multivariable Cox regression analysis of the effect of metropolitan county status defined by the NCHS Urban-Rural Classification Scheme on the incidence of tubal ligation among women aged 22-45 years of age in the FUCHSIA Women's Research Study (N = 2160).

Geographic Area	N	No. of Tubal Ligations[2]	Crude[#]		Adjusted[#,1,2]	
			HR	95% CI	HR	95% CI
Large Metro	1501	160	1.0	Referent	1.0	Referent
Small Metro	364	52	1.4	1.0, 2.0	1.1	0.8, 1.4
Non-Metro	233	51	2.5	1.8, 3.5	1.9	1.4, 2.7

[#] Clustering within counties accounted for using robust standard errors
[1] 62 observations excluded because of missing values on covariates
[2] Adjusted for race, education, household income, type of insurance, and parity

FIGURES

Figure 1. Prevalence of Tubal Ligations among FUCHSIA Participants by Georgia Public Health Districts (N = 2160)

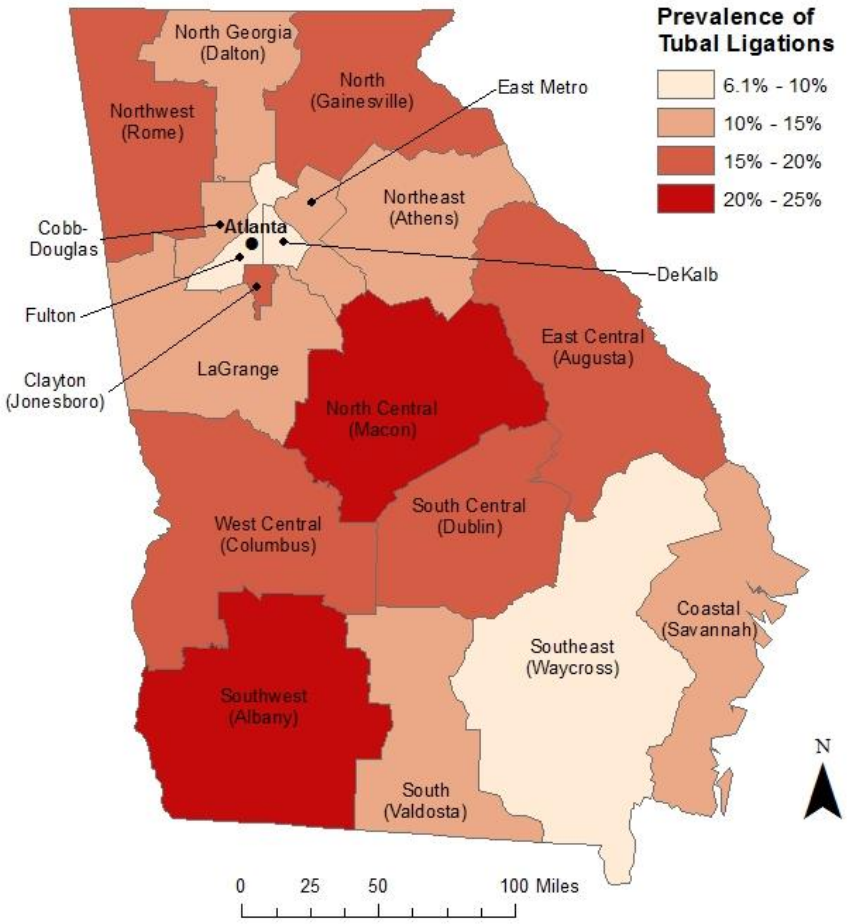
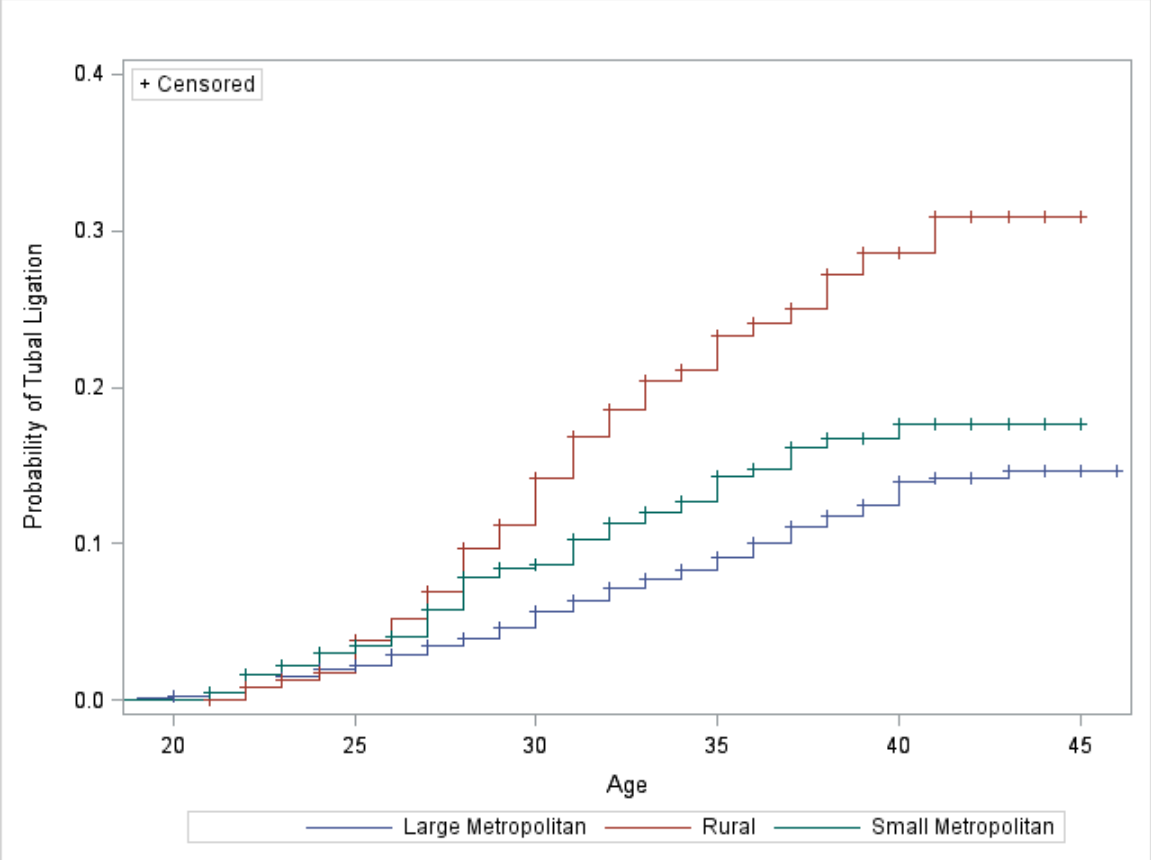
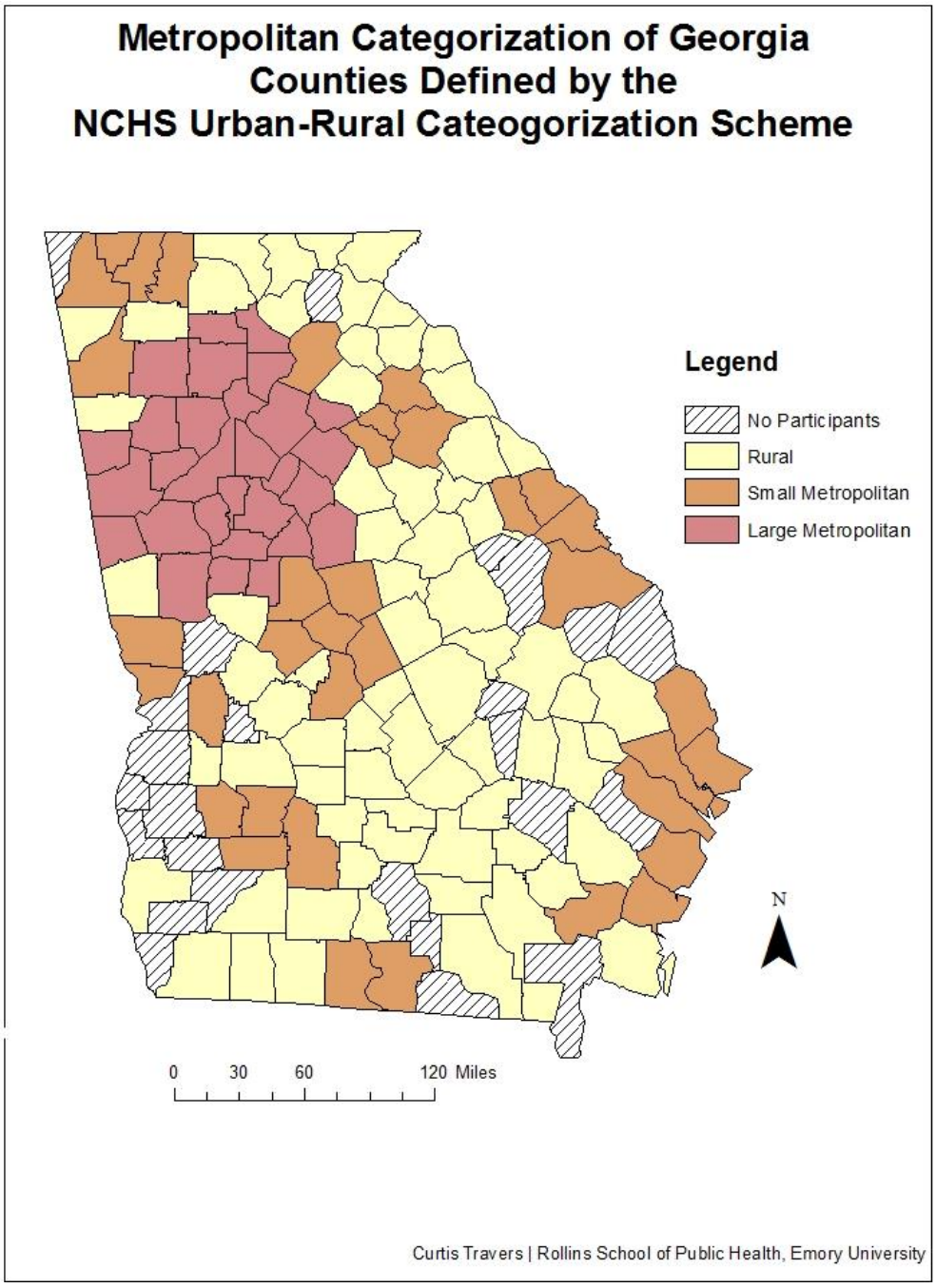


Figure 2. Unadjusted Kaplan-Meier survival curve of tubal ligations in women aged 22-45 living in Georgia from the FUCHSIA Women's Research study by county metropolitan status defined by the NCHS Urban-Rural Classification Scheme (N = 2160).



APPENDIX A:

RURAL-URBAN COUNTIES OF GEORGIA



APPENDIX B:

IRB APPROVAL

EMORY UNIVERSITY

Institutional Review Board

TO: Penelope Howards, PhD
Principal Investigator
Epidemiology

DATE: May 21, 2013

RE: **Notification of Amendment Approval**

AM20_IRB00045004

IRB00045004
A population-based study of fertility in female survivors of young adult cancers

Thank you for submitting an amendment request. The Emory IRB reviewed and approved this amendment under the expedited review process on **5/21/2013**. This amendment includes the following:

Personnel change only: Adding moving Monique Farone from other personnel to study coordinator; Julia Interrante, Curtis Travers, Eric Huh and Loree Mincey-Jackson as other Emory study staff. Remove Stephanie Gretsch, Lina Inagaki and Annum Shaikh from the study.

Important note: If this study is NIH-supported, you may need to obtain NIH prior approval for the change(s) contained in this amendment before implementation. Please review the NIH policy directives found at the following links and contact your NIH Program Officer, NIH Grants Management Officer, or the Emory Office of Sponsored Programs if you have questions.

Policy on changes in active awards: http://grants.nih.gov/grants/guide/notice-files/NOT-OD-12-129.html

Policy on delayed onset awards: http://grants.nih.gov/grants/guide/notice-files/NOT-OD-12-130.html

In future correspondence with the IRB about this study, please include the IRB file ID, the name of the Principal Investigator and the study title. Thank you.

Sincerely,

Donna Thomas
Administrative Assistant
This letter has been digitally signed

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