Social Determinants of Women's Reproductive Health

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Abstract

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Reducing health disparities and achieving health equity in maternal and infant health is a critical concern for social work and public health stakeholders more generally. This three-paper dissertation is dedicated to exploring program or policy modifiable social determinants of maternal and infant health with a particular focus on vulnerable populations. Paper one explores the influence of household members on women's sexual and reproductive behaviors. Paper two studies the impact of smoke-free regulations on birth outcomes in Latin America. Lastly, paper three looks at the effects of police use of force, and racialized police use of force, on maternal and infant health. The findings of these papers provide important information to inform programs and policies aimed at improving reproductive health and well-being in the U.S. and Latin America.

Table of Contents

List of Figures and Tables

Tables

Figures

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Preface

Maternal and infant health are critical areas of concern, and reducing health disparities and achieving health equity in these areas are of paramount importance. It is well established that social determinants of health significantly impact maternal and infant health outcomes. These determinants, including social, economic, and environmental factors, have a profound effect on the health of vulnerable populations such as low-income individuals, racial and ethnic minorities, and those living in underserved areas. This dissertation aims to delve deeper into the social determinants of maternal and infant health, with a particular focus on vulnerable populations. It explores the complex interplay between individual-level and structural-level factors that perpetuate health inequalities in sexual and reproductive health.

Each paper examines different aspects of reproductive health, including adolescent sexual behavior, household exposures, and policing practices, to provide a holistic understanding of how social determinants impact maternal and infant health in diverse contexts.

The first paper, **"Racialized Police Use of Force and Birth Outcomes,"** investigates the associations between police violence at the community level and birth outcomes of Black women compared to White women. I find that a 1% increase in a measure of racialized police use of force is associated with a .06% increase in the odds of low birth weight and preterm birth among Black women and has no associations with birth outcomes of White women. I also find no associations between overall PUOF and birth outcomes among Black or White women. The findings suggest

that structural racism adversely affects the health of Black people in the U.S. and points to the need to address health inequalities at the structural level.

The second paper, "**The influence of co-residing women on adolescent sexual and reproductive behaviors,"** explores the effect of co-residing with other women on young women's sexual risks and behaviors in Colombia, a country with exceptionally high teenage pregnancy rates. I find that young women living in predominantly female households in Colombia have lower odds of engaging in risky sexual behavior, are more likely to wait until the age of 20 to have sex, and are less likely to become teen mothers compared to women in gender-neutral or predominantly male households, and that the protective effect is stronger for young women in low socio-economic status households. This study shows that family and household composition can have a significant impact on young women's sexual behavior and that programs and policies should consider the role of siblings and household adults when designing interventions to improve women's sexual and reproductive health.

The third paper, "**Effects of second-hand smoking regulations on birth outcomes in Latin America and the Caribbean: A Multi-country Analysis,"** examines the impact of smoke-free regulations on birth outcomes in Latin America and the Caribbean. The study finds positive effects of smoke-free policies on birthweight, with an average increase in birthweight ranging from 58 to 94 grams. I also find the impact to be particularly strong among low SES women. These findings provide valuable insights into the impact of smoke-free policies in low- and middle-income countries, especially among the most vulnerable populations.

Together, these three papers share a common goal of understanding the impact of social and structural determinants, in different contexts, on maternal and infant health. The papers collectively provide evidence to inform interventions and policies that can help reduce health disparities and promote health equity among women and children. The findings underscore the importance of understanding the complex relationships between social determinants and health outcomes in different contexts, and have significant implications for policymakers and stakeholders seeking to improve the health and well-being of disadvantaged women.

Chapter 1: Racialized Police Use of Force and Birth Outcomes

1.1 Abstract

This paper investigates the associations between police use of force (PUOF) in local jurisdictions and birth outcomes of Black and White women. The study uses birth records linked to municipal police department data on PUOF incidents to estimate associations between overall and racialized PUOF and birth outcomes across women in New Jersey from 2012 to 2016. The results indicate that overall PUOF is not associated with birth outcomes of Black or White women but that a 1% increase in the rate of discriminatory PUOF is associated with a 0.06% increase in the odds of low birth weight and preterm birth among Black women, and is not associated with birth outcomes of White women. The lack of associations between overall PUOF and birth outcomes coupled with significant associations between racialized PUOF and adverse birth outcomes among Black women and not White women is consistent with increasing evidence that structural racism adversely affects the health of Black people in the U.S. These findings highlight the need to address health inequalities at the structural level.

1.2 Introduction

Rates of low birth weight and preterm birth among infants born to Black women have been twice those of infants born to White women in the U.S. for decades (Artiga, et al., 2020; MacDorman & Mathews, 2011; Mathews & Driscoll, 2017). These large and persistent disparities in infant health have implications for disparities in cognitive development, educational achievement, earnings, and other long-term outcomes (Case, el at., 2004; Conley & Bennett, 2000; Figlio, et al., 2014; Lambiris, et al., 2022). Differences in maternal education, income, occupation,

health insurance, and prenatal health behaviors explain little of the observed racial disparities in birth outcomes (Reichman & Teitler, 2013).

Few studies have explored the roles of racism or discrimination—particularly institutional racism—in explaining the much poorer birth outcomes of Black women compared to White women, despite an increasing recognition that entrenched social disadvantages associated with racial minority status in the U.S. take a toll on health (Braveman, et al., 2022; Noonan, et al., 2016). Some of the obstacles to studying the effects of institutional racism on health have been difficulties in constructing measures that convincingly reflect institutional racism and finding appropriate population-level micro-level data on health that can be linked to those measures.

Emerging research has found adverse associations between violent policing and birth outcomes of Black women (Curtis, et al., 2022; Freedman, et al., 2022; Goin, et al., 2021; Hardeman, et al., 2020; Jahn, et al., 2021). Potential mechanisms underlying the associations include direct effects through harm to pregnant women (which would be very rare) or, more plausibly, indirect effects. One person's experiences can vicariously affect acquaintances or other community members (Heard-Garris, et al., 2018; Moody, 2022), and policing practices that result in high rates of incarceration could lead to changes in the social fabric of communities (e.g., by removing significant numbers of young men and constraining their opportunities when they are released) (Roberts, 2003). Finally, when violent policing is racialized (i.e., disproportionately targeted to Black subjects), it may reflect general levels of racism in communities that permeate local policies and institutions affecting residents' housing, healthcare, child care, and education, all of which can affect human capital and health.

Existing studies of police violence and birth outcomes have generally focused on indirect, but not race-specific, exposures and differential effects on Black and White women. One study found small and positive associations between fatal police violence (from the Fatal Encounters database and death records linked to birth records) in the mother's census tract or within a specified physical distance from her residence and preterm birth (PTB) in California, and it appeared that the associations were stronger for Black women than for White women (Goin, et al., 2021). Another investigated the extent to which fatal police violence in core-based statistical areas of the U.S. census (and counties, which are smaller) was associated with pregnancy loss (Jahn, et al., 2021). Specifically, the authors estimated associations between month-to-month fatal police violence and conceptions resulting in live births and found that exposure to police killings during pregnancy was associated with lower birth rates, especially for Black women; they attributed this finding to increases in pregnancy loss. A third study of fatal police violence and birth outcomes created exposure measures involving 49 high-publicity incidents of police lethal force toward Black persons, legal decisions not to indict/convict officers involved, and hate crime murders of Black victims in the U.S. using Google Trends (Curtis, et al., 2022). The authors found some associations between exposure to high publicity incidents and higher odds of PTB, with stronger associations for Black women than for White women, but the findings were not robust to alternative model specifications and their race-specific measures of lethal force involving Black victims were at too broad a geographic level (national) to reflect community-level factors.

Two studies from U.S. cities focused on measures of police contact more broadly. The first found that higher levels of community-level police contact were associated with higher rates of

PTB for both Black and White women in Minneapolis (Hardeman, et al., 2020). The authors also found that individuals in predominantly Black neighborhoods had more police contact than those in predominantly White neighborhoods but they did not specifically measure racially-disproportionate rates of police contact within neighborhoods. The second investigated associations between formal complaints filed for excessive use of force against police in Chicago and cardiovascular disease and birth outcomes of Black women from one hospital (Freedman, et al., 2022). The authors found that Black women had a 19% higher risk of PTB, 16% higher risk of delivering a small-for-gestational-age infant, and a 42% higher risk of cardiovascular disease (which is associated with adverse pregnancy outcomes) in census block groups where residents frequently complained about the police using excessive force, even after accounting for neighborhood socioeconomic conditions and homicide frequency.

In this study, I expand upon this literature by using unique linked data from the state of New Jersey (NJ) to investigate associations between measures of police violence at the community level and individual-level birth outcomes of Black women compared to White women. The state of NJ has one of the largest numbers of municipal police departments in the country (Reaves, 2011), one of the highest numbers of police officers per resident (55% higher than the national rate) (Reaves, 2011), one of the largest racial disparities in incarceration in the nation (Mauer & King, 2007), and has been collecting data on police use of force. NJ is, therefore, a highly suitable state for investigating associations between police practices and disparities in birth outcomes.

I consider measures of overall and racially-disproportionate police use of force (PUOF) in municipalities, which generally have their own police departments that implement policies and

provide oversight. I hypothesize that: (1) Racially-disproportionate PUOF against Black people is adversely associated with birth outcomes of Black women but not White women. (2) Overall PUOF, which is not necessarily racialized, is adversely associated with birth outcomes of Black women, but less so than racially-disproportionate PUOF.

1.3 Methods

1.3.1 Data

I use pooled records on all births in NJ from 2012-2016, including maternal residential addresses under a restricted data use contract with the NJ Department of Health. Using the mother's municipality and county of residence, I linked the birth records to information on PUOF incidents that involved local or NJ state police officers in each of 468 municipal police departments in NJ during the same period.

The information on PUOF incidents belongs to The Force Report (FR) dataset, which contains information from >70,000 use-of-force forms completed by NJ police officers and compiled by NJ Advance Media. The data includes reports of all violent encounters between officers and civilians in every police department in NJ from 2012-2016 (NJ Advance Media, 2019). The recording of these encounters was mandated by the NJ Attorney General's Office for all incidents that involved compliance holds, takedowns (leg sweeps or tackles), strikes and punches, leg strikes, baton strikes, pepper spray, or deadly force (e.g., firing a service weapon). The most common types of force in the data are compliance holds (81%) and punches and hand strikes (28%). Discharging of weapons is rare (0.4%). My use of force measures are computed using the total number of incidents involving any type of force within each police department.

There were 8441 reported incidents of PUOF in NJ in 2012, 8455 in 2013, 8381 in 2014, 8054 in 2015, and 8121 in 2016.

I use police department-level information on racial-ethnic proportion of PUOF subjects, average number of PUOF incidents per officer, size of police force, and an age-adjusted measure of racial-ethnic distribution of residents in their jurisdiction that the Force Report team constructed using 2012-2016 population data from the American Community Survey (ACS). I also linked municipal-level information published by the NJ Department of Labor on resident population from the 2010 decennial U.S Census (DEC Redistricting Data - PL 94-171), median household income from the 2010 ACS 5-year estimates, and 2012-2016 city and town violent crime data published by the Criminal Justice Information Services Division of the U.S Federal Bureau of Investigation (FBI). Violent crimes in the FBI's Uniform Crime Reporting Program are offenses that involve force or threat of force, and include murder and nonnegligent manslaughter, rape, robbery, and aggravated assault. I merged all of these data elements to the individual-level birth records using identification variables for municipalities or county subdivisions (boroughs, cities, and towns).

A total of 501,689 singleton births took place in the state of NJ in 2012-2016. I exclude multiple births because they are more likely than singletons to be low birth weight and preterm and it would have been necessary to address that additional source of clustering. Of the 501,689 births, 500,904 (99.8%) had non-missing data on maternal county and city of residence. Of those, I exclude 30,417 that were to non-residents of NJ or to mothers whose residence was not in one of the municipalities in NJ that had a police department or were served exclusively by State police.

Eight municipalities were under the jurisdiction of police departments that served multiple municipalities; in those cases, I used consolidated police department information.

To test my hypotheses, I limit the sample to births to the 375,167 Black or White women who lived in municipalities with at least one birth to a Black woman and at least one birth to a White woman. Of those, I exclude 120 births (0.03%) because of missing information on birth weight or gestational age and another 21,214 (5.6%) because of missing data on maternal or municipal-level factors. The final analysis sample consists of 353,833 births to women that lived in 430 municipalities; of those, 75,461 (21.3%) were to Black women, and 278,372 (78.7%) were to White women.

1.3.2 Measures

Outcomes

Outcomes are low birth weight (LBW) (<2500 grams) and PTB (<37 completed weeks of gestation), which have become standard markers of poor infant health in population-based research studies and are highly predictive of long-term health and economic outcomes (Case, et al., 2004; Conley & Bennett, 2000; Figlio, et al., 2014; Lambiris, et al., 2022). These measures are constructed from birth weight indicators in grams and clinical gestational age in completed weeks that are available in the birth records. The reporting of birth weight is highly accurate in US birth records, including in NJ (Reichman & Hade, 2001). The clinical assessment of gestational age in the NJ birth records was "judged by the clinician using the best available information (physical examination of the infant and/or ultrasound visualization) (p. 53)" (Bolden & Mammo, 2018).

Covariates

Maternal characteristics, from the birth records, include parity (first birth), Hispanic ethnicity, age, education, and Medicaid coverage for the birth. Municipality-level variables, from the sources cited earlier, include 2010 median household income, 2010 resident population, and 2012-2016 average rate of violent crimes.

Exposures: PUOF and Disproportionate PUOF

Before describing the main exposure variables used in this study, it is crucial to define *use of force* and what it represents. Laws and guidelines governing PUOF can vary across states and agencies in the U.S. Still, all grant police officers with the authority to use a "reasonable" or "necessary" amount of force to *compel compliance by an unwilling subject* (International Association of the Chiefs of Police, 2001). What is unreasonable or excessive force is not clearly defined, and is usually judged on a case-by-case basis considering information surrounding the event of force (i.e. the severity of the crime committed by a suspect or whether the suspect was resisting, attempting to flee, or posed a threat to the officer or the community). The continuum of force includes an escalating series of actions that an officer may take to resolve a situation (NIJ, 2009). In this study, I consider all interactions that involve physical, non-cooperative contact between an officer and a subject, from empty-hand control to the use of lethal force, to be PUOF.

What legitimizes the use of force among law enforcers is not entirely clear, but the excessive use of force against particular minorities in our society has stirred the conversation about the role played by institutional racism. Institutional racism creates material conditions that enable one group to enact power over another, usually through coercion and hierarchization practices (De

Paula, 2020). If officers ordinarily use force, and this practice is never judged or penalized, it is therefore legitimized by the institution they represent and the institutions above that control and regulate these agencies. It is very uncommon for officers in the U.S to face any legal consequences for enforcing lethal force against civilians, and current legislation makes it very difficult to hold police officers legally accountable for any kind of misconduct (Thomson-DeVeaux, Rakich, & Butchireddygari, 2020). If PUOF is a practice that is consistently used and directed towards specific subpopulations, and if violent officers are never held accountable for their actions, then it is reasonable to conclude that such behaviors are tolerated, legitimized, and promoted by higher institutions and that such institutions promote racist values and practices within the communities they serve. One common challenge of studying structural racism is that it is deeply embedded within institutions in ways that are unverifiable, unquantifiable, and very hard to measure. Analyzing police practices, and their differential impact in a community, can help to build a sound approximation of racial bias within institutions.

Under these premises, I create two measures of PUOF:

1) *PUOF incidents per officer* is the number of incidents in a police department jurisdiction divided by the number of officers in that department. This measure captures the level of aggressiveness of the average police officer in the department.

$$PUOF\ Incidens\ per\ Officer = \frac{Incidents\ of\ PUOF\ in\ department\ X}{Number\ of\ police\ officers\ in\ department\ X}$$

2) *Racially-disproportionate PUOF* is the ratio of the number of incidents involving Black subjects to the number of incidents involving White subjects, divided by the ratio of Black to White residents in the municipality.

$$Racially\ disproportionate\ PUOF_m = \frac{\left(\frac{\#\ of\ PUOF\ incidents\ involving\ Black\ subjects}{\#\ of\ PUOF\ incidents\ involving\ White\ subjects}\right)_m}{\left(\frac{\#\ of\ Black\ residents}{\#\ of\ White\ residents}\right)_m}$$

This relative risk reflects the extent to which PUOF was disproportionately experienced by Black subjects. In supplementary analyses, I use an alternative measure of municipal PUOF—the number of incidents per capita, which is a measure of population exposure to PUOF. The exposure measures are intended to characterize police behavior in communities so they include incidents whether or not the subjects resided in those communities.

1.3.3 Statistical Analyses

First, I investigate the distributions and stability of the PUOF measures by documenting the ranges of the two measures and calculating Pearson correlation coefficients for the measure of incidents per officer over time within municipalities. I then document the correlation between the PUOF measures and the racial composition of communities using Spearman's rank-order correlations. Since my interest is in the effects of community-level policing, I am particularly interested in the extent to which PUOF varies across municipalities, how stable it is over time within municipalities, and how much it varies by the racial composition of municipalities.

Second, I estimate a series of race-stratified logistic regression models that adjust for the individual and municipal-level covariates listed above and account for the data structure by clustering standard errors at the municipality level. Because the distributions of PUOF measures

are highly skewed, I use linear logarithmic transformations, in this case *Log(x+0.001)*, which de-emphasize outliers to improve model fit and avoid losing observations with values of 0. The density plots of the log-transformed variables approximate a normal distribution (See Appendix A1). Logistic regression coefficients of log-transformed measures are elasticities—the percentage change in the odds of the dependent variable associated with a 1% change in the (untransformed) measures.

Finally, I estimate supplementary models that use quartiles of municipal PUOF and PUOF incidents per capita as alternative exposure measures. I exclude municipalities with their own police departments but that report zero incidents of PUOF; limit the sample to municipalities with >= 5000 residents; limit the sample to municipalities with >=20 births to Black women and >=20 births to White women; include year fixed effects; and use alternative functional forms.

1.4 Result

Compared to White women, Black women had significantly higher proportions of LBW and preterm infants, lower levels of education, and higher rates of Medicaid-financed deliveries (**Table 0.1**). They also resided in municipalities with higher crime rates, lower median household incomes, and more aggressive officers, as characterized by PUOF incidents per officer. However, Black women lived in municipalities with lower rates of *racially-disproportionate* PUOF, which was higher in municipalities with higher proportions of White residents.

Average annual municipality-level number of incidents of PUOF per officer ranged from close to 0 to 12 (**Figure 0.1**). The annual municipality-level racially-disproportionate PUOF measure (the

relative risk of PUOF involving Black subjects compared to White subjects) ranged from nearly 0 to 2,943; i.e., municipal police departments ranged from no observed racially-disproportionate PUOF to extreme racial disproportionality in PUOF.

Within-municipality correlations of the number of incidents of PUOF per officer across the 5 years range from .59 to .80 and are highest for adjacent years, indicating that the measure was fairly stable from year-to-year (**Table 0.2**).

PUOF is also correlated with racial composition of municipalities. The percentage of residents that were Black is positively correlated with higher PUOF per officer (r_s = 0.43) but negatively correlated with racially-disproportionate PUOF (r_s = -0.26).

Logistic regression models of associations between PUOF and birth outcomes, adjusted for individual-level characteristics as well as municipality-level median household income, rate of violent crimes, and population size, indicate no significant associations between incidents per officer and birth outcomes for Black women (LBW: β: 0.04; 95% CI: -0.01 to 0.09; PTB: β: -0.00; 95% CI: -0.06 to 0.05) or White women (LBW: β: 0.01; 95% CI: -0.04 to 0.06; PTB: β: 0.00; 95% CI: -0.05 to 0.05) (**Figure 0.2**). However, in corresponding models using racially-disproportionate PUOF instead of incidents per officer, PUOF is significantly associated with worse outcomes for infants born to Black women; specifically, a 1% increase in the racially-disproportionate PUOF is associated with a .06% increase in the odds of LBW (β: 0.06; 95% CI: 0.03 to 0.09) and a .06% increase in the odds of PTB (β: 0.06; 95% CI: 0.03 to 0.10). I find no

significant associations between racially-disproportionate PUOF and birth outcomes of infants born to White women.

Supplementary models (see Appendix A2) using the alternative measures of PUOF (number of incidents per capita) produce results substantively similar to those when using number of incidents per officer (i.e., no significant associations between PUOF and birth outcomes for Black or White women). The estimates are also insensitive to using quartiles of the PUOF measures instead of the logged transformations, excluding municipalities that reported zero incidents of force during the study period, restricting the sample to municipalities with >=5000 residents, restricting the sample to municipalities with >= 20 births to Black women and >=20 births to White women, and including year fixed effects.

1.5 Discussion

In this population-level study of New Jersey municipalities, I find significant and robust adverse associations between racially-disproportionate PUOF and birth outcomes of Black women, but no associations between overall PUOF and birth outcomes or between racially-disproportionate PUOF and birth outcomes of White women. Municipal police departments are highly consistent over time in their use of force and there is substantial variation across municipalities in both use of force per police officer and disproportionate PUOF directed at Black subjects. These findings suggest that living in communities with violent policing that is racialized takes a toll on Black women's health that crosses generations, while living in communities with violent policing that is not necessarily racialized has little adverse effect on birth outcomes for Black women or White women.

On average, Black women in the sample resided in municipalities where PUOF involving Black subjects was 8.2 times that of PUOF involving White subjects. My estimate of the effect of racially-disproportionate PUOF suggests that the elimination of racialized PUOF would reduce the overall rate of LBW among Black women in NJ from 9.7% to 9.3% and the Black-White gap in LBW by 8% (from 5 to 4.6 percentage points) (see Appendix A3 for calculations).

The null associations for overall (not specifically racialized) PUOF and birth outcomes, the robust associations between racially-disproportionate PUOF and birth outcomes for Black women, and the lack of associations between racially-disproportionate PUOF and birth outcomes for White women are consistent with racially targeted policing having indirect effects on birth outcomes, but could also reflect the effects of broader community values, norms, and tolerance of discrimination and racism that infiltrate policies, institutions, and organizations. In the latter case, the associations between racialized PUOF and birth outcomes of Black women could reflect broad exposure to structural racism of which discriminatory policing may be only a part. Although I cannot identify the precise sources of the associations, the findings suggest that institutional factors are associated with racial disparities in health and are consistent with previous theoretical and empirical research suggesting that racialized policing, as a core aspect of structural racism in the U.S., adversely affects the health of Black people (Alang, et al., 2017; DeVylder, et al., 2022; Sewell & Jefferson, 2016; Sewell, 2017). I was also unable to investigate biological pathways linking racial disproportionality in PUOF and birth outcomes in this population-level study. Findings from other studies suggest that stress resulting from racial profiling and real and perceived disproportionate

risks of facing police violence can have adverse and cumulative effects on health (Braveman, et al., 2022; Krieger, 2012; Sullivan, 2013; Calvin, et al., 2003).

The findings from this study are generally consistent with, and add to, the small existing literature on police violence and birth outcomes by focusing on any PUOF and not just fatal incidents, investigating associations between police violence and birth outcomes at the municipality level within an entire state, and considering both overall PUOF and racial disproportionality in PUOF, the latter of which I argue may reflect structural racism. From a more practical standpoint, the data and measures created for this study can be used to identify communities with high rates of racialized policing and target interventions.

While fatality at the hands of police is an extreme outcome of interaction with police, only a small fraction of incidents of police violence are fatal and those that are not fatal can induce substantial harm, fear, and stress (Geller, et al., 2014; Hirschtick, et al., 2019). Moreover, because fatal police violence is relatively rare, rates are less stable over time, necessitating measures of exposure with precise timing relative to pregnancy. Finally, studies focusing on fatalities address acute effects of police violence and not overall effects of chronic police or community-level racism. Detailed discussion of the limitations of fatal police violence data is in Klinger (2012). Only two of the previous studies focused on police violence beyond fatal encounters, one in census block groups in a major U.S. city (Freedman, et al., 2022) and the other in census tracts in another large U.S. city (Hardeman, 2020).

One of the challenges of studying effects of structural racism on health is identifying appropriate geographical units of aggregation (Hardeman, et al., 2022). This study is unique in that it focuses on exposure to PUOF at the municipal level, which corresponds more closely than any census-defined areas to police department jurisdictions. Census tracts and block groups, the most widely used geographical levels in the literature on police violence and health, are statistical subdivisions of counties that are designed for census taking and serve no governmental functions, whereas municipalities are governmental jurisdictions within states (and usually within counties) that directly provide services including education, transportation, public health, recreation, and police. As far as I know, no previous studies of police violence and infant health or health more broadly have focused on exposures to police violence at the municipal level. Because municipal police forces are operationally and geographically linked to other administrative and social services that reflect preferences of voters and tolerance of racism at the community level, I argue that municipalities are the appropriate geographic unit for studying consequences of racially-disproportionate police violence and that measures of racialized policing in municipalities are likely to be good indicators of racism in communities more generally.

Two previous studies of police violence and health outcomes considered racial disproportionality in the use of force (Sewell, 2017; Sewell & Jefferson, 2016). Focusing on exposures to not only overall levels of PUOF but also to racial disproportionality in PUOF allows me to differentiate between the estimated effects of policing practices in general and more refined indicators that arguably reflect systemic and structural racism in the community. I find that racialized PUOF, but not overall PUOF, is associated with adverse birth outcomes and only for Black women. My measure of racialized policing is somewhat different than that used in the Sewell

et al. studies as it captures the relative risk of the Black population in a municipality being subject to a stop involving use of force compared to the risk of the White population being subject to a stop involving use of force, whereas the Sewell et al. studies focused on racial disproportionality in police violence among people who were stopped by police. As such, their measure did not account for the very real possibility that Black and White subjects were differentially exposed to police stops. Despite differences between those studies and this one in how racialized policing is operationalized, the different geographical units considered (they focused on hospital service areas within New York City, whereas I focused on municipalities within a state), and health outcomes examined (they focused on self-rated health, diabetes, blood pressure, and body mass index, while I focused on provider-assessed birth outcomes), their bottom line findings are consistent with mine in that racialized policing is adversely associated with health.

Despite the strengths of my PUOF measures and the focus on municipalities within an entire state, this study has limitations. First, my data are limited to NJ and may not be generalizable to other states. Second, although the FR data were based on reports that officers are required to file after any incident involving force, there is some evidence that officers fail to systematically and accurately document use of force in encounters with civilians and during arrests (Moore, et al., 2018). If PUOF was systematically underreported in my data, the resulting measurement error could have biased my estimates of associations between PUOF and birth outcomes, although the expected direction of bias is not obvious.

Third, some readers might question my interpretation of the study findings, arguing that I should have accounted for the need to use force—e.g., in order to subdue individuals engaged in

violent crimes. While PUOF may be justified in some circumstances, it should be limited to preventing immediate harm (to an officer or someone else) by the subject, which is very rare. The Use of Force Policies of the Office of the Attorney General in the State of NJ are clear in stating that PUOF should be used only as a last resort and when absolutely necessary, regardless of the type of crime (Office of the Attorney General, 2022), and most incidents of PUOF in my data involved punches and hand strikes with at least 40%-50% of cases occurring in the course of minor incidents such as traffic stops and violations, suspicion, and disorderly conduct. Additionally, I control for violent crimes in the municipality in my models and I also found that racially-disproportionate PUOF tended to be higher in predominantly White communities, which tend to have lower rates of violent crime than predominantly Black communities. For all of these reasons, I argue that it is implausible that the variation in Black/White disproportionality in PUOF across municipalities reflects justifiable and consistently-applied use-of-force protocols.

1.6 Implications for social work practice and policy

Low birth weight and preterm birth are markers of poor infant health that presage lifelong health disadvantages that can severely impact quality of life and are costly for society. Much as physical environments can take a toll on health, so too can social environments that embed structural racism. In this study, I find that racialized police violence is adversely associated with birth outcomes of Black women. I cannot ascertain whether the associations reflect effects of policing or whether police violence is an indicator of other community-level exposures, but either way, the findings point to the need to address health inequalities at the structural level.

1.7 Tables and Figures

Table 0.1: Individual and municipal-level characteristics of sample by mother's race, 2012-2016

	Black Women	White Women
Birth Outcomes		
Low Birth Weight	9.7	4.7
Preterm Birth	10.4	6.7
Maternal Characteristics		
First Birth	38.8	39.2
Hispanic	15.5	31.8
< 20 years	8.2	3.1
20 to 35 years	74.8	73.3
35+ years	16.3	22.6
High School or less	51.7	35.5
Some College	26.6	20.2
College Graduate	21.7	44.3
Medicaid	54.9	27.8
Municipal Characteristics		
Number of PUOF Incidents per Officer	2.6	2.2
Black-White disproportionality in PUOF	3.1	9.6
PUOF (per 1000 residents)	7.7	5.2
Violent Crimes (per 100,000 residents)	690	276
Median Household Income ($1000s)	52.5	69.7
N	75,461	278,372

Notes: Figures are column percentages unless indicated otherwise. Municipal characteristics are weighted by number of individuals in the sample; e.g., on average, Black women resided in municipalities with 2.6 PUOF incidents per police officer. Among municipalities with at least 20 births per year, on average, the rate of low birth weight ranged from 0.8% to 9.6% and the rate of preterm birth ranged from 2.5% to 11.9%.

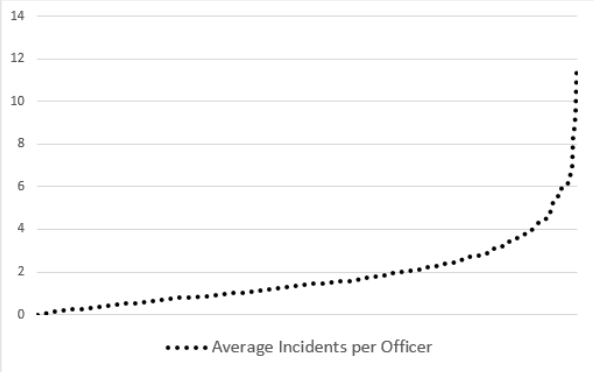
Table 0.2: Pearson correlation of within-municipality police use of force per officer over time

	2012	**2013**	**2014**	**2015**	**2016**
2012	1				
2013	0.72	1			
2014	0.70	0.79	1		
2015	0.65	0.70	0.80	1	
2016	0.59	0.68	0.69	0.74	1

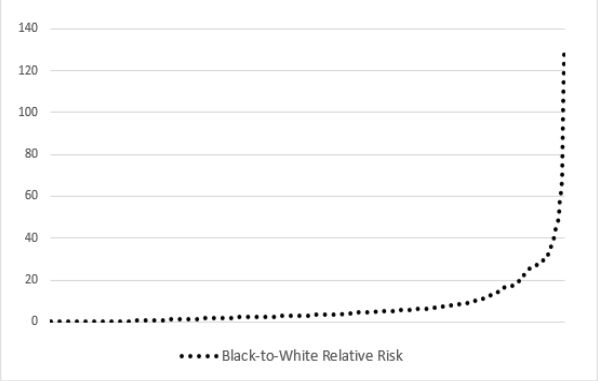
Observations: 2,300

Figure 0.1: Rank-ordered municipality-level police use of force (PUOF) measures, NJ, 2012-2016

Average Number of PUOF Incidents per Officer



Black-to-White Relative Risk of PUOF

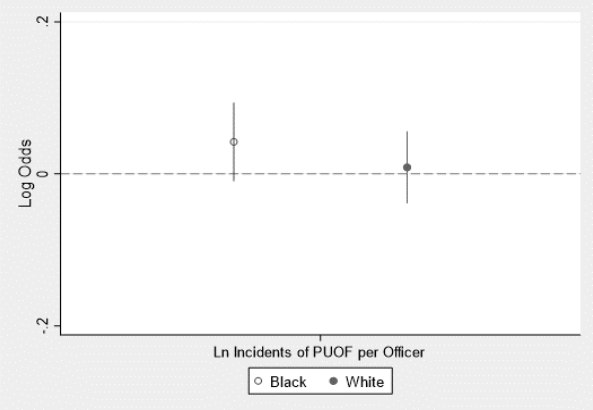


Note: 6 Municipalities with racially-disproportionate PUOF values of 160,172, 223, 269, 523, and 2943 are omitted to improve the readability of the figure.

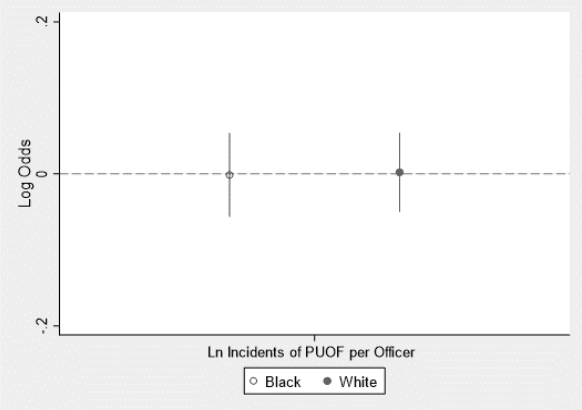
Figure 0.2: Adjusted logistic regression estimates of associations between municipality-level police use of force (PUOF) measures and birth outcomes by maternal race

Incidents of PUOF per Officer*

Low Birth Weight

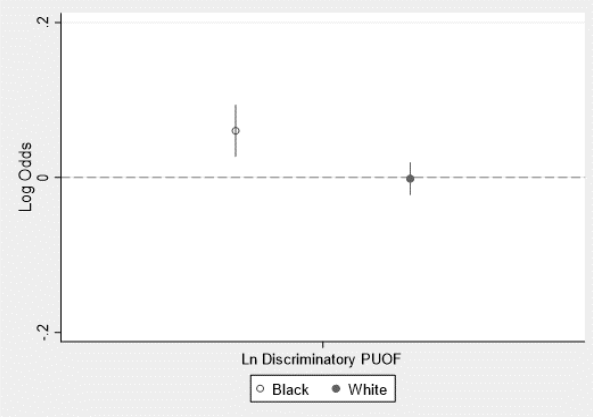


Preterm Birth

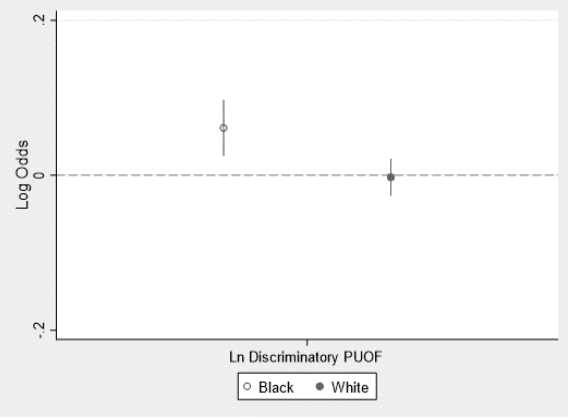


Racially-disproportionate PUOF*

Low Birth Weight



Preterm Birth



Note: Logistic regression models of associations between PUOF and birth outcomes adjusted for parity (first birth) and maternal Hispanic ethnicity, age, education, and Medicaid coverage, as well as municipality-level median household income, rate of violent crimes, and population size.

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Chapter 2: The influence of co-residing women on adolescent sexual and reproductive behaviors

2.1 Abstract

This paper explores how the gender composition of a household affects young women's sexual behavior in Colombia. It exploits the "randomness" in gender variation across households to estimate the associations between the exposure to co-residing women and measures of women's sexual and reproductive outcomes. The study also explores how socioeconomic status and sibling gender moderate these effects. The results indicate that young women living in predominantly female households have lower odds of engaging in risky sexual behavior, are more likely to wait until the age of 20 to have sex, and are less likely to become teen mothers. Furthermore, the protective effect is stronger for young women in low socio-economic status households, and having a sibling, whether a sister or brother, can influence a young woman's likelihood of engaging in risky sexual behavior. The findings suggest that there might be amplified effects of interventions focusing on first (oldest) children and that social programs designed to improve the sexual behavior of young women might benefit from modifications based on household characteristics.

2.2 Introduction

Latin America and the Caribbean have one of the highest adolescent pregnancy rates in the world, where adolescents aged 15–19 account for 16 percent of total fertility (Rodriguez Ribas, 2021). In Colombia, the situation is particularly concerning, with one in every five girls aged 15 to 19 having experienced pregnancy, and women continue to face numerous barriers to accessing

appropriate medical care and contraception services (DNP, 2021). The consequences of early motherhood can be severe, impacting the health, education, economic, and social opportunities of both mothers and their children. This can create cycles of poverty and hinder social mobility, particularly in developing countries (CDC, 2015; Tull, 2020; The World Bank, 2022). Although many countries have implemented national strategies to tackle this issue, the evidence of the effectiveness of programs aimed at empowering young women to make healthy reproductive choices and reducing teenage pregnancy remains limited and inconclusive (UNFPA, 2020). While increasing access to contraceptives and implementing sexual education initiatives have been important steps in improving teenage sexual and reproductive health, there is still much to be learned about the factors influencing young women's decisions about their sexual and reproductive behavior.

Social networks are increasingly being recognized as an essential element of social capital, with growing evidence indicating that individuals do not make decisions in isolation, and that social contexts shape their attitudes and behaviors (Kohler, Behrman, & Watkins, 2007; Hogg, 2001). Interactions within networks provide opportunities for individuals to exchange and evaluate information, which ultimately influences the attitudes and behaviors of its members. For instance, interactions within a family, seen as a network of close relationships, provide a venue for social learning and influence (Hanneman & Riddle, 2005). Women within the family network may exchange information about contraceptive methods, advantages and disadvantages of motherhood, and many other relevant topics to their lives (Valente, Watkins, Jato, Der Straten, & Tsitsol, 1997; Pasqualini, Sacker, & McMunn, 2021; Kolburn Kowal & Blinn-Pike, 2004). Young women may seek and be influenced by the interactions with women within their close network, particularly

when subjects related to sexual practices can be hard to discuss with parents. Therefore, there may be a systematic difference between female teenagers who reside in predominantly female households and those in predominantly male households.

In the U.S., parents, peers, and siblings have been found to be the social ties that most influence adolescent sexual behavior (Brooks-Gunn & Furstenberg Jr, 1989; Steinberg, 2002; DiIorio, Kelley, & Hockenberry-Eaton, 1999; Rink, Tricker, & Harvey, 2007; Treboux & Busch-Rossnagel, 1990). In particular, older siblings have been found to serve as standards of comparison for younger siblings (Bank & Kahn, 1997; Hesser & Azmitia, 1989), and research suggests that their sexual behavior influences the timing and type of sexual activity of younger brothers and sisters (Friedman et al., 2019; Kowal & Blinn-Pike, 2004; East, Felice, & Morgan, 1993). Moreover, older siblings are one of the critical sources of beliefs about sexual activity, including safe sexual practices, and can even exert pressure to engage in sexual activities beyond parental supervision and peer pressure (Haftu, Berhe, Tesfay, & Gebremesk, 2019). However, what remains unclear is what factors make sibling influences most salient. Research on sibling influences is limited and inconsistent. While Friedman et al. (2019) found no mediation effects of sibling gender on adolescent sexual attitudes, Kornreich et al. (2003) found that the gender of the older sibling influenced the value a girl placed on becoming a parent and their level of sexual responsiveness or interest.

This paper aims to study the extent to which gender composition within the household can influence young women's sexual behaviors and reproductive outcomes. I focus on whether the presence of female family members increases the availability of information that young women

receive and whether explicitly having female siblings influences their sexual behaviors. I exploit the "randomness" in gender variation across households and estimate a series of regressions to answer the following research questions:

1) Does the gender composition of a household affect young women's sexual outcomes and reproductive behaviors (SRB)?
2) Does the effect of living with other women on young women's SRB vary by socio-economic status (SES)?
3) Does sibling gender moderate the effect of older siblings on young women's SRB?

Given that access to information regarding sexuality, the physiology of sexual activities, and that the use of contraceptive methods is likely to vary by gender, I hypothesize that co-residing with older women influences adolescent SRB through role modeling, increased communication, and the transfer of SRB information/knowledge, more so than living in predominantly male households. Therefore, this study aims to improve our understanding of how household gender composition affects teenage sexual and reproductive behavior.

The paper is organized as follows: First, I present a review of relevant literature and point to gaps that are addressed by this study. Then I describe the data used and the methods employed to analyze the data. Lastly, I present the results and discuss their relevance and contribution to the existing evidence on sibling and gender influence on adolescent sexual behaviors.

2.3 Framework

One framework that has been proposed in past literature looking at the propagation of adolescent sexual activity is the Social Contagion Theory. A theory of behavioral contagion across siblings has been documented and would be expected, as siblings socialize throughout the lifespan (Friedman et al., 2019), and scholars have emphasized the importance of siblings as role models when studying adolescent behavior (Widmer, 1997; Bank & Kahn, 1997). Still, the role that gender plays in socialization processes between family members has yet to be understood, since interactions and intimacy might drastically differ across same and cross-gender family members, and even influence dynamics within the household. How, when, and what contributes to the behavioral contagion are questions still waiting to be answered, especially in the context of sexual and reproductive behaviors that are so closely tied to identity and gender-specific determinants. Despite the findings showing that children and adolescents can be influenced by both male and female peers, there is also a growing body of literature that has emphasized the role of female models on the information, choices, and outcomes of young women (Porter & Serra, 2020; Fried & MacCleave, 2009; Meier, Niessen-Ruenzi, & Ruenzi, 2018). Some scholars have found that communication between women can lead to richer friendships (more intense and emotional), that women prioritize personal talk in close relationships and that women generally talk about feelings, while men tend to emphasize doing activities together and are less self-disclosive during conversations (Fowler, 2009). Research in "femaleness" suggests that female bonds, and specifically sister-dyads, enjoy greater self-disclosure, contact, and relational maintenance than other pairs (Fowler, 2009), per the ''principle of sex commonality,'' by which the closest pairs of siblings would be those where both parties are the same gender (Spitze & Trent, 2006). Women networks, and information sharing within those networks, has been found to influence women's

reproductive behaviors, risk perceptions, and the adoption of new behaviors (Kohler, Behrman, & Watkins, 2007; Valente, Watkins, Jato, Der Straten, & Tsitsol, 1997; Watkins & Danzi, 1995).

The existing studies on sibling influence and gender have been especially limited to small observational studies, and little has been done in developing countries, especially in Latin America (See section *2.5 Background*). Given the relevance of social and cultural factors as determinants of sexual behavior (Rojas, et al., 2016; Rao, et al., 2012; Córdova Pozo, et al., 2015), findings from research on adolescents and college students in the United States can hardly be extrapolated to populations living in countries and societies that face very dissimilar circumstances. Familism, for example, is a cultural feature that has particular relevance within individuals of Hispanic origin (Hardway & Fuligni, 2006; Telzer & Fuligni, 2009; Sabogal, et al., 1987), and that is a protective factor for adolescent physical and mental health (Espinosa-Hernández, et al., 2013; Espinosa-Hernandez, et al., 2015)). The prevalence of familisms within some cultures might make siblings, and other family members, an expressly relevant source of information, as this social value implies that family is expected to provide emotional and instrumental social support, and creates a sense of obligation in young adults to consider their family when making decisions. (Sabogal, et at., 1987; Calzada, Tamis-LeMonda, & and Yoshikawa, 2012; Parsai, et al., 2009; Davila, Reifsnider, & Pecina, 2011). Besides, household compositions that extend beyond the nuclear family are very common in developing countries, and especially countries in the LAC region have a strong tradition for coresidence of young couples with parents and/or others (Esteve, Lesthaeghe, López-Gay, & García-Román, 2016). There has been a rise in unmarried cohabitation across the region in the last couple of decades, as well as an increase in the proportion of single mothers. In Colombia, the percentage of single mothers is above 50%[1]. More than 70% of single mothers

[1] DANE (2017). National Administrative Department of Statistics. Population Statistics.

between the ages of 25 and 29 live in composite households, and at least 25% reside with both their children and a husband/ partner in these extended homes (Esteve, García-Román, & Lesthaeghe, 2012). Since cohabiting women and single mothers are frequently found in their parental households or other composite households, it is extremely relevant to consider extended family dynamics when studying the context and decision-making processes of adolescents in these environments.

Within the literature on drivers of adolescent sexual behavior, little is known on the role of gender as a moderator of family influence on teenage agency and decision-making. Evidence on the extent to which female relatives shape young women's knowledge and sexual attitudes becomes of particular relevance in contexts that have failed to control teenage pregnancy, and with persistent structural barriers to education and health services. Most existing programs that aim to positively influence teenagers at home have focused on improving communication between parents and their children. Nevertheless, the ability of these interventions to achieve results has been modest, and very few initiatives recognize that besides parental influence, other family influences might play an important role, and could be actively utilized, to educate and empower teenagers in their sexual and reproductive journeys (Kantor, 2015). New evidence on what and how family dynamics influence adolescent behavior could aid in the construction of a more holistic and complete understanding of the determinants of teen decision-making, attitudes, and risks. That knowledge could contribute to the design of more effective family policies and interventions that recognize these household interactions, and thus effectively incorporate or acknowledge their existence.

2.4 Background

Over the last couple of decades, there has been a growing body of literature studying peer effects on adolescent behaviors. Some studies have focused on the influence of older siblings on the sexual and reproductive health of younger siblings and have consistently documented that such influence exists and matters (Coleman-Minahan & Scandlyn, 2021; Pasqualini, Sacker, & McMunn (2021; Mott & Haurin, 1990) but little is known about the differential effect of gender as a moderator of these influences. The very few studies in this area have provided inconclusive evidence.

Mott & Haurin (1990) examined the influence of an older sibling's age at first sexual intercourse on the sexual initiation of a younger sibling and found a direct but modest-sized older sibling effect for White but not Black youth and no difference in the magnitude for same- and opposite-sex siblings. While Haurin & Mott were within the pioneering studies that examined sibling influences on adolescent sexual activity, this paper used a small sample of about 2000 sibling pairs from the National Longitudinal Survey on Labor Market Experience of Youth and stratified by gender and race. The sample size in this study has power restrictions to correctly estimate the associations of interest, which could explain why they found no differences in the magnitude of the effect for same, and opposite-sex siblings.

East, Felice, & Morgan (1993) studied the effects of sisters' and female friends' sexual and childbearing behavior on early adolescent girls' sexual outcomes in a sample of 455 girls from predominantly minority racial backgrounds. Using multiple hierarchical regression analyses, they found that the number of sexually active female friends, the number of sexually active sisters, and

the presence of an adolescent childbearing sister were positively associated with permissive sexual attitudes, positive intentions for future sexual activity, and a greater likelihood of being a nonvirgin. They also found that having an adolescent childbearing sister had particularly strong effects on permissive sexual attitudes and nonvirgin status, contributing to evidence of the influence of sisters' behavior on female teenagers. These findings provide observational evidence on the role of peer and sibling effects on adolescent behavior. Still, their findings are also limited to a small and specific sample, meaning they cannot be extrapolated to other populations. Additionally, this study assessed girls' perceptions of others' sexual activity and did not attempt to capture the actual sexual status of specific girlfriends or sisters, which introduced additional measurement error to self-reported data known to be subject to this problem.

Similarly to East, Felice, & Morgan (1993), three other studies have been conducted in school settings (two in the U.S. and one in Ethiopia) that study sibling communication and its influence on adolescent sexual behaviors.

Kolburn Kowal & Blinn-Pike (2004) provided evidence supporting the relevance of sibling communication on adolescents' attitudes towards safe sex practices. Using responses from 297 adolescents who were part of a 42-month longitudinal study of sexual attitudes and behaviors, they found that older siblings could play a beneficial role in their younger sibling's sexuality, understood as less risky attitudes about appropriate sexual behaviors for their age, and higher levels of self-efficacy for communicating with partners about condom use and for buying and using condoms. They found that the associations were stronger among sister-sister dyads. Later, Haftu, Berhe, Tesfay, & Gebremesk (2019) studied older siblings' influence on sexual behavior in a

random sample of 285 high school adolescents in Mekelle, northern Ethiopia, in 2018. Consistent with the “role-model” effect, they found that adolescents that perceived the sexual behavior of their older sibling as risky had an increased likelihood of engaging in risky sexual behavior themselves. Additionally, they found that high intimacy between siblings decreased the odds of risky sexual behavior, suggesting that communication between siblings might play a role as a mediating factor.

Kornreich, Hearn, Rodriguez, & O'Sullivan (2003) examined whether older siblings influence early adolescent girls' sexual socialization in a sample of 180 girls, 12 to 14 years old, from predominantly ethnic minority backgrounds. Their findings suggest that compared with other girls, girls with older brothers placed greater value on becoming a parent, had lower levels of sexual responsivity or interest, and reported smaller age discrepancies between themselves and their partners for their first romantic kiss. This evidence suggests that older male and female siblings may differentially influence the sexual socialization of their younger siblings. Contrary to what the “principle of sex commonality” would suggest, Widmer (1997) analyzed 183 pairs of cohabiting adolescent siblings and found that younger sisters' beliefs about the best age to become sexually active were related to their older brothers' sexual beliefs, but not to their older sisters' sexual beliefs.

A limitation of all of these studies is their small sample sizes, which limits the generalizability of the findings. Kolburn Kowal & Blinn-Pike (2004) and Haftu et al. (2019) had samples of 297 and 285 adolescents, respectively, while Kornreich et al. (2003) studied a sample of 180 girls. As such, it is challenging to generalize the findings beyond the specific populations

studied. Despite these limitations, these studies highlight the importance of considering the influence of siblings on adolescents' sexual attitudes and behaviors and the role of communication between siblings in shaping these attitudes and behaviors.

Lastly, Pasqualini, Sacker, & McMunn (2021) investigated the relationship between birth order and timing of sexual initiation and whether this, in turn, influenced risk-taking behavior and sexual health, and looked at differences between men and women. They used the National Survey of Sexual Attitudes and Lifestyles (NATSAL-3), a cross-sectional dataset with detailed information on the sexual behavior of more than 15,000 randomly selected adults aged 16–74 in the UK, and where young people aged 16–34 were over-sampled to examine behaviors among the age-group at highest risk for a range of sexual health outcomes. Through a path analysis, they found some evidence suggesting there is a positive effect of having a sister as a reference person in learning about sexual issues, and that girls may be effective teachers to their younger siblings, not only in using contraceptives or avoiding unplanned pregnancies but also in reporting STIs. Their findings provide important evidence on the role of gender on sibling influence, but do not consider how these associations might depend on contextual characteristics such as family SES.

Although the existing research consistently documents that family members, especially older siblings, can influence the sexual behavior of their younger siblings and that the effects may vary by gender, there are three important gaps in this research area. First, all studies but Pasqualini, Sacker, & McMunn (2021) are limited to specific populations and have small sample sizes, limiting their findings' generalizability. Second, the role of gender as a moderator of the influence of siblings on teenage sexual behaviors has not been studied in any Latin American country.

Consequently, it is unclear whether the presence of women within a household might be influencing teenage girls in populations with the cultural, social, and economic particularities of countries in this region. Third, little is known about sibling influence in different contexts, that is if socio-economic characteristics reinforce or mitigate the extent to which adolescent behavior responds to sibling influences. This study aims to contribute to the literature on adolescent sexual behaviors from both a conceptual perspective and by using an extensive and nationally representative dataset from an understudied population. To my knowledge, this is the first study to look at the gender composition of households in association with teenage sexual behavior in contexts where big homes are prevalent and to assess the heterogeneous effects across socioeconomic levels.

2.5 Methods

2.5.1 Data

This study uses data from the 44,614 Colombian households sampled for the *2015 Demographic and Health Survey (DHS*). The DHS is a nationally representative survey carried out by the National Administrative Department of Statistics in Colombia every five years since 1990. The DHS's purpose is to help map the demographic changes of the Colombian population through time and obtain updated information on the sexual and reproductive health of women and men of childbearing age. The 2015 wave collected demographic information on all household members, and within each household interviewed all men and women between the ages of 13 and 69. For my main analysis, I restrict the data to households with at least a female above the age of 13 and below the age of 21 for a sample of 9051 households.

Both the men's and women's modules contain information on sexual and reproductive knowledge, attitudes, and practices, including questions on the age at first sexual intercourse, the number of recent sex partners, and the use of contraceptive methods. I further restrict the sample to households with no missing data on age, strata, education of the household head, household size, or missing data on the variables used in the construction of the outcome variables (age at first sex, condom use, age at first birth (if they had given birth), and the number of recent sex partners), for a final sample of 8,033 households. I conducted a Little's MCAR test on the missing covariates that showed that values were not missing completely at random, so I also ran supplementary models after imputing missing values.

In Part 3 of the empirical strategy (see section *Empirical Strategy*), to test the effects of having a sibling, and sibling behavior, on young women's behavior, I further restrict the sample to women who lived with at least one parent and who were single children or had one older brother or one older sister, for a subsample of 4,451 observations (about 55% of the original sample).

2.5.2 Outcomes

To explore the extent to which family influences might be determined by gender, I test the effect of exposure to male and female members in the household, and the interaction between sibling gender and their behavior (See section *Empirical Strategy* for information on exposure measures), on the following outcome variables:

1) **Abstinence:** Defined as never having engaged in any sexual activity at the time of the interview. *Abstinence* is a binary indicator that takes the value of 1 if a woman reported never having had sex, and 0 if they reported having had sex with another person at any age.

2) **Risky sexual behavior (RSB):** Following Rojas, et al., 2016, RSB is defined as having sex without a condom or with multiple sex partners in the last 12 months (Rojas, et al., 2016). *RSB* is a binary indicator that takes the value of 1 if a woman reported having sex without a condom or having more than one sex partner in the last year, and 0 otherwise.

3) **Early childbearing:** Defined as becoming a mother after 13 and before the age of 21[2]. *Young mom* is a binary indicator that takes the value of 1 if a woman reported giving birth before their 21st birthday, and 0 otherwise. I use 21 years to define early childbearing because, in Colombia, 21 is the age at which a woman would graduate from college when following the institutional education path (Ministerio de Educación Nacional, 2008). After 21, the opportunity costs of becoming a mother strongly decrease. Additionally, in Colombia, as in other LAC countries, young men and women co-reside with their parents way past adolescence. According to Colombia's National Department of Statistics, by 2018 44% of young men and women between the ages of 14 and 26 still resided with their parents (DANE, 2020). I test the robustness of the results to only the inclusion of teenagers (between 13 and 19) in supplementary analysis (see Appendix B1).

2.5.3 Empirical Strategy

[2] Early adolescent childbearing in Colombia is high, rising, and a particularly pressing public health concern in the country (Jaramillo-Mejía & Chernichovsky, 2019). Still, the DHS only collects data on adolescent behavior from 13 years of age an up, which limits my ability to include early adolescents in this study.

Given that gender can be considered randomly "assigned," a simple estimation strategy can be used to study the effects of household gender composition on the sexual and reproductive behavior of young women.

My empirical strategy consists of three main parts focused on understanding how: 1) The presence of other females in the household influences young women's SRB; 2) whether SES moderates the influence they have; and 3) if their gender moderates the influence of an older sibling's behavior. Since education is an essential determinant of both knowledge and sexual behavior, it is fair to assume that as SES increases, the influence of cohabiting family members could decrease (I discuss this hypothesis further below). And because communication is more likely to happen among siblings of the same gender (Kolburn Kowal & Blinn-Pike (2004), I also hypothesize that female siblings could have more influence than male siblings on young women's RSB.

Thus, for Part 1, the estimating equation takes the form:

$$Y^{y}{}_{i} = \beta_0 + \beta_1 FR_i + \beta_2 X_i + \varepsilon_i$$

where

$$FR_i = 1 \; if \; \frac{Women \; in \; the \; HH - 1}{Men \; in \; the \; HH} > 1$$

$$and$$

$$FR_i = 0 \; if \; \frac{Women \; in \; the \; HH - 1}{Men \; in \; the \; HH} \leq 1$$

Where $Y^{y}{}_{i}$ is an outcome of the teenage female (i) associated with her sexual and reproductive behavior and health. FR_{f} is a binary indicator that is equal to 1 if the ratio of *additional* women in the household (the number of women in the household excluding the youngest women, which is part of the sample of study) to men in the household is above one, and zero if the ratio is equal or less than 1. β_1, our coefficient of interest, captures the effect of living in a predominantly female household, or a *more women-populated* household. The vector X_f contains a set of individual and family controls, including age, household size, and SES-related covariates such as household strata, education of the household head, and whether the household head is female. The strata variable is a representation of the socio-economic division of Colombian cities into six distinct strata, ranging from the lowest stratum 1 to the highest stratum 6. This classification groups households based on their characteristics and the area in which they are located (Chica-Olmo, Sanchez, & Sepulveda-Murillo, 2019). The strata system is considered an effective measure of household socio-economic status (SES) as it is used by municipal governments to allocate subsidies, collect municipal taxes, and apply varying rates for residential services based on the classification of the household, as highlighted by DANE (2021A). These controls ensure that the estimations account for maternal, family, and household characteristics to estimate the average effect of female presence in the household on young women's SRB. The main independent variable, FR_{i}, represents the availability, and thus exposure, to a higher proportion of women relative to men within a household.

Additionally, I run a supplementary model using the *number of women in the household* instead of the men-to-women ratio to explore the absolute effect of co-residing with other women, regardless of the number of men in the household. I also run models using the *number of men in*

the household as a falsification test, to contrast the effect of living with women to that of living with men.

Together, the results shed some light on the implications of both the gender composition of a household and household size (number of women and men) on my outcomes of interest.

For Part 2, the estimating equation takes the form:

$$Y^{y}{}_{i,SES} = \beta_0 + \beta_1 FR_{f,SES} + \beta_2 X_{i,SES} + \varepsilon_{i,SES}$$

$$\text{where } SES = 1\ (Low), 2\ (Medium), and\ 3(High)$$

I explore whether there are heterogeneous effects of female exposure on women's RBH by two different measures of SES: household strata and the level of education of the household head. For this purpose, I stratify the sample across SES levels (SES) and estimate the effect of living in a predominantly female household on the three main RSB outcomes.

I hypothesize that formal education and higher SES displace the relevance of family members as a main source of information and weaken the differential role model effect. Still, I recognize that the presence of females in a household could have not only different but opposite effects across population groups. It is plausible that a higher number of females in a household could lead to earlier sexual activity and childbearing among low SES women, while among higher SES groups, it could lead to later sexual activity and childbearing. In the discussion section, I

elaborate on these hypotheses, analyze the findings, and draw some conclusions within the context of the population of study.

Finally, for Part 3, I use the subsample of the population that cohabits with at least one parent and either an older sister or an older brother.

The estimating equation takes the form of:

$$Y_i = \gamma_0 + \gamma_1 (SF_s * Y_s) + \gamma_4 X_{i,f} + \varepsilon_{i,f}$$

In this case SF_s is an indicator that is equal to 1 if female (i) has an older female sibling (s) and Y_s is an indicator that is equal to 1 if the older sibling engages in RSB, and 0 otherwise. γ_1, the coefficient of interest, captures the effect of an outcome of the older sibling on the youngest **given** the sibling's gender. To compare the effect of female siblings to that of male siblings, I run the equivalent model but look at the effect of RSB in male siblings.

Testing the extent to which gender dynamics influence adolescent behavior can provide information on existing peer and household dynamics that have not been previously considered by policymakers. Poorly designed policies and interventions can perpetuate and replicate existing inequalities if they ignore how behavioral decisions are made. Any evidence that brings awareness to the risks and resources that shape the environment of women in their adolescent years can guide novel strategies to empower, educate and aid them in their decision-making processes.

2.6 Results

Sample Description

The analysis sample consists of young women between the ages of 13 and 20 across 32 departments, 220 municipalities in Colombia, and 4 main cities. The average number of people per household is 5, with about 3 members above the age of 12 (See **Figure 0.1**, 1A). Regarding adult gender composition, the average women-to-men ratio is **1.8**, meaning that there are 1.8 women for every man in an average Colombian household with children (See **Figure 0.1**, 1B). The women-to-men ratio in our sample corresponds to the composition of households in Colombia, where more than 40% of the household are led by a female (DANE, 2021B).

Given the Colombian population,[3] most households in the sample are middle and low-income, with a low representation of high-SES households (**Figure 0.2**). Most households are classified as belonging to Strata 1 (48%), Strata 2 (36%), and Strata 3 (13.53%), and 40% of homes have household heads that finished primary education, while the other 40% completed secondary education.

Regarding sexual behaviors and health, the young women in our sample who report never having engaged in sexual behaviors with a partner, tend to be significantly younger, live in a household with more women, and have similar SES levels than sexually active women (See **Table 0.1**)

As described above, engaging in risky sexual behaviors is defined as having sex without a condom or with multiple sex partners in the last 12 months, and women that reported never having

[3] The distribution of the Colombia population by SES strata is the following: Strata 1 (21%), Strata 2 (32%), Strata 3 (29%), Strata 4 (11%), and Strata 5 and 6 (7%), as reported by Kantar in their Consumer Insights report, Q4, 2021.

sex are categorized as not engaging in RSB. Within the sample, young women that engage in risky sexual behavior are older, live in smaller households with fewer women, but have similar SES of women not engaging in RSB (See **Table 0.2**).

Lastly, young mothers in the sample are older and live in households with fewer women compared to women that did not become mothers during their adolescence. Still, differences in household size and SES status between these two groups of women are small (See **Table 0.3**).

Associations between co-residing with older women and young women's sexual risk behaviors

To answer the first research question of this paper – *Is there an effect of living with older women on young women's SRB?* – I ran logistic regression models between the outcomes of interest and my variable of female exposure, a dichotomous variable that takes the value of 1 if the women-to-men ratio in the household is above 1, and 0 otherwise. The models control for age, socio-economic strata, education of the household head, household size, whether or not the household head is female, and whether the women were born to women that were young mothers themselves. The results show that young women that live in predominantly female households have lower odds of engaging in risky sexual behavior (β: - 0.26; 95% CI: -0.40--0.12), are more likely to wait until turning 20 to have sex (β: 0.16; 95% CI: 0.023-0.28), and are less likely to become teen mothers (β: -0.77; 95% CI: -0.99--0.56), compared to women that inhabit gender neutral or predominantly male households (see **Figure 0.3**). I ran additional models using two alternative measures of female exposure: the number of women in the household (See Figure 4)

and women to men ratio (See Appendix B2). The results are robust to these two alternative specifications, although the effects using the ratio of women to men are still significant but of a smaller magnitude. The results for the three outcomes show that the exposure to women in the household in positive for young women (less RSB, higher likelihood of abstinence, and less likelihood of early childbearing) and suggest that the protective effect of female exposure is mostly driven by the availability of other women in the household, and not by gender dynamics caused by the relationship between the number of women to men in the household.

To further explore the effects of women-to-men dynamics, I also ran models to compare the effects of living with women in the household to the effect of number of men. The number of women, or "additional women", refers to the number of women in the household not counting the focal, youngest, woman in the household. It is equal to the total number of women in the HH minus 1.

The coefficients plotted in **Figure 0.4** indicate that there is a significant protective effect of co-residing with women but exposure to co-residing men is not associated with young women's behaviors. On average, living an additional woman in the household is associated with a reduction in the odds of RSB by 0.42 (CI: -0.51--0.32), and an increase in the odds of abstaining from sex until the age of 20 by 0.32 (β: 0.32; 95% CI: 0.22-0.41), and reduces their odds of becoming a young mother by 1.23 (β: -1.23; 95% CI: -1.42--1.11). These findings are consistent with my hypothesis that women in the household have more influence on the RSB of young women than

do men. All results were robust when imputing the missing values in the covariates in the analysis (See Appendix B3)

The interactive effect of women in the household and SES

To understand how the protective effect of women in the household varies across levels of SES, I ran stratified models by SES strata and education of the household head. Because SES has been found to be closely associated with teenage development and behavior (Mellor, Hooley, & Devenish, 2017; Singh, Darroch, & Frost, 2001), I hypothesize that the effect of additional women could depend on SES in one of two ways. On the one hand, the protective effect of other females in the household could be strongest in low SES households if these women serve as a primary source of information for co-residing younger women with scarce resources, and weakest in high SES households with access to more resources, more educated parents and peers, and more comprehensive sexual education programs at their schools. Alternatively, the direction of the effect could be opposite in high and low-SES households if having close role models reproduces class-based behavioral norms. In that case, other low-SES women in the household might promote early sexual and fertility behaviors, and other high-SES women in the household might promote delayed sexual and fertility behaviors. If women are closely exposed to other women whose behavior is a product of their environment, both as a source of information and as a role model, the influence of women in environments with higher levels of RSB could turn from protective to harmful. If this were to be the case, I would expect the protective effect of co-residing women in high SES to be higher since family income, education, and school environment could all be closely associated with less risky sexual behaviors and increased knowledge among young women.

Figure 0.5 shows the effect of living in a predominantly female household, and

Figure 0.6 shows the effect of additional women in the household on the odds of RSB, waiting until 20 to have sex, and early childbearing, stratified by SES. Contrary to the hypothesis stated above, the results show that, overall, the protective effect of women in the household is stronger for young women in low SES households, which means that young women in less privileged households benefit more from living with other women than women in high-income households.

The influence of female vs male siblings: How do having brothers and sisters, and their behavior, affect co-residing young women?

My third research question looks deeper into the mechanisms through which co-residing sisters and brothers have an impact on young women. I limited the sample to 4,650 young women co-residing with at least one parent, who either are only children or have one older sister or one older brother, to make sure we are comparing families with similar structures. I also control for whether the household head is female or not. I also limit households to those with a young woman who is an only child or has a brother or a sister to estimate the differential effect of having a sibling or being an only child, and the differential effect by sibling's gender.

Within this subsample, 65% of the women were only children, while about 18% lived with a brother and 18% with a sister in the household (see Error! Reference source not found.**). Table**

0.5 shows that both older brothers and sisters in the sample engaged in RSB at similar rates, suggesting that exposure to sibling RSB does not depend on sibling gender.

Table 0.6 shows the results from logistic regression models that look at (1) the associations between having a sibling on RSB and (2) the differential effect of having a sibling that engages, or not, on RSB. As with the models in section 1, I control for age, household strata, education of the head of household, household size, and for whether the head of the household is female.

In **Table 0.6**, results shown in column (1) suggest that having co-residing siblings has a beneficial influence on the sexual behavior of young women (β: -0.4; 95% CI: -0.65--0.24), but when analyzing the differential effect of siblings that do and do not engage in RSB (column 2), I find that the protective effect exists only when the sibling does not engage in RSB, and the effect is insignificant when the older sibling does engage in RSB. Young women with older siblings that do not engage in RSB have fewer odds of engaging in RSB (β: -0.82; 95% CI: -1.10--0.54) compared to young women without siblings, but the protective effect disappears if the sibling does engage in RSB (β: -0.11; 95% CI: -0.36-0.14).

To understand the role of gender on sibling influence, I ran a final set of models that estimate the interaction effect of sibling behavior and gender on the likelihood of RSB. **Figure 0.7** shows the effects of sister RSB on young women's RSB, versus the effect of brother RSB on the same outcome. Section 2.8A of **Figure 0.7** shows the odds that a young woman engages in RSB when having a sister that engages in RSB, and when having a sister that does not, compared to

women with no siblings or with brothers. Section 2.8.B shows the equivalent but for young women with brothers that engage, and that do not engage, in RSB. The results show that there is a protective and significant effect of both sisters and brothers that do not engage in risky behaviors on the likelihood that a woman engages in RSB, while there is no significant influence of siblings that engage in risky behaviors. This result suggests that the role model effect would seem to play a role when it comes to positive influences across siblings, but not as much when it comes to negative influences.

Effect of having a sister VS having a brother OR not having siblings on RSB

Figure 0.8 shows the interaction between the sibling's gender, sibling RSB, and the sexual behavior of the co-residing young woman. The probability that an only child engages in RSB is close to 24%. Young women with brothers are about 7 percentage points less likely to engage in RSB if the sibling does not engage in RSB and those with older sisters that do not engage in RSB are 11 percentage points less likely to engage in RSB, but the protective effect of having a sibling completely disappears if the older sister does engage in RSB. These results suggest that when it comes to sexual behavior and health, positive sibling influences act as a protective factor for young women's decisions, while negative influences seem to play a lesser role. I found that both male and female influences matter, but that the magnitude of female influences is slightly larger than male influences.

2.7 Discussion

This study aims to understand the effects of household composition and gender dynamics on young women's sexual behavior. I hypothesized that living in a predominantly female household positively benefits young women when it comes to their RSB, and specially co-residing with an older female sibling, under the assumption that higher exposure to a close network of older women could increase the direct sources of information for young women, and accentuate the role model effect of RSBs since these women could become the closest, most relatable representations of attitudes and behaviors for young women.

Consistent with these assumptions, my first finding shows that young women living in predominantly female households are less likely to engage in risky sexual behavior than women in gender-neutral or predominantly male households. These results provide evidence of two distinct dynamics: first, living in a predominantly female household, that is, a household where there are more women than men, seems protective for young women's RSB, which suggests that gender dynamics in their close networks do play a role in teenage girls' sexual development. Additionally, the fact that the marginal effect of additional female household members has an effect beyond the gender composition of the household, while additional men alone have no effect, suggests that beyond gender dynamics, access to older women does represent an additional protective resource for the decision-making process of young women.

My second research question focused on understanding if the effects depended on SES, or whether the protective effect of female influences varied across the SES spectrum.

The direction of the interactions between SES and the protective effect of female influences on risky sexual behavior (RSB) is not immediately apparent. On the one hand, as I briefly described earlier, it is possible that as SES increased, the protective effect of other women in the household could disappear, as women in high SES households have access to resources that might replace, or be more relevant, than any existent influence within the household. On the other hand, past literature on the effects of SES on women's RSB could also suggest that teenage behavior in low SES contexts might reflect the resources in the environment and that if the behavior of older siblings within the same household was also the product of that environment, then female influence at low SES levels could reinforce generalized behaviors in that particular context and negatively influence young women's RSB. Consistent with the first hypothesis, my results show that socio-economic status determines the impact of social environments on young women's sexual behaviors, with the protective effect of co-residing women being stronger for young women in low SES households. These results are encouraging because they suggest that household dynamics, and especially female influences, could play a role to mitigate risk factors in the most disadvantaged populations.

Lastly, and consistent with previous literature, the last set of results shows that sibling behavior and gender play a role in shaping adolescent decision-making. I find that female siblings that engage in healthy sexual practices yield a positive influence on younger sisters, and these positive influences might be stronger than the potential influence of negative behaviors in older siblings. I did find that both male and female siblings influence the RSB of younger women, but the magnitude of the influence is bigger for sisters than for brothers. These findings suggest that young women might be more influenced by positive role models than by negative ones and that

older siblings play a role in the sexual development of young women. Theoretical frameworks in past research have tried to understand the effects that siblings and other peers can have on adolescent behavior, with siblings being identified as significant influencers due to their role as role models and frequent socialization. Research has also found that female role models, specifically, can have a significant impact on the information, choices, and outcomes of young women, with women's networks being found to influence women's reproductive behaviors and the adoption of new behaviors.

Altogether, this research shows that household composition, family dynamics, socio-economic status, and sibling influence play a role in shaping adolescent sexual attitudes and behaviors. This knowledge could contribute to the design of more effective family policies and interventions that recognize the multifaceted nature of adolescent decision-making and the potential impact of household interactions on adolescent decision-making. Still, further research is needed to explore the mechanisms by which co-residing older women influence young women's sexual behaviors, and to determine if the protective effect of a female network varies by other factors such as race and ethnicity. These findings also expose the need for more diverse and extensive research in different cultural settings to gain a more comprehensive understanding of the impact of household interactions on adolescent RSB, and a deeper understanding of the potential influence of family members in shaping young women's outcomes.

2.8 Conclusion

The study investigates the effect of co-residing with other women on young women's sexual risks and behaviors. Logistic regression models were used to examine the relationship between the outcomes of interest and a series of measures of female exposure. The results show that young women living in predominantly female households in Colombia have lower odds of engaging in risky sexual behavior, are more likely to wait until the age of 20 to have sex, and are less likely to become teen mothers compared to women in gender-neutral or predominantly male households. The results are robust to alternative measures of female exposure and found that there is a significant protective effect of co-residing women, compared to the effect of co-residing older men. I also find that the protective effect is stronger for young women in low socio-economic status households, which highlights the importance of considering SES when evaluating the influence of social environments on young women's sexual behaviors. Lastly, I find that having a sibling, whether it be a sister or brother, can have an impact on a young woman's likelihood of engaging in risky sexual behavior. Having a sister who does not engage in risky RSB has a protective effect on young women, reducing the likelihood of RSB by 11%, and having a brother who does not engage in RSB reduces the likelihood of risky RSB by 7%. I find no effect of having a sibling that engages in risky SRB on the behavior of younger sisters. The results of this study provide a couple of important insights for policymakers: First, early intervention programs that focus on reducing risky sexual behavior (RSB) could prioritize targeting the oldest children, whether male or female, as reducing their RSB could have beneficial spillover effects on younger siblings. Second, programs that provide social support and resources for young women living in low SES households could include household members, and consider household composition, to maximize the potential impact of their interventions. Overall, these findings suggest that family and household composition can have a significant impact on young women's sexual behavior and

that programs and policies should consider these factors when designing interventions to reduce risky sexual behaviors and teen pregnancies.

2.9 Tables and Figures

Table 0.1: Sample characteristics by reported abstinence

	Has had sex (N: 3,852)	Has never had sex (N: 5,152)
Avg Age	18	15
Avg size of HH	5	5
Avg # of women in the HH	1.7	2.1
Avg # of men in the HH	1.5	1.5
Avg ratio of women to men	1.7	1.9
Avg years of education of HH head	8	7.5
HH Strata	2.0	1.9

Notes: HH refers to household

Table 0.2: Sample characteristics by reported RSB status

	Engages in Risky Sexual Behaviors (N: 2,872)	Non- Risky Sexual Behaviors (N: 6,179)
Avg Age	17.9	15.4
Size of HH	4.5	5
# of women in the HH	1.6	2.0
# of men in the HH	1.5	1.5
Avg ratio of women to men	1.6	1.9
Avg education of HHH	8.1	7.5
HH Strata	2.0	1.9

Table 0.3: Sample characteristics by reported young mother status

	Teen Mom (N: 1,314)	Non-Teen Mom (N: 7,737)
Avg Age	18.5	15.8
Size of HH	5	5
# of women in the HH	1.4	2
# of men in the HH	1.5	1.5
Avg ratio of women to men	1.4	1.9
Avg education of HHH	8.0	7.7
HH Strata	1.9	2

Table 0.4: Characteristics of women that live with at least 1 parent in the household

	N	%
Only Childs	3,014	65%
Has a Sister	817	18%
Has a Brother	819	18%
Total	4,650	

Table 0.5: RSB across older brothers and sisters in the sample

	Sister	Brother
RSB	44%	43%
No RSB	56%	57%

Table 0.6: The effect of an older sibling's RSB on young women's sexual behavior

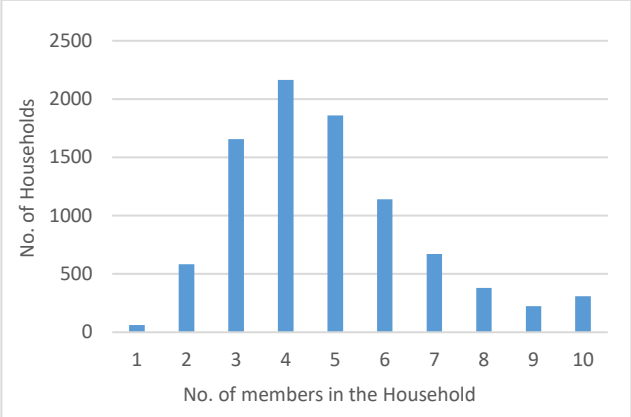
VARIABLES	(1) RSB	(2) RSB
No Sibling in HH	(Omitted)	(Omitted)
Sibling	-0.442***	
	(0.105)	
Sibling with RSB		-0.824***
		(0.144)
Sibling with no RSB		-0.111
		(0.128)
Age	0.601***	0.595***
	(0.024)	(0.024)
Strata	-0.022	-0.024
	(0.065)	(0.065)
Education head of HH	-0.139**	-0.137**
	(0.063)	(0.063)
Female head of HH	0.551***	0.535***
	(0.099)	(0.099)
Constant	-11.05***	-10.94***
	(0.477)	(0.478)
Observations	4,053	4,053

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Figure 0.1: Size and gender composition of households in the study

1A: Size of HH



1B: Distribution of Women-to-Men Ratio

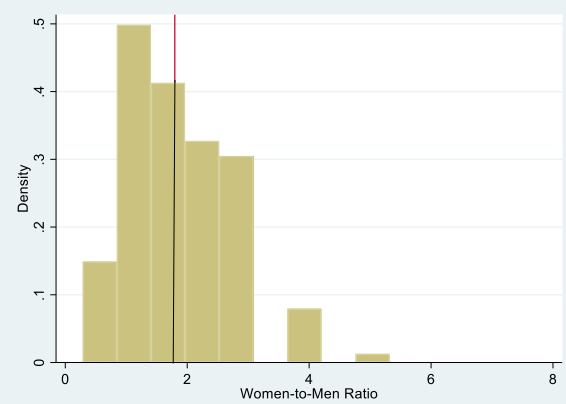
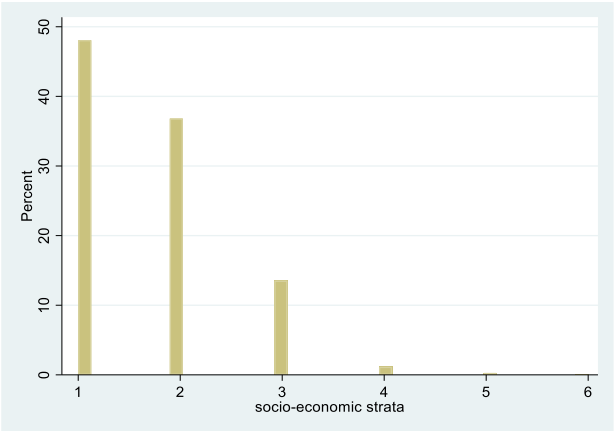


Figure 0.2: SES of the households in the study

2A: Socioeconomic strata of sample households



2B: Highest educational level attained by the household head

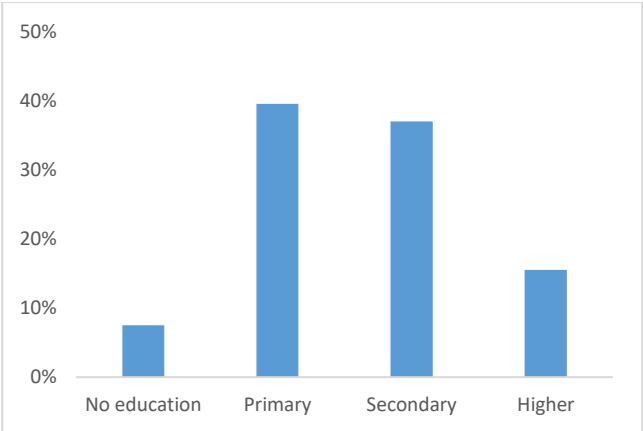


Figure 0.3: The effect of living in a predominantly female household on the sexual behavior of young women.

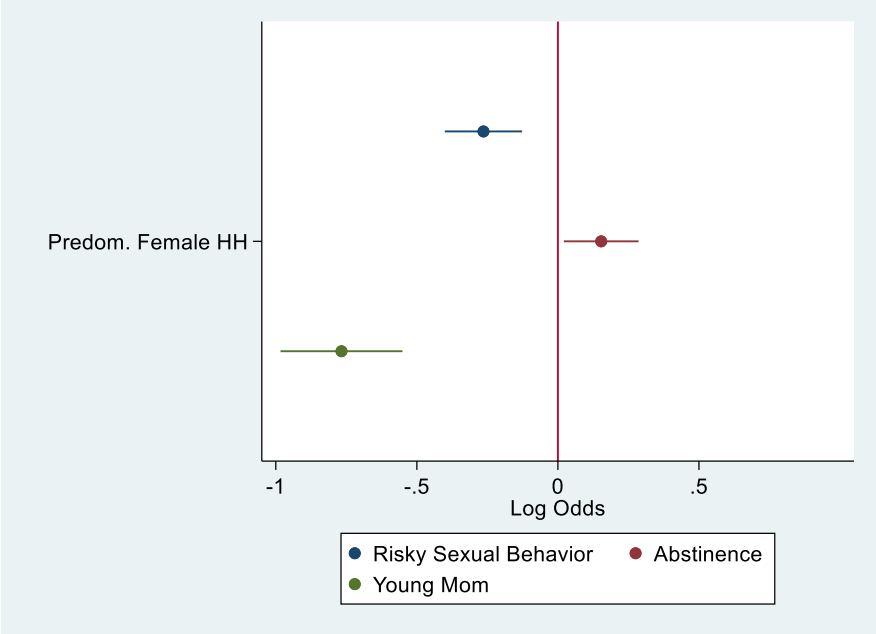
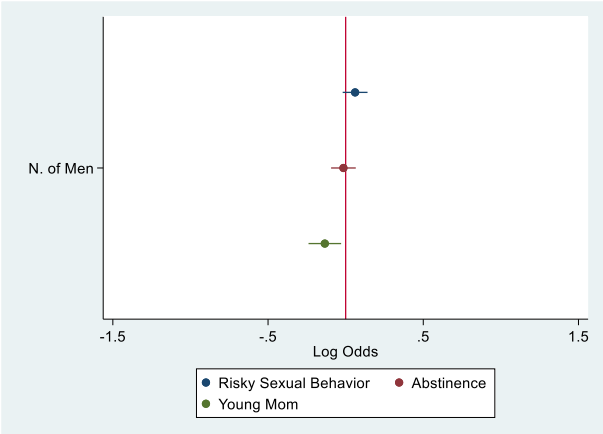
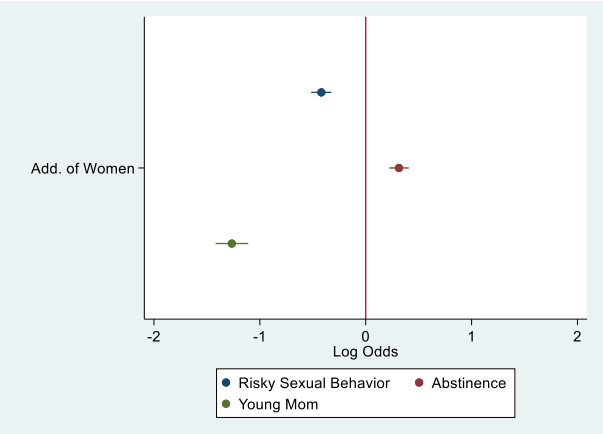


Figure 0.4: The effect of living with men and living with women on the sexual behavior of young women

Effect of Exposure to Men in the HH



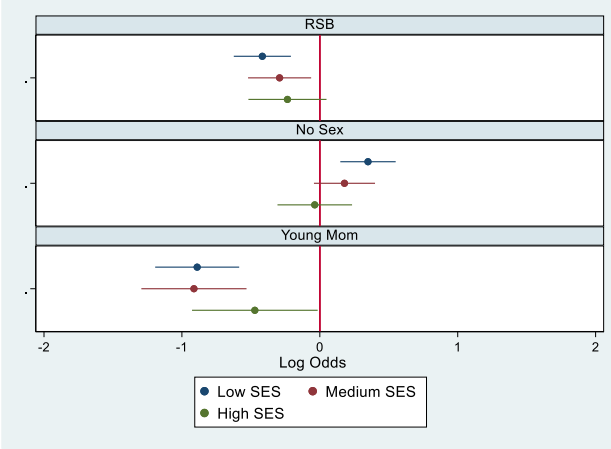
Effect of Exposure to women in the HH



Note: *Exposure to women* refers to the number of women in the household excluding the youngest in the household, the one included in the main sample (*No of women in the HH – 1*)

Figure 0.5: The effect of a predominantly female household by SES Strata and educational attainment of the head of household

By Strata



By Educational Attainment - Head of household

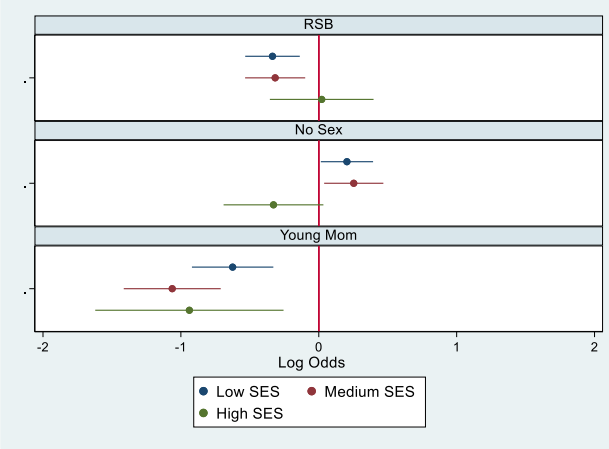
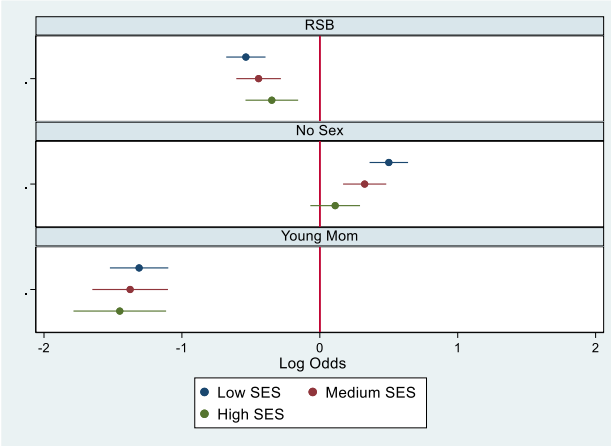


Figure 0.6: The effect of additional women in the household by SES Strata and by educational attainment of the head of household

By Strata



By Educational Attainment - Head of household

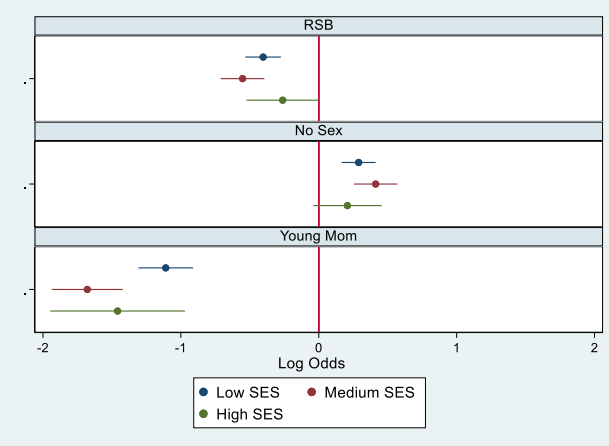
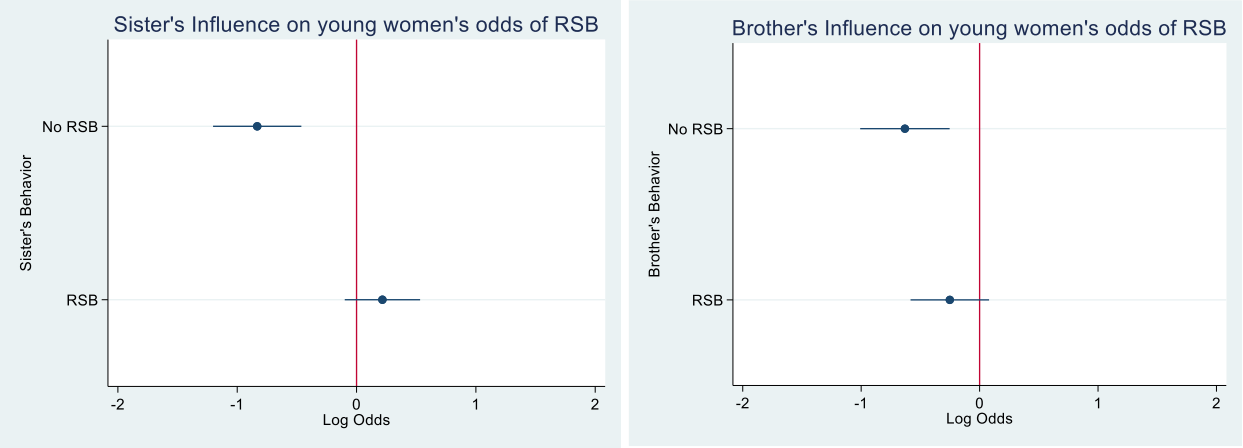


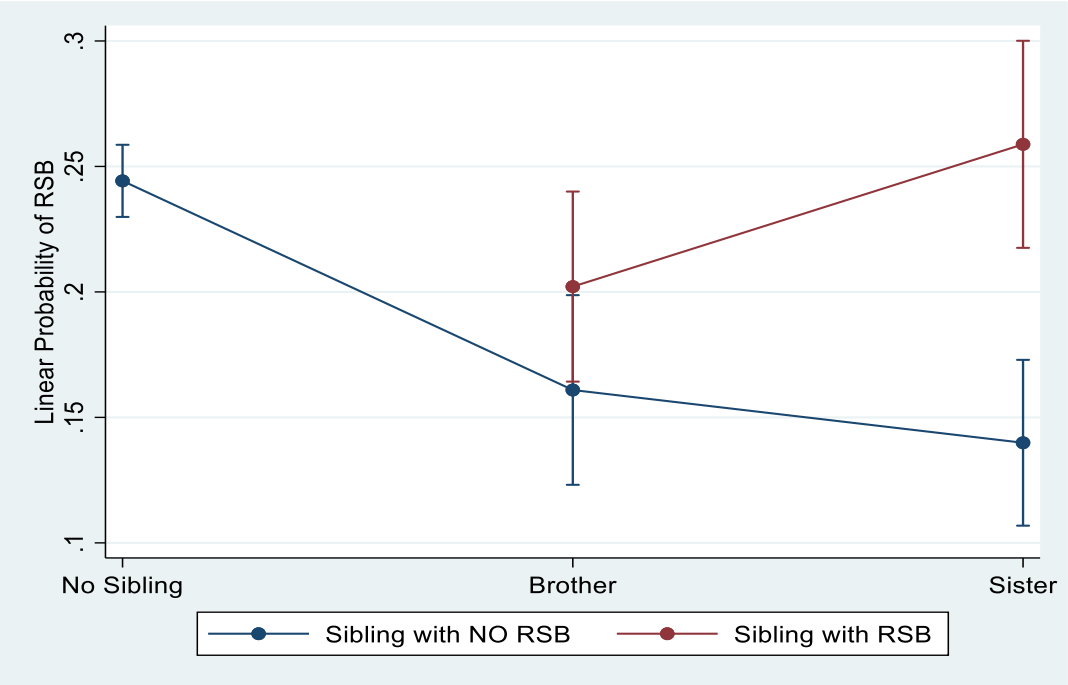
Figure 0.7: Sibling's influence: The effect of sibling RSB on young women's RSB

2.8 A **2.8 B**



Note: 28.A plots the coefficients of a logit model of sisters's RSB on young women's RSB that controls for women's age and education, household size, strata and gender of the household head, and municipality fixed effects. 28. B plots the coefficients of a logit model of brother's RSB on young women's RSB that controls for women's age and education, household size, strata and gender of the household head, and municipality fixed effects.

Figure 0.8: The interaction between gender and sibling behavior on the likelihood of RSB among co-residing women



Note: Marginal probability plot of logit model of sibling's RSB on young women's RSB that controls for women's age and education, household size, strata and gender of the household head, and municipality fixed effects.

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Chapter 3: Effects of second-hand smoking regulations on birth outcomes in Latin America and the Caribbean: A Multi-country Analysis

3.1 Abstract

This paper examines the impact of smoke-free regulations on birth outcomes in Latin America and the Caribbean (LAC). It uses a staggered difference-in-differences approach to exploit the variation in implementation timing across LAC countries. The study finds that smoke-free policies in the region had a positive effect on average birthweight that ranged from 58 to 94 grams. Additionally, treated countries experienced a decrease in low birth weight rates of up to 1.8 percentage points. The results also show that the impact of smoke bans on pregnant women is positive across all socioeconomic strata, but particularly pronounced among low SES women. These findings provide strong evidence that the implementation of smoke-free regulations in the region had a positive effect on birth outcomes, particularly among vulnerable populations. They also suggest that policymakers should prioritize the adoption and enforcement of smoke-free bans as a means of improving maternal and child health, while also promoting health equity across socio-economic groups.

3.2 Introduction

Environmental tobacco exposure remains a generalized public health concern with over 80% of the world's population currently unprotected by comprehensive smoke-free laws (Faber, Been, Reiss, Mackenbach, & Sheikh, 2016). Tobacco exposure has been linked to numerous health problems in adults and children (CDC, 2021A; CDC, 2021B), with evidence suggesting that exposure to second hand smoking (SHS) is directly associated with health conditions like coronary heart disease, stroke, lung cancer, and many other diseases (HHS, 2006; ANRF, 2009). Prenatal

passive smoke exposure has been found to increase the risk for negative birth outcomes, making SHS especially concerning for pregnant women (Schechter, et al., 2018).

Global tobacco epidemics continue to shift from high-income countries to low- and middle-income countries (LMICs) (WHO, 2013). Around 80% of the 1.1 billion smokers worldwide are living in LMICs, and tobacco consumption has become concentrated in the developing world where the health and economic burden is heaviest and likely to increase (ASH, 2019). In Latin America, smoking is among the five leading risk factors for death and disability, and contributes to poverty by decreasing productivity and deteriorating health, thus increasing private and public healthcare costs (Pichon-Riviere, et al., 2020; WHO, 2008). Although some countries in Latin America, including Colombia, have transition to having comparatively low (<20%) prevalence in smoking (Dai, Gakidou, & Lopez, 2022), and despite the fact that smoking among pregnant women is low, SHS exposure, particularly among pregnant women, jeopardizes the ongoing efforts to improve maternal and child health in these countries (Quiñones, et al., 2022; Bloch, et al., 2008).

Over the past decades, smoke-free (SF) regulations (non-price-related tobacco control policies) have been enacted across the world. Progressively, many developing countries became parties of the WHO Framework Convention on Tobacco Control (FCTC) and issued legislation prohibiting smoking in most enclosed public places and workplaces.

In early 2021, Paraguay joined the rest of South America in establishing smoke-free environments in indoor public spaces and workplaces as mandated by the FCTC, making the region the first multi-nation continent to achieve this benchmark (PAHO, 2021; Myers, 2021).

Still, many of these countries do not have strong tobacco-control policies, and the effectiveness and intensity of enforcement of the measures adopted by each government vary across the region (Navas-Acien, et al., 2004; Pichon-Riviere, et al., 2020). Countries like Chile adopted national legislations highly influenced by tobacco industry policies designed to minimize the impact on smoking[4]. Such legislations admitted a variety of exceptions that did not comply with WHO recommendations nor WHO FCTC guidelines (Sebrié, et al., 2012). Caribbean countries have also followed the trends in the region. Non-Latin Caribbean countries (English and Dutch speaking) like Trinidad and Tobago and Barbados have passed 100% smoke-free laws, while Latin Caribbean countries (Spanish and French-speaking) are lagging. As of today, Cuba and Haiti have made little to no progress in effectively implementing smoke-free policies.

Given the increase in SHS regulation in LAC countries, an assessment of the effectiveness of such policies in benefiting particularly vulnerable populations seems timely. Evidence of the positive health effects of the existent laws is limited and necessary if domestic or international stakeholders wish to promote similar initiatives in other developing countries.

This paper studies the effects of the implementation of smoke-free regulations on birth outcomes in the LAC region. I hypothesize that smoke-free regulations have positive effects on newborn health, potentially thought a reduction of maternal smoking and, primarily, by reducing SHS exposure by non-smoking mothers (Bartholomew & Abouk, 2016)[5].

[4] One of the primary obstacles to progress smoke-free regulation in the region continues to be the persistent opposition of Tobacco companies, whose strategies include lobbying to block regulations and even promoting a presidential veto, litigation in the courts, as well as amendments and preemption in the congress after a law passes (Sebrié, Veronica, Travers, McGaw , & Glantz, 2012).

[5] What's known about the effects of smoke-free regulations on health outcomes?
(Bartholomew & Abouk, 2016) These population-based smoking restrictions have been effective public health interventions in reducing hospital admissions for acute myocardial infarction, stroke, and asthma, as well as decreasing cigarette consumption and smoking prevalence with variations by sex, age, and socioeconomic status. In addition to these improvements, smoke-free

3.3 Background

Previous research has documented consistent associations between prenatal tobacco exposure and various adverse birth outcomes such as low birthweight, preterm delivery, small-for-gestational-age, intrauterine growth, perinatal deaths, sudden infant death syndrome, as well as certain birth defects (Marufu, et al., 2015; Gould, et al., 2020; Avşar, McLeod, & Jackson , 2021). These findings are not limited to active smoking, but the literature focused on the impacts of second-hand smoking (SHS) on birth outcomes has also found negative associations between SHS and maternal and infant health (Adgent, 2006; Fantuzzi, et al., 2008; Hoyt, et al., 2018; Ion, Wills, & Bernal, 2015; Khader, et al., 2011).

There is strong evidence of health benefits to communities that have implemented comprehensive smoke-free regulations, and pregnant women have been at the center of the debate as a particularly important subset of the population for policymakers and public health officials (Been , et al., 2014; Hahn, 2012; Bloch, et al., 2008). Recent literature has identified pathways underlying the potential link between smoke-free regulations and improved birth outcomes (Faber, et al,. 2016). On one hand, smoke-free laws have been found to reduce maternal smoking during pregnancy (Adams, et al., 2012; Bartholomew & Abouk, 2016; Bharadwaj, et al., 2014; Nguyen, et al., 2013; Page, Slejko, & Libby, 2012). On the other hand, these policies reduce SHS exposure among the general population, in addition to reducing smoking among the young, overall smoking

regulations have the potential to improve birth outcomes by decreasing smoking prevalence among pregnant women and/or reducing exposure to secondhand smoke (SHS) during pregnancy.

prevalence and increasing smoking cessation (Hoffman & Tan, 2015; Faber, Been, Reiss, Mackenbach, & Sheikh, 2016). Together, both mechanisms play a role in making smoke bans, especially when accompanied by other comprehensive tobacco control regulations, effective strategies to improve public health among all segments of the population.

Within recent studies conducted in developed countries, Been, et al., 2015 examined the impact of the July 2007 national smoke-free legislation in England on perinatal outcomes using interrupted time series logistic regression analysis, and found that smoke-free legislation was associated with a significant reduction in stillbirth (7.8%), low birth weight (3.9%), and neonatal mortality (7.6%). Not much after, Bakolis, et al., 2016, also evaluated the impact of England's SF policy on birth outcomes in England using Hospital Episode Statistics maternity data with a regression discontinuity approach, and found that the introduction of the legislation had an immediate beneficial impact on birth outcomes overall, with a decrease in the risk of low birth weight (8-14%), very low birth weight (28-32%), preterm birth (4-9%), and small for gestational age (5-9%)—however, the impact varied by maternal age, deprivation, ethnicity, and region.

Mackay, et al., (2012) analyzed the impact of Scotland's 2006 smoking ban on pregnancy outcomes. Using national pregnancy data, they found a significant decrease in the prevalence of smoking after the ban was implemented. Additionally, they found that months before the ban, there were significant reductions in small for gestational age, preterm delivery, and spontaneous preterm labor among both current and never smokers. Shortly after, Cox, et al., (2013) evaluated the impact of three phases of smoke-free legislation in Belgium on the incidence of preterm delivery. The study analyzed routinely collected birth data from 2002 to 2011 and found that there were

reductions in the risk of preterm birth after the introduction of each phase of the smoking ban. Their findings show a consistent pattern of reduction in the risk of preterm delivery with successive population interventions to restrict smoking, and conclude that smoking bans have public health benefits from early life.

In the U.S, Bartholomew & Abouk (2016) examined the impact of different levels of smoke-free regulations on birth outcomes and prenatal smoking in West Virginia, and found that only comprehensive smoke-free regulations (workplace/restaurant/bar bans) were associated with favorable effects on birth outcomes, including increased birthweight and gestational age, as well as reductions in very low birthweight and preterm birth. Less restrictive regulations had no significant effect, and the effects were broadest among mothers 21+ years, non-smokers, and unmarried mothers. The study also found a slight decline in prenatal smoking, but only among married women with comprehensive regulations. More recently, McGeary, Dave, Lipton, & Roeper (2020) examined the impact of comprehensive smoking bans on smoking and the health of children and infants using state- and county-level changes to smoking ban legislation over time. The findings indicated that comprehensive smoking bans improved the health of infants and children. They also found no evidence of smokers shifting their smoking habits from public venues to their homes, suggesting that these policies do not harm children and infants. In fact, the bans led to a reduction in smoking inside homes, which may explain the observed improvements in children's health. The study suggested that expanding comprehensive smoking bans to cover 100 percent of the population could prevent a significant number of low birth weight births among low-educated mothers, resulting in substantial economic cost savings and additional health benefits for older children.

Additionally, Xu, et al. (2020), examined the association between changes in statewide SF laws and the rate of preterm or low birth weight delivery hospitalizations using a quasi-experimental difference-in-differences design. They found no overall association between the change in smoke-free laws and preterm or low birth weight delivery rate. However, among non-Hispanic black mothers, the change in statewide smoke-free laws was associated with a reduction in preterm or low birth weight delivery rate beginning in the third year after the laws took effect. Their study also found a decline in the black-white disparity of preterm or low birth weight delivery rates associated with the change in state smoke-free laws.

In South America, only Mallma, Carcamo, & Kaufman (2020) performed a quasi-experimental study looking at the effect of SF legislation on birth outcomes. They evaluated the impact of Peru's anti-tobacco laws on birth weight, prematurity, and small for gestational age (SGA) by comparing children born to mothers from urban areas (the treatment group) to children born to mothers from rural areas (the control group). Their results showed that the anti-tobacco law in Peru reduced the incidence of prematurity by 30 cases per 10,000 live births, but found no effects on overall birth weights and the incidence of SGA.

There are important gaps in the existing research, especially when it comes to developing nations. Almost all of the studies that have assessed the effects of SHS regulations on birth outcomes have focused on developed countries. It is not obvious that the effects of SHS regulation would be the same in LMICs given the different burdens of smoking and tobacco-related death and disease there (Been, et al., 2014; Faber, et al., 2016), and the challenges LMICs might face in

implementation and enforcement of policies. Second, there are currently no evaluations, to my knowledge, that assess the impact of smoke-free policies using a regional approach or that exploit cross-country variations in the timing of adoption of smoking bans. As I describe in the section below, South America has come a long way in moving towards compliance with all the WHO recommendations to combat the tobacco epidemic and its public health repercussions. A regional approach to understand the impact of smoke bans in developing nations could serve as a tool to improve existing policies and promote such strategies across the region and in regions with similar challenges.

This paper is the first study to assess the impact of these regulations on birth outcomes in LAC countries, and exploits not only across countries but within mother variations across births before and after the policy.

3.4 The implementation of Smoke-Free policies in LAC

The Latin American and Caribbean countries have been working towards smoke-free tobacco policies for several years. In 2003, Uruguay became the first country in the region to implement a comprehensive smoke-free law, which included all indoor public places, workplaces, and public transportation (Ernesto, Schoj, & Glantz, 2008). Two decades later, in December 2020, South America became the first subregion in the Americas to achieve 100% smoke-free environments, with part of the Caribbean following suit, and other countries lagging behind (Severini, et al., 2022).

In 2005, the WHO Framework Convention on Tobacco Control (FCTC) came into force, providing a comprehensive set of guidelines for countries to follow in their efforts to reduce tobacco consumption (World Health Organization, 2004). At that time, many Latin American and Caribbean countries ratified the FCTC and one by one embarked on a road to implement its provisions, including smoke-free laws, among other comprehensive strategies for tobacco control. While some countries launched and ratified their smoke-free policies shortly after the FCTC, others took years to transform their commitments into legislative actions within their populations. For this study, I focus on two sets of LAC countries. The first are countries that implemented 100% smoke-free policies between 2006 and 2011, and that had DHS surveys that covered births in that particular timeframe (see *Data* section for more details). The second set are countries that by 2013 had not implemented any smoke-free policies (See **Table 0.1**). This is an important definition because the tobacco control legislation in the region has been bumpy. Since the begging of the century, tobacco companies have implemented programs and campaigns in Latin America to prevent the implementation of effective smoke bans in public places and workplaces, resulting in early accommodating and ineffective legislation that followed tobacco industry policies designed to minimize impact on smoking (Sebrié & Glantz, 2007; Sebrié, et al., 2012). While some countries, such as Peru and Bolivia, later updated their policy to comply with FCTC guidelines, others have maintained many exemptions to smoke-free norms. In this paper, I evaluate the effect of 100% smoke-free policies and exclude countries with policies that do not comply with WHO international guidelines.

While the region has made significant progress in implementing smoke-free policies, challenges remain. One of the biggest obstacles, as I briefly mentioned before, continues to be the tobacco industry's influence on policy-making. Tobacco companies have been known to lobby

governments and use marketing tactics to promote their products, despite the harmful effects of smoking (Sebrié, et al., 2012).

Another challenge in implementing SF legislation in Latin America is achieving full compliance. Compliance levels vary across the region, with some countries reporting high compliance and social acceptance, while others struggle due to a lack of monitoring and surveillance by public officials. Some countries, such as Guatemala, face difficulties due to a lack of resources and infrastructure for reporting violations and enforcing the law, particularly in bars and pubs at night. In other countries, such as Colombia, despite no political will to promote enforcement, tremendous social acceptance has been reported, thus maintaining high levels of compliance (Sebrié, et al., 2012).

To address these challenges, many Latin American and Caribbean countries have taken a comprehensive approach to tobacco control. This includes implementing smoke-free laws, raising taxes on tobacco products, and providing access to smoking cessation programs. This multi-faceted approach has aided these countries to reduce smoking rates (Apollonio, Dutra, & Glantz, 2021; CDC, 2021) and are likely to have improved the overall health of their populations (CDC, 2021B; Faber, et al., 2016).

3.5 Smoking prevalence among Latin American women and their exposure to SHS

The prevalence of smoking among women and the consequences of SHS remain a public health concern in Latin America, especially among pregnant women (Nichter, et al., 2010; Palloni,

Novak, & Pinto-Aguirre, 2015). As mentioned before, smoking during pregnancy can have harmful effects on the developing fetus, increasing the risk of complications and low birth weight, while women exposed to secondhand smoke face additional risks beyond those associated with direct smoking. Studies have shown that exposure to secondhand smoke during pregnancy can increase the risk of preterm birth, stillbirth, sudden infant death syndrome (SIDS), and developmental disorders (Leonardi-Bee, Britton, & Venn, 2011; ANRF, 2009). Furthermore, exposure to secondhand smoke can also affect the mother's cardiovascular health, increasing the risk of hypertension and other cardiovascular diseases (Wipfli, et al., 2008; Bernabe-Ortiz & Carrillo-Larco , 2021).

As shown in **Figure 0.1**, the prevalence of tobacco use is significantly higher among men, compared to women, in the LAC region. Although smoking rates have been decreasing over the last decade, without regulations, pregnant and non-smoking women remain exposed to SHS both at home and in their workplaces, particularly in industries such as hospitality, which are particularly big in this region. Efforts to promote tobacco control policies in the regions have prioritized the protection of pregnant women and children, as the abolishment of smoking in public places could not only improve public health outcomes in the region, but also to battle existing health inequities.

Table 0.2 shows the prevalence of tobacco use in my analysis sample as well as the national rates for men and women for each country. Consistent with national figures, the % of mothers that claim to smoke is relatively low in all countries (below 10%). The national figures by gender show that in some countries, the % of men that smoke is more than 10 times that of women, putting women at more risk of SHS in their households than men. As I discuss in the sections below, the

enactment of smoke-free policies in a country could improve health outcomes through two distinct channels: the first is by promoting cessation among current smokers, and the second by decreasing the exposure to SHS among non-smokers. While it is very hard to separate the mechanisms behind the effects of these policies, given the LAC context, it is important to note that the SHS channel would primarily benefit women by reducing their exposure to tobacco in their workplaces, but potentially also by decreasing their exposures at home if the newly enacted legislations also lead to smoking cessation among men and women.

To further understand women's prevalence of smoking during that period, **Table 0.3** shows the pre vs post-policy difference in average rates of tobacco use among women in countries that implemented smoke bans between 2006 and 2011. The rate of smoking mothers was about 1% point lower after the implementation of the SF policies, which suggests that although small, cessation might have occurred among women, and pregnant women, in a way that could contribute to improved birth outcomes post-policy. It is important to mention that there was already a downward trend in smoking prevalence in most LAC countries at the time, which means that we can not necessarily attribute the fall in the number of smoking women to the enactment of SF policies. Still, it is plausible that SF legislation, together with other comprehensive efforts to reduce smoking, did encourage cessation and thus indirectly benefit the health of pregnant women and their children.

3.6 Methods

3.6.1 Data

This study uses data from Latin American and Caribbean countries included in the Demographic and Health Surveys (DHS), namely Bolivia, Colombia, Guatemala, Guyana, Honduras, Haiti, and Peru. Colombia, Guatemala, Honduras, and Peru implemented SF policies between 2008 and 2012, while the other 3 had not passed any restrictive SHS regulations by 2014. Each DHS wave collects information on all births to interviewed mothers that happened within a period of 5 years before the date of the interview. The countries selected have data within the timeframe necessary for this study (births that occurred between 2005 and 2013), allowing me to account for trends before the implementation of the policy, and the subsequent impact of the SF policies as they were gradually implemented through the years. I pool the available waves of data within that time frame, which contain information on 62,144 births in the 7 countries, with no missing data on birthweight (excluded 20% of all births because of missing birthweight data) and with conception dates between 2005 and 2013 (See **Table 0.4**).

As indicated above, the never-treated (NT) countries (Bolivia, Guyana, and Haiti) did not implement any regulation to restrict smoking in public areas during the period of study, while the treatment (SF) countries (Colombia, Guatemala, Honduras, and Peru) did implement restrictions sometime within that timeframe. In total, the study includes 3 never-treated countries, and 4 treated countries. As can be seen in **Table 0.5**, there is variability in the timing of the adoption of SF policies across countries in a "close enough" time window that allows a comparison of outcomes before and after the implementation in each country, and across countries, to assess the effects of SF regulations on the outcomes of exposed women.

The outcome of study is birthweight (BW), which is recorded in grams, and reported by mothers while completing the survey. In most countries, the information reported by the mother is verified with the information found in the birth certificate. I also conduct additional analysis using a dichotomous variable of whether a newborn's weight is less than 2500 g (LBW). Both BW and LBW have been found to be predictors of later health, as well as other future outcomes (Risnes, et al., 2011; Case, et al., 2005; Conley & Bennett, 2000; Figlio, et al., 2014).

Additionally, the DHS also contains mother-level covariates such as age, education, and marital status, as well as household SES (wealth index and gender of household head), which I use in the model specifications described in the *empirical strategy* section.

3.6.2 Empirical Strategy

To evaluate the effects of SHS on birth outcomes, I exploit the variation occurring from the different timing of implementation of smoke-free laws across countries. More specifically, I use a staggered difference-in-differences (SDID) approach to capture the variation in birthweight in births before and after the implementation of the policy in each particular country, given the existing trends across countries.

The main independent variable is an indicator equal to 0 for all observations in a particular country before the enactment of a policy, and equal to 1 in all years after a smoke-free policy was enacted, so this variable will vary across years and countries.

To utilize a SDID approach to estimate the average treatment effect of implementing a smoke-ban at the country-level, the model requires (i) multiple periods, (ii) variation in treatment timing, (iii) that the parallel trends assumption holds after conditioning on observed covariates and (iv) that once a group is treated, it remains treated in the following periods (Callaway & Sant'Anna, 2020).

Thus, my estimation of model 1 (DD) takes the following form:

$$BW_{ic(t+3)} = \beta_1 SHS_{c,t}^{\kappa} + \alpha X_i + \eta_c + \tau_t + \varepsilon_{ict} \quad (1)$$

where BW_{ict} corresponds to the weight of an infant born to mother i, in country c, and in quarter of the year $t + 3$. SHS is an indicator that is equal to one for country c adopting a smoke-free policy in all $\kappa \geq t$ periods. The vector X_i contains a set of mother characteristics, η_c are country fixed effects, τ_t are year-month fixed effects and ε_{ict} is an error term. I use cluster-robust standard errors at the country level to correct for the within-country serial correlation in a DD design (Ji, et al., 2020), and for any other changes in each month and year that could have an impact on the health of pregnant women and their subsequent birth outcomes.

Since the effect of the treatment (exposure to smoke-free areas) can impact gestating mothers at different periods of their pregnancy, a lag would exist between the implementation of a law and a change in birth outcomes given the time between the implementation of the law and pregnancy gestation. To account for these lags, I consider women to be treated if the date of birth

happened 9 months subsequent to the implementation of the policy, hence the outcome of study, BW, corresponds to the weight of infants born 3 quarters post-SF regulation $(t + 3)$.

I consider the complete period of pregnancy as the window where exposure to tobacco is most likely to affect health outcomes, and consequently, pregnancies occurring after the time of implementation, the ones more likely to benefit from the effects of the policy. To further explore the timing of the policy effects on gestating women, I also ran supplementary models limiting treatment exposure to women that were about to enter their second and third trimester when the policy was implemented (6 and 3-month cutoff), to explore the differential effect of the policy across the gestational period.

To further isolate the effects of the policy beyond the country-level effects of model 1 (DD), I also estimate the within-mother effect of the policy, that is, a triple difference model (DDD). I limit the sample to women that report more than 1 birth, and compare the outcome of births that happened to the same women before and after the policy, to births of women that had multiple untreated births, across treated and untreated countries in time t, controlling for order of birth. The triple-difference method allows me to estimate the within mother-across time average effect of a policy implementation by introducing mother fixed effects into the original estimation strategy.

Model 2 (DDD), takes the following form:

(2) $$BW_{i(t+3)} = \beta_1 SHS^{\kappa}_{c,t,m} + Bord_i + M_m + \eta_c + \tau_t + \varepsilon_{ict}$$

Where $SHS_{c,t,m}^{\kappa}$ is an indicator that is equal to one for infant i, from mother m, and born in country c after a smoke-free policy was enacted. M_m, the mother fixed effects, adds the third difference to this model, so β_1 captures the difference in BW before and after the policy, across children born to the same mother, compared to the difference in weight of "placebo" mothers that had two untreated children, across countries that enacted SHS legislation and others that did not. Lastly, I control for birth order to account for systematic differences in higher parity births.

Since the causal interpretation of my estimation strategy relies on a conditional parallel-trends assumption, I also conducted an event study to show the compliance of the parallel trends in the periods pre-treatment for countries that implemented smoke bans and in countries that did not implement them during the period of study, and show the average treatment effect for treated and control countries pre and post-SF regulations. Quarterly post-reform estimations also allow to assess short vs long-term effects of the policy change.

3.7 Results

Table 0.6 presents the mean difference in the outcomes of interest between the pre and post-policy implementation periods for countries that introduced SF policies between 2006 and 2011. Column 1 of the table indicates that the mean birthweight in the treated countries increased by approximately 37 grams after the policy implementation. However, no significant difference in the rate of low birthweight (LBW) births was observed post-policy (Column 2).

It is important to note that the changes in birth outcomes presented in **Table 0.6** only consider the pre-post rates of birthweight and LBW in countries that implemented SF legislation. Therefore, these changes in birthweight cannot be directly attributed to the policy change. Nevertheless, the coefficient's direction suggests that birth outcomes improved during this period in the treated countries, and that the implementation of SHS regulations could have played a role in this improvement.

In addition to tobacco-related policies, maternal and household characteristics play a crucial role in determining birth outcomes (Ngandu, et al., 2020). Therefore, to ensure that my identification strategy accurately captures the effect of policy enactment on birth outcomes, it is essential to assess whether other critical determinants of infant health changed after the policy change.

Table 0.7 presents the pre-post mean differences in maternal characteristics for countries that had implemented smoke-free policies by 2012. The results indicate that there are no discernible differences in the SES-related characteristics of mothers or households before and after the implementation of SF policies.

The absence of significant differences in maternal and household characteristics before and after the policy implementation suggests that non-policy related circumstances surrounding births remained consistent throughout the study period. This consistency is important because it enables us to rule out the possibility that other external factors may have influenced maternal and household SES and, as a result, potentially affected birth outcomes.

In addition to the pre-post policy differences within treated countries, it is important to note that countries that implemented smoke-free policies earlier may differ from those that did not implement at the time or implemented them later on. **Table 0.8** provides a comparison of the pre-policy characteristics between countries that implemented smoke-free policies and those that did not. Notably, there were significant differences in outcomes as well as maternal and household characteristics. Prior to policy implementation, treated countries had an average birth weight 66 grams lower than never-treated countries, and a slightly higher rate of low birth weight. Women in treated countries had slightly higher levels of education, but were significantly more likely to be unmarried compared to women in never-treated countries. Furthermore, women in treated countries were more likely to live in low socioeconomic households compared to those in the never-treated group.

The observed differences in maternal and household characteristics across countries suggest that each country was on its unique development trajectory. These differences underscore the importance of carefully accounting for baseline differences in maternal and household characteristics when assessing the impact of smoke-free policies on birth outcomes. In my estimations, I use SDD models that take into account these differences across countries. However, to ensure the validity of the effect estimates, it is crucial to examine whether there were parallel trends in the outcomes of interest across all countries before the policy implementation.

Effects of SF legislation on BW

Table 0.9 depicts the aggregate ATT effects on BW after the implementation of SF regulations. Change in BW is measured as mean change in weight, in grams, after 9 months of

maternal exposure to smoke-free areas as dictated by tobacco control regulations. I find that, overall, treated mothers gave birth to babies that where about 47 grams heavier than children born to untreated mothers.

Table 0.10 shows the within-mother effect of SHS on birthweight. When comparing the within-mother, within-country effect of SHS policies, I find that infants to women exposed to smoke-free regulations during pregnancy were 93 grams heavier than those born in never-treated countries or before the implementation of the policy. This effect is significantly larger than the effect found in model 1.

Controlling for mother-fixed effects allowed me to quantify the change in birth outcomes among mothers that had children before and after the policy. In contrast to the first estimation, this model controls for any unobservable, non-time-varying characteristic that could confound the effect of the policy.

Lags and Leads in SF policy effects

To further understand the timing and magnitude of the effects found in models I and II (DD and DDD models), it is important to consider these potential lags and leads when evaluating the effects of smoke-free legislation on birth outcomes.

There are a few reasons to be concerned about the potential anticipatory effects of smoke-free legislation on birth outcomes. Firstly, there are typically government announcements and media coverage that precede the actual approval and implementation of a policy, which may lead

to anticipatory reactions among populations with many policy sympathizers, creating an anticipated treatment effect that could affect birth outcomes prior to the actual policy implementation.

Conversely, despite the sanctions that result from non-compliance with newly enacted SF legislation, it may take some time for the population to fully comply with the policy. This delay in compliance may result in a delay in the actual treatment effect, especially in populations with limited enforcement mechanisms. Delayed treatment effects may not be immediately apparent, and it may be necessary to monitor outcomes over a longer period of time in order to fully capture the impact of the policy.

To assess anticipatory effects of the policy implementation, I ran two additional models leading the treatment by 3 and 6 months, which means that births conceived 3 and 6 months before the implementation are considered as treated. Additionally, to assess the question of potential delays in policy effects, I ran models that lagged the treatment by a year, to assess whether the effect occurred gradually and would manifest only in births that were conceived at least a year after the implementation of the policy.

The results of these models are shown in **Table 0.11**, and indicate that there is no evidence of anticipated reactions before the legislation was officially announced, or at least not large enough to have an early impact. I also find no significant differences in results when lagging the treatment effect a year. These results are consistent with the policy actually being implemented when the legislation came into force.

Event study: Parallel trends and quarterly post-reform effects of SF policies

Figure 0.2 show the estimated coefficients by trimester of exposure to an SF environment from both the DD and DDD models. We shouldn't observe significant differences between certified and non-certified municipalities prior to the enactment of the policy in each country; preexisting differences could indicate that the estimations were biased, as they would be capturing preexisting trends between treated and untreated countries. The quarterly post-reform differences also allow one to assess the short vs long-term effects of the policy change.

The pre-reform coefficients in both figures show no significant pre-existing differences between treated and untreated countries, which indicates the existence of parallel trends before the enactments of the SF policies, in both the across-country (**Figure 0.2**, 2A) and the within-mother models (**Figure 0.2**, 2B). Both figures show that after the reform there is an increase in the average birthweight of treated countries, relative to control countries. The within-mother model shows more of an upward trend, and the small delay in the periods following the implementation date could correspond to mothers exposed during their second and third trimester of pregnancy, consistent with the literature that suggests that exposures during the first trimester of gestation are less relevant than exposures later in the pregnancy (Lieberman, er al., 1994; Suzuki, et al., 2014; Raisanen, et al., 2014).

Overall, it would seem that the effects persist during the first few years after the implementation of the policy. The persistence, and the non-reversal of the change, suggests that the policy implementation did benefit treated countries compared to the trends observed pre-policy and in control countries.

Effects of SF legislation on LBW

To test whether the marginal effect of the policy was strong enough to affect the rate of LBW in treated countries, I re-ran the models but replaced the outcome (birthweight) with an indicator of whether the birth was LBW or not. As shown in **Table 0.12** there seems to be a moderate effect on the LBW threshold in treated countries in the DDD model. The interaction coefficient in the DD goes in the expected direction but is insignificant, while in the DDD model the policy is associated with a reduction in the likelihood of LBW by 1.8 pp. These results suggest that the effects found for BW (between 48 and 94 grams after SHS legislation) might be just enough to "move the LBW needle," with an effect of about 1.8 percentage points in the rate of LBW in treated countries.

Are the effects the same for women at all SES levels?

The previous findings suggest that SF legislation in the treated countries had a positive impact on birth outcomes. However, it remains unclear whether the benefits were evenly distributed across all SES levels or if there was a heterogeneous effect that depended on maternal characteristics. As previously stated, my hypothesis was that low SES women would experience the most significant impact from smoke restrictions in public places, while high SES births would also benefit, but to a lesser degree.

Table 0.13 provides evidence that SHS legislation did have an impact on birth weight (BW) across all SES levels, but appears stronger among low SES women. Low SES women were

defined as living in Strata 1 and 2 households, and high SES declared their Strata to be above 3. Specifically, low SES women experienced a 60-gram increase in birth weight, whereas the magnitude of the effect was almost half among high SES women, at around 34 grams. These results indicate that the benefits of SF legislation extend to all SES levels, but low SES women may be more vulnerable to the adverse effects of secondhand smoke exposure and, therefore, stand to gain the most from such policies.

There are a couple of potential underlying causes, and implications, of these observed disparities in the impact of SF legislation on birth outcomes across SES groups. One possible explanation is that low SES women may have higher levels of exposure to secondhand smoke in their homes and workplaces. Previous research found that exposure to SHS among people living below the poverty level is two times that of people living at or above the poverty level (Ham, et al., 2011). Others have found that adults working in the service industry or in blue-collar jobs are less likely to have workplace rules restricting smoking, and have the highest exposure of SHS, compared to adults working in white-collar jobs (Su, et al., 2019; CDC, 2023). Additionally, low SES women may have less access to prenatal care, which could further increase their vulnerability to adverse birth outcomes (Kim, et al., 2018).

These results provide compelling evidence not only of the potential benefits of reducing SHS exposure for overall maternal and infant health but also of its potential to help combat existing health disparities across subgroups of the population.

3.8 Limitations of the study and efforts to address them

Although these findings provide valuable evidence on beneficial effects of smoke bans on birth weight in the region, there are some limitations to this study, as well as important questions that remain.

What is the mechanism? SHS or smoking cessation?

It is difficult to determine the precise contribution of reductions in exposure to SHS and reductions in smoking to the policy effects. The benefits of reduced exposure to SHS may be enjoyed by non-smokers, while limitations on smoking and increased awareness of the costs associated with smoking may lead to increased smoking cessation and improved birth outcomes. However, given the very low prevalence of smoking among Latin American women, before policy changes, it is likely that the effects I found are primarily driven by the SHS channel.

Supplementary analysis, as presented in Appendix C, show that our main findings are very similar even when smoking mothers are excluded, which also suggests that non-smoking mothers are the primary beneficiaries of the policy. The DD results are slightly higher than those found on our main model (within country effects), while the DDD results, controlling for mother fixed effects, are slightly lower (within mother effects).

The mechanisms underlying the effects of smoke-free regulations are further complicated by the comprehensive restrictions on tobacco control that typically accompany such policies, including sale regulations, tax increases, and advertisement restrictions. Some of these policies have been highly effective in promoting smoking cessation, which could confound the effects of smoke bans on birth outcomes. A reduction in the number of smokers in the population could

directly benefit birth outcomes by promoting smoking cessation in mothers or indirectly by reducing SHS exposure. However, these findings, combined with the existing literature, consistently demonstrate that smoke bans have been effective in improving maternal and newborn health.

Restrictions in the Data and Methods

While the DHS surveys contain a wide variety of birth, mother, and household characteristics, there is no consistency in the frequency at which the data are collected in each country, not all countries participate in the program, and some opt to conduct their own health surveys. Because the FCTC was put in force in 2005, the years that followed saw the implementation of SF legislation in many countries in the region, but some are not included in this analysis because they did not take part of the DHS program or because the years in which the data were collected did not correspond to the window necessary to observe births before and after the policy. Lastly, because the DHS surveys are not panel data, but repeated cross-section data, I am unable to introduce time-varying characteristics in the models in order to control for potential changes in maternal and household characteristics through time.

Regarding the methods, although the staggered difference-in-differences estimator is a popular approach for evaluating the impact of policy interventions using observational data, there have been recent discussions questioning whether there is bias in standard staggered differences in differences estimations. The main critique of this estimator, outlined by Callaway and Sant'ana (2020), is that it can be biased when the treatment effect varies over time and across groups in a

complex manner. When the timing of the treatment varies across groups, the staggered DD estimator assumes that the treatment effect is constant over time and across groups, but if this assumption is violated, the estimator can be biased. Specifically, if the treatment effect varies over time and across groups, the estimator may not be able to capture the full effect of the treatment, thus usually underestimating its effect.

As a response to this concern, I also ran two-way fixed effects models that controlled for mother fixed effects in order to eliminate as many non-observable confounding variables as possible. Still, since I do not have access to time-varying maternal characteristics, there is still some risk of bias within my estimations, and these models might exclude useful variation that could aid in the estimation of the real effect of the policy.

3.9 Conclusion

This paper studies the effects of the implementation of smoke-free regulations on birth outcomes in the LAC region using a staggered Differences-in-Differences model that exploits the different timings in the implementation of SF regulations in LAC region. The results show that:

1. On average, smoke-free policies in the region had a positive effect on birthweight that ranged from 58 to 94 additional grams for births that occurred post-SF legislations, compared to average birthweight pre-reform. I also find that after the policy, treated countries experienced a decrease in LBW rates of up to 1.8 percentage points.

2. The implementation of smoke bans has a positive impact on the health of pregnant women and children across all socio-economic levels. However, the benefits are particularly pronounced among low SES women. This finding suggests that smoke-free legislation can not only improve the overall health of pregnant women and children, but also has the potential to address existing health disparities among different population subgroups.

The results of this study are consistent with previous literature on the effects of smoke-free regulations on birth outcomes, and provide valuable insights into the impact of such policies in low- and middle-income countries. By taking an innovative approach that exploits the regional progressive advancement in LAC towards implementing strategies against SHS, this study contributes to the scarce evaluations focused on the effects of smoke-free policies in these countries.

The observed disparities in the impact of SF legislation on birth outcomes across SES groups may be due to higher levels of exposure to secondhand smoke among low SES women in their homes and workplaces, as well as their potentially limited access to prenatal care. These results underscore the importance of SF regulations not only for improving maternal and infant health but also for addressing health disparities among different socioeconomic groups.

Overall, these findings provide strong evidence that the implementation of smoke-free regulations in the LAC region has led to positive outcomes for birthweight and LBW rates, with particularly strong benefits for low SES women. They also suggest that policymakers should prioritize the adoption and enforcement of smoke-free regulations as a means of improving

maternal and child health outcomes, while also promoting health equity across socio-economic groups.

Lastly, despite the contributions of this study, there is still a need for further research to fully understand disparities in the effects of smoke-free policies and the mechanisms behind these effects. Future studies could explore how individual-level characteristics such as smoking behavior and access to healthcare interact with smoke-free policies to produce differential effects on birth outcomes. Moreover, researchers could investigate how contextual factors, such as the level of policy enforcement and community support, influence the effectiveness of smoke-free policies. By gaining a better understanding of the factors associated with the effectiveness of smoke-free policies, policymakers can design more targeted and effective interventions to improve maternal and child health outcomes and reduce health disparities.

3.10 Tables and Figures

Table 0.1: Tobacco Regulation in LAC Countries in this study

Country	Year of 100% smoke-free policy adoption	Legislation
Bolivia	August 15, 2020	Law No. 1280 of 2020
Colombia	July 21, 2009	Law 1335 of 2009
Guatemala	February 2, 2009	Decree No. 74-2008 Government Agreement No. 137-2009
Guyana	July 27, 2017	Act No. 17 of 2017
Haiti	No Tobacco Control Policies	
Honduras	February 21, 2011	Decree No.92-2010

Peru[6]	July 5 2008	Law No. 28705 of 2006

Table 0.2: Prevalence of current tobacco use, sample and national rates (%)

	Sample Rate	National Women's Rate	National Men's Rate
Bolivia	4.1	7.5	21
Colombia	1.4	5.3	12
Guatemala	0.7	1.9	20
Guyana	2.0	2.9	22
Honduras	1.4	2	28
Haiti	1.9	3.7	12
Peru	2	4.3	13

Source: Sample rate are authors calculations from DHS data. National rates are from World Bank Databank (2015), except for Honduras which came from World Atlas Data (2020) for men and (2016) for women.
Note: The sample and national discrepancies could come from the different populations they represent. Our sample includes women ages 13 and over, while the WB data includes female population ages 15 and over. Additionally, our figures of tobacco use only include cigarettes, while the WB data includes tobacco products including cigarettes, pipes, cigars, cigarillos, waterpipes (hookah, shisha), bidis, kretek, heated tobacco products, and all forms of smokeless (oral and nasal) tobacco.

Table 0.3: Pre-post difference in smoking prevalence in countries that implemented smoke free policies

VARIABLES	(% of Smokers)
Difference Pre-Post Policy	-0.01***
	(0.00)
Observations	42,671
R-squared	0.00
Standard errors in parentheses	
*** p<0.01, ** p<0.05, * p<0.1	

[6] Although the law 28705 was approved in 2006, its regulation was not approved until July 5, 2008

Note: Mean difference in the prevalence of smokers among mothers in the sample, controlling for country FE., and discussions.

Table 0.4: DHS waves, by country, between 2006 and 2013

Status	Country	DHS Waves	No of births with reported birthweight
NT	Bolivia	2008	3,470
SF	Colombia	2010	11,920
		2015	7,308
NT	Guatemala	2014	10,789
SF	Guyana	2009	1,324
SF	Haiti	2012	1,666
NT	Honduras	2012	8,617
NT	Peru	2014	17,050
	Total		62,144

Note: NT (Never Treated) identifies the countries that did not implement any SF policy between 2006 and 2013, while SF (Smoke-Free) identifies countries that did enact a policy at any moment during that time period.

Table 0.5: Year of SF policy implementation across countries

	2006	2007	2008	2009	2010	2011	2012	2013
Peru[7]	NT	NT	**SF**	**SF**	**SF**	**SF**	**SF**	**SF**
Colombia	NT	NT	NT	**SF**	**SF**	**SF**	**SF**	**SF**
Guatemala	NT	NT	NT	**SF**	**SF**	**SF**	**SF**	**SF**
Honduras	NT	NT	NT	NT	NT	**SF**	**SF**	**SF**
Bolivia	NT	NT	NT	NT	NT	NT	NT	NT
Guyana	NT	NT	NT	NT	NT	NT	NT	NT
Haiti	NT	NT	NT	NT	NT	NT	NT	NT

Note: SF stands for Smoke-Free, which means that for the specified years, the policy had already been enacted in each particular country

Table 0.6: Pre vs post mean difference in birth outcomes in countries with SF policies

	Birth Outcomes	
	(1)	(2)
VARIABLES	BW	LBW
Difference Pre-Post Policy	36.96***	-0.01
	(10.27)	(0.01)
Observations	55,684	55,684
R-squared	0.01	0.01
Standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

Note: Table 5 shows the estimated mean difference in birth outcomes pre and post policy implementation, in countries that implemented SF policies (Colombia, Guatemala, Honduras, and Peru). The estimation controls for country and the time trend before and after the date of the policy implementation

Table 0.7: Pre vs post mean differences in maternal characteristics in countries that implemented smoke free policies

	Maternal Characteristics			Household Characteristics			
VARIABLES	Years of Education	Never lived together	Married	Female head of household	Low Income	Middle Income	High Income
Difference Pre-Post Policy	0.00	0.02***	-0.03***	0.00	0.01	0.00	-0.01*
	(0.03)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Observations	52,775	55,675	55,675	55,675	55,675	55,675	55,675
R-squared	0.02	0.01	0.06	0.02	0.01	0.00	0.01
Standard errors in parentheses							
*** p<0.01, ** p<0.05, * p<0.1							

Note: Table 6 shows the estimated mean difference in maternal and household characteristics pre and post policy implementation, in countries that implemented SF policies. The estimation controls for country effects, as well as the time trend before and after the date of the policy implementation

Table 0.8: Pre-policy characteristics of treated and never-treated countries

	Treatment (4 countries, 27, 017 births)	Never-Treated (3 countries, 6,460 births)	Difference
Outcomes			
Average Birthweight	3228	3294	-65.8*** (11.1)
Rate of LBW (%)	7.5	6.6	1.0*** (0.00)
Maternal Characteristics			
Years of Education	4.2	3.8	0.3*** (0.02)
Married (%)	19.3	39.5	-20.2*** (0.00)
Household Characteristics			
Low Income	54.4	46.4	8.0*** (0.00)
Middle Income	22.3	22.0	0.3* (0.00)
High Income	24.5	31.5	-7.6*** (0.00)
Urban	70.9	57.6	13.3*** (0.316)

Table 0.9: The effect of SHS policies on BW across countries

VARIABLES	DD Model BW
PostxTreated	47.54**
	(16.26)
Birth order	19.67***
	(2.715)
Constant	2,913***
	(29.75)
Observations	62,144
R-squared	0.021
Controls for:	
Maternal Characteristics	X
Country FE	X
Month-Year FE	X
Robust standard errors in parentheses	
*** p<0.01, ** p<0.05, * p<0.1	

Note: This is a TWFE model with country fixed effects (SDD), as well as month, year and month-year fixed effects. It also controls for birth order, maternal education, marital status, whether the head of household is female, and household SES.

Table 0.10: The within-mother effect of SHS policies on BW

VARIABLES	DDD Model BW
PostxTreated	93.55***
	(13.46)
Birth order	-33.11
	(27.17)
Constant	3,205***
	(83.48)
Observations	16,966
R-squared	0.716
Controls for:	
Maternal Characteristics	X
Country FE	X
Month-Year FE	X
Mom FE	X
Robust standard errors in parentheses	
*** p<0.01, ** p<0.05, * p<0.1	

Note: This is a TWFE model with mother fixed effects, country fixed effects, as well as month, year and month##year fixed effects (DDD Model).

Table 0.11: Lead and lagged effects of SF policies on birthweight

	Lead 6 months	Lead 3 months	Lag 1 year
VARIABLES	BW	BW	BW
PostxTreated *Lead6m*	14.66		
	(25.83)		
PostxTreated *Lead3m*		-9.172	
		(20.06)	
PostxTreated *Lag1Y*			26.00
			(19.34)
Birth Order	19.71***	19.71***	19.72***
	(2.717)	(2.726)	(2.731)
Constant	2,922***	2,929***	2,921***
	(34.18)	(33.69)	(31.02)
Observations	62,144	62,144	62,144
R-squared	0.021	0.021	0.021
Controls for:			
Maternal Characteristics	X	X	X
Country FE	X	X	X
Month-Year FE	X	X	X

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 0.12: The effects of SF policies on LBW

VARIABLES	(1) DD Model LBW	(2) DDD Model, LBW
PostxTreated	-0.00345	-0.0182*
	(0.00706)	(0.00791)
Trend	-0.000662	0.00123
	(0.00114)	(0.00180)
Birth order	-0.000446	0.0148
	(0.00103)	(0.0144)
Constant	0.160***	0.0892*
	(0.00836)	(0.0424)
Observations	62,144	16,966
R-squared	0.015	0.642
Controls for:		
Maternal Characteristics	X	
Country FE	X	X
Month-Year FE	X	X
Mother FE		X
Robust standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

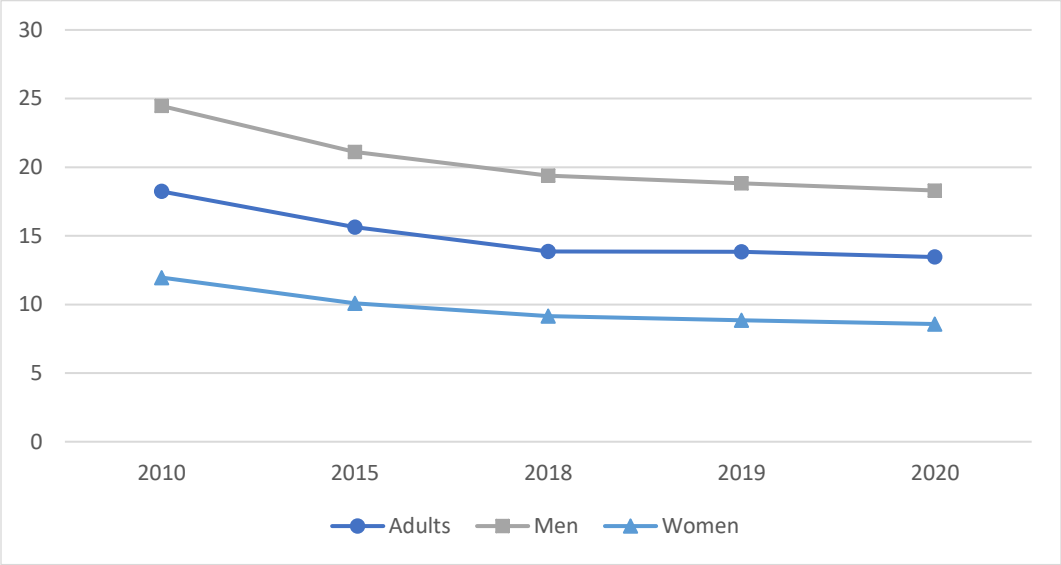
Notes: TWFE models that estimate the effect of SHS legislation on LBW. The DD model controls for birth order, maternal and household characteristics, country and month-year fixed effects, that is, estimates across country effects of SHS legislation on LBW. The DDD model additionally controls for mother fixed effect, which means that it estimates the within mother pre-post variation in BW, compared to children born to untreated mothers.

Table 0.13: DD model by SES levels: Stratified effect of SF polices on BW

	Low SES	High SES
VARIABLES	BW	BW
PostxTreated	59.94*	33.95*
	(27.02)	(16.02)
Trend	5.106**	3.075
	(1.847)	(4.067)
Birth order	13.36**	23.98***
	(4.022)	(3.090)
Constant	3,014***	3,084***
	(18.04)	(27.77)
Observations	32,114	30,030
R-squared	0.019	0.025
Controls for:		
Maternal Characteristics	X	X
Country FE	X	X
Year-Month FE	X	X
Robust standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

Notes: Stratified TWFE models that estimate the effect of SHS legislation on LBW. The DD models controls for birth order, maternal and household characteristics, and country and month-year fixed effects. Model 1 (Low SES) restricts to mothers in households of strata 1 and 2, while Model 2 (High SES) restricts to mothers in strata 3, 4 and 5.

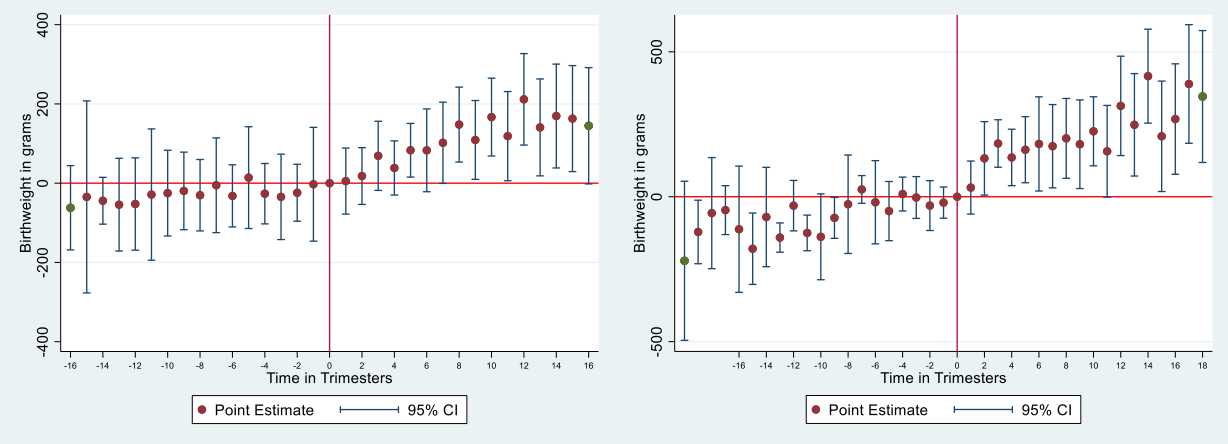
Figure 0.1: Prevalence of current tobacco use in LAC (% of adults, men and women)



Source: World bank Databank. Prevalence of current tobacco use (% of adults, % of male adults and % female adults)
Note: This figure shows tobacco use averages, by year, for all LAC countries according to World Bank country classifications. This includes countries such as Chile, Argentina, Cuba, Urugay, and Brazil with some of the highest rates of tobacco use in the region, but that are not included in our sample of study.

Figure 0.2: Quarterly DD and DDD coefficients of SHS policies on BW

Figure 2A: DD Models **Figure 2B: DDD Models**



Note: Figure 2A plots quarterly coefficients of TWFE models that control for country and year-month fixed effects, birth order, maternal education, marital status, whether the head of household is female, and household SES. Figure 2B shows quarterly coefficients of TWFE models that control for birth order and mother, country and year-month fixed effects.

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Conclusion or Epilogue

The three papers in this dissertation provide valuable insights into the social and structural determinants of maternal and infant health, and highlight the complex interplay between individual-level and structural-level factors that perpetuate health inequalities. The first paper found that structural racism, as evidenced by racialized police use of force, adversely, and disproportionately, affects the health of Black women in the US, leading to higher rates of low birth weight and preterm birth among this population. The second paper showed that family and household composition have a significant impact on young women's sexual behavior, with young women living in predominantly female households in Colombia having lower odds of engaging in risky sexual behavior, more likely to wait until the age of 20 to have sex, and less likely to become teen mothers compared to women in gender-neutral or predominantly male households. Finally, the third paper demonstrated that smoke-free policies in the LAC region had a positive impact on birth outcomes, particularly among low SES women.

The findings of these studies have significant implications for policymakers and stakeholders seeking to improve the health and well-being of disadvantaged women. They underscore the importance of understanding the complex relationships between social determinants and health outcomes in different contexts and emphasize the need to address health inequalities at the structural level.

More specifically, this dissertation carries important implications for social work and social policy by highlighting the crucial role of social and structural factors in shaping maternal and infant health outcomes. The first paper emphasizes the detrimental impact of structural racism on

the health of Black women, revealing the urgent need to address systemic inequalities that contribute to adverse birth outcomes. This calls for social work practitioners and policymakers to take holistic approaches when focalizing interventions, and to advocate for policies that combat racism and promote equitable access to healthcare and support services.

The insights from the second paper on the influence of family and household composition on young women's sexual behavior suggests that social policies aimed at strengthening family structures and providing supportive environments can have a positive impact on reducing risky sexual behavior and teen pregnancies. Social workers can play a pivotal role in designing and implementing interventions that promote healthy relationships, comprehensive sex education, and access to reproductive health services.

The findings from the third paper on the positive effects of smoke-free policies emphasize the importance of implementing and enforcing policies that protect vulnerable populations from environmental risks. Social workers can collaborate with policymakers to advocate for smoke-free environments, provide education on the health risks associated with smoking and SHS, and ensure that disadvantaged communities have access to resources for smoking cessation.

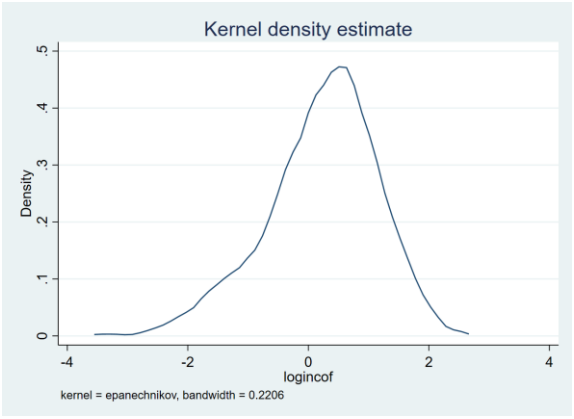
Overall, these studies contribute valuable insights into the multifaceted nature of health inequalities and the interconnectedness of individual and structural factors. Social work and social policy must adopt a comprehensive approach that addresses both individual-level determinants and structural barriers to improve the health and well-being of disadvantaged women. By utilizing the evidence provided by these studies, policymakers and stakeholders can develop targeted

interventions, allocate resources effectively, and strive towards achieving health equity for women and children.

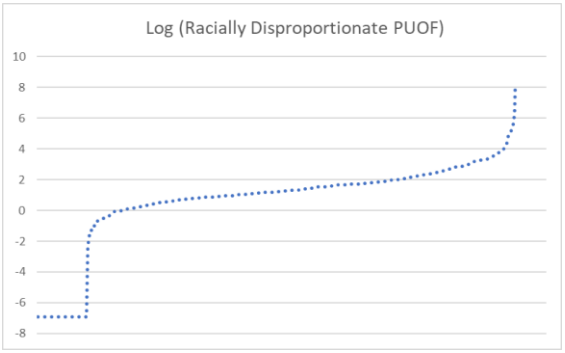
Appendix A

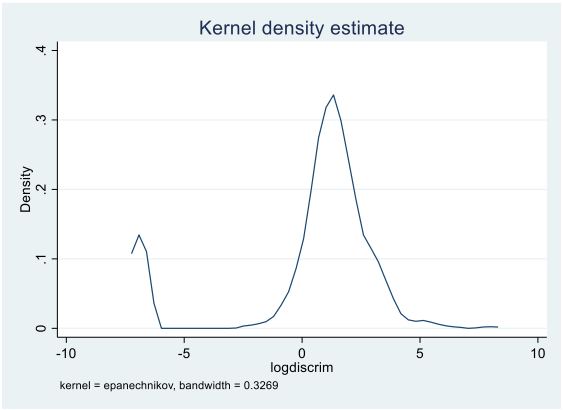
Appendix A1: Distribution of Log-Transformed PUOF measures

Incidents per Officer



Racially Disproportionate PUOF

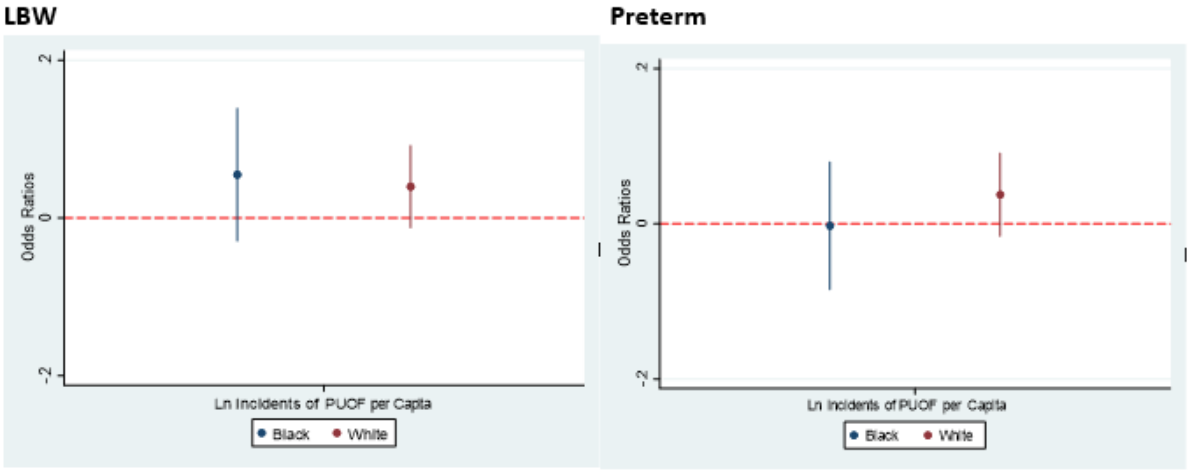




Appendix A2: Supplementary Models

Robustness Check 1: Using an alternative measure of overall PUOF

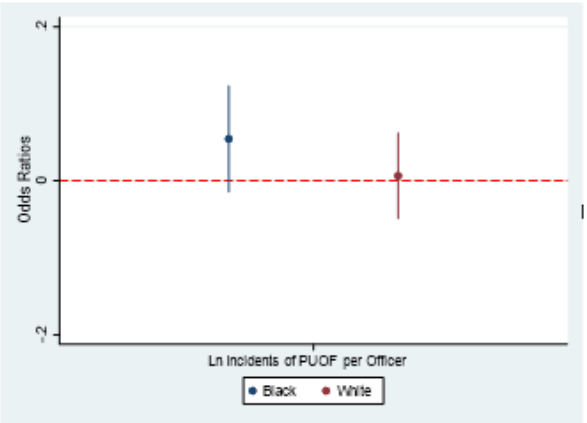
Incidents per Capita



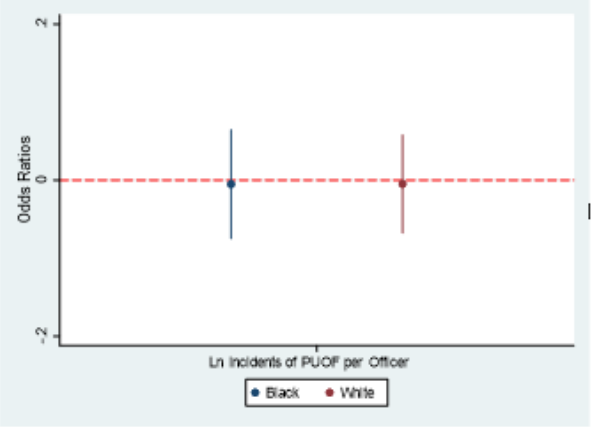
Robustness Check 2: Dropping births in municipalities that reported 0 incidents of force

Incidents per Officer

LBW

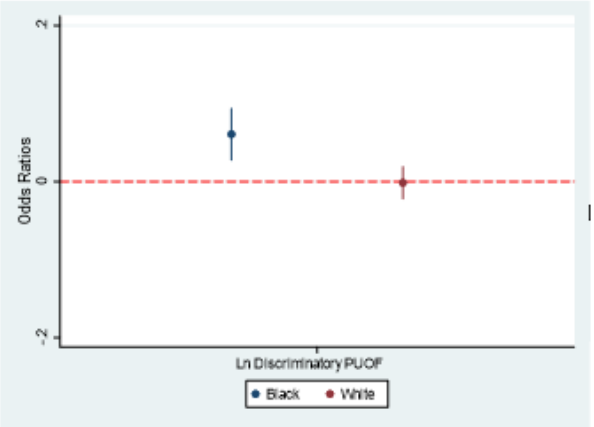


Preterm

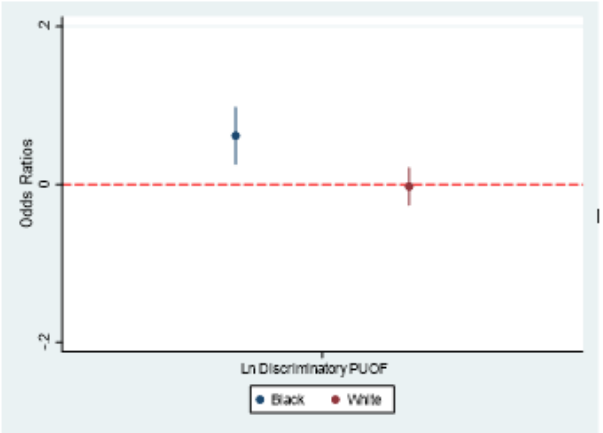


Discriminatory PUOF

LBW



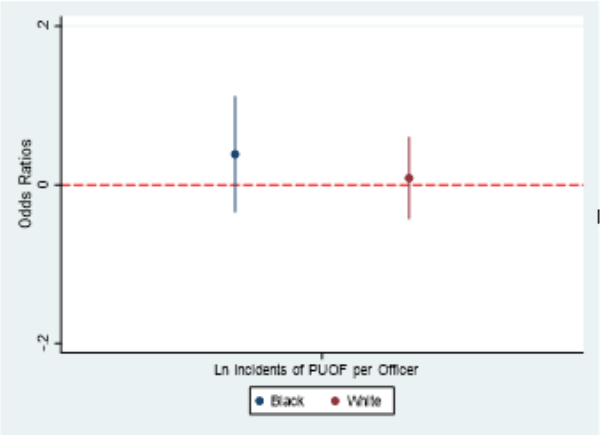
Preterm



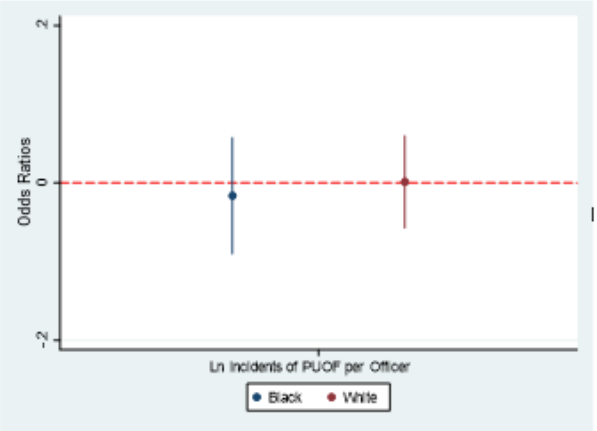
Robustness Check 3: Limiting to municipalities with at least 5000 residents

Incidents per Officer

LBW

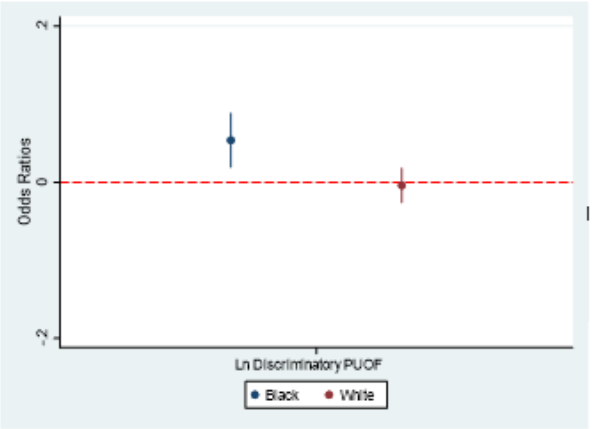


Preterm

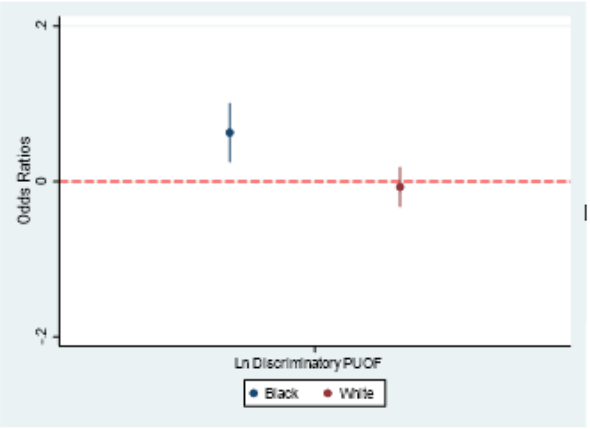


Discriminatory PUOF

LBW



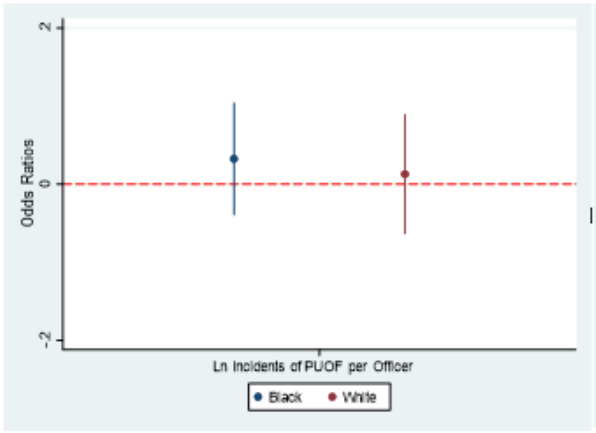
Preterm



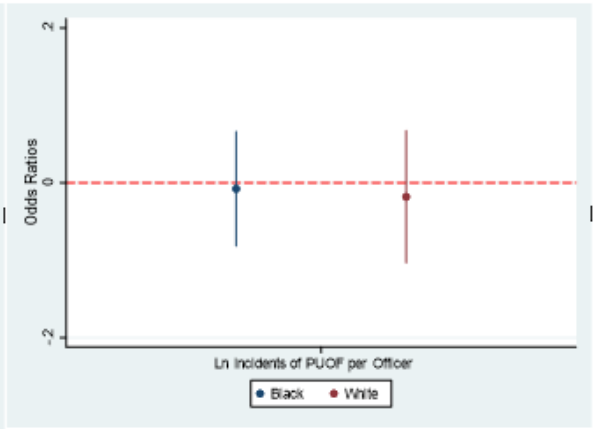
Robustness Check 4: Limiting to 20 Black births and 20 White births

Incidents per Officer

LBW

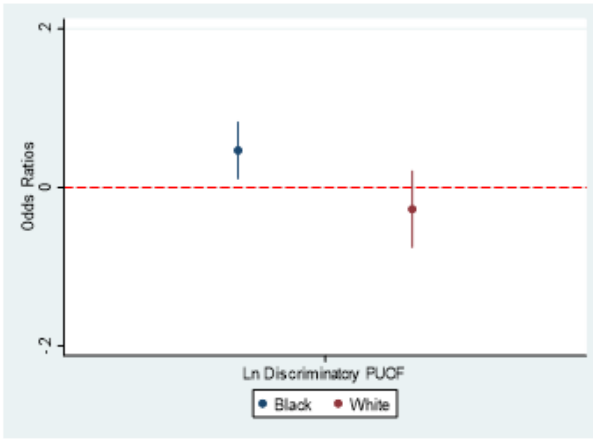


Preterm

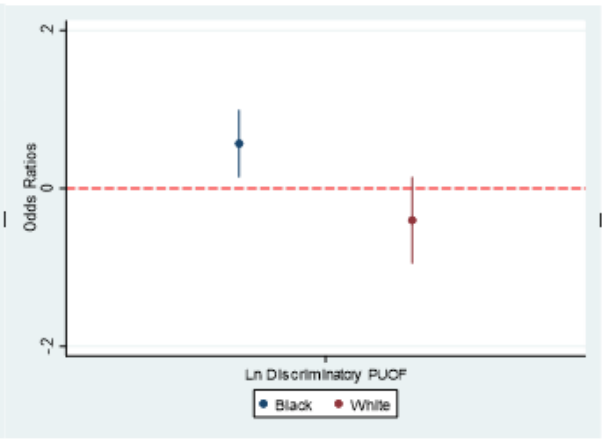


Discriminatory PUOF

LBW



Preterm



Appendix A3: Converting coefficient of discriminatory PUOF for Black women to estimate of effect of elimination of discriminatory PUOF on Black/White gap in rates of LBW in NJ

Parameters:

Rate of LBW among Black mothers in NJ = 9.7%

Rate of LBW among White mothers in NJ = 4.7%

Mean discriminatory police use of force experienced by women in NJ = 8.22

Logit coefficient of discriminatory PUOF for Black women = .06

Calculations:

1% change in discriminatory PUOF associated with $(1+0.01)^{0.06}$ = 1.0006 = .06% change in the odds of low birth weight

Black women are 8.22 times more likely than White women to be exposed to discriminatory PUOF = 88% increased risk ((8.22-1)/8.22)

$(1+0.88)^{0.06}$ = 1.0386 = 3.86% increase in odds of LBW

9.7% rate of LBW converts to an odds of .107

Reducing the .107 odds by 3.86% =.103, which converts back to a probability of 9.3%

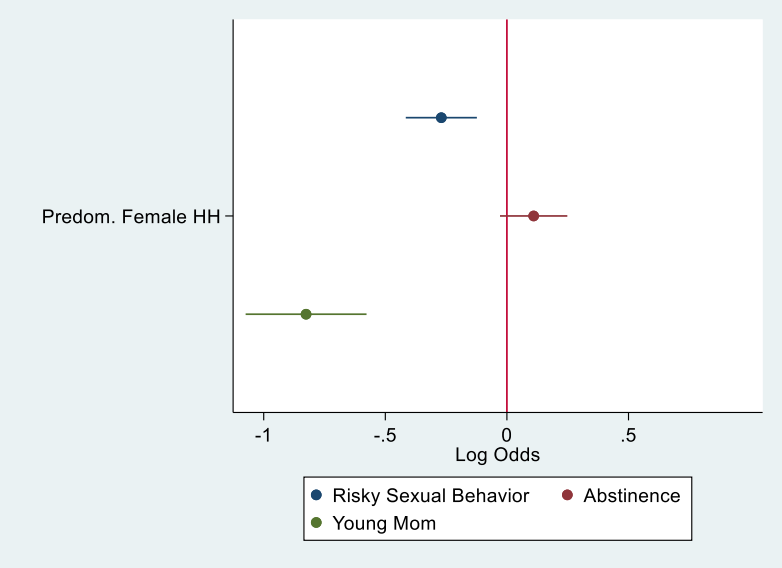
The Black/White gap in LBW = 5.0 percentage points (9.7% - 4.7%)

The adjusted Black/White gap in LBW (no discriminatory PUOF) = 4.6 percentage points (9.3% - 4.7%)

The reduction in Black/White gap in LBW = (5 - 4.6) / 5 = .08 = 8%

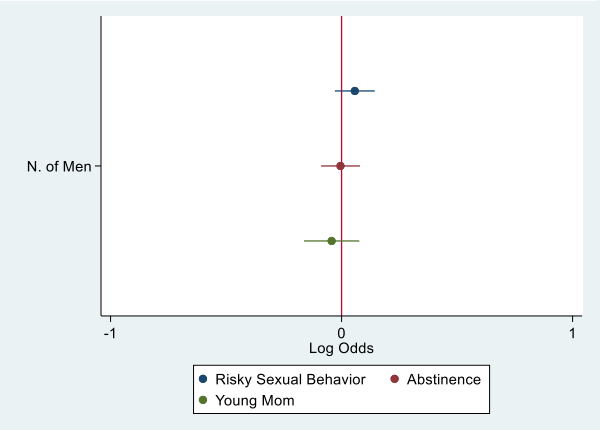
Appendix B

Appendix B1.1: The effect of a predominantly female household on the sexual behavior of co-residing young women restricting the sample of only teenagers

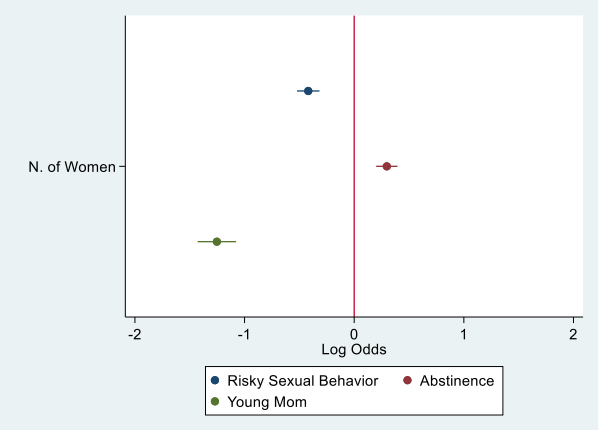


Appendix B1.2: The effect of men and additional women in the household on the sexual behavior of co-residing young women

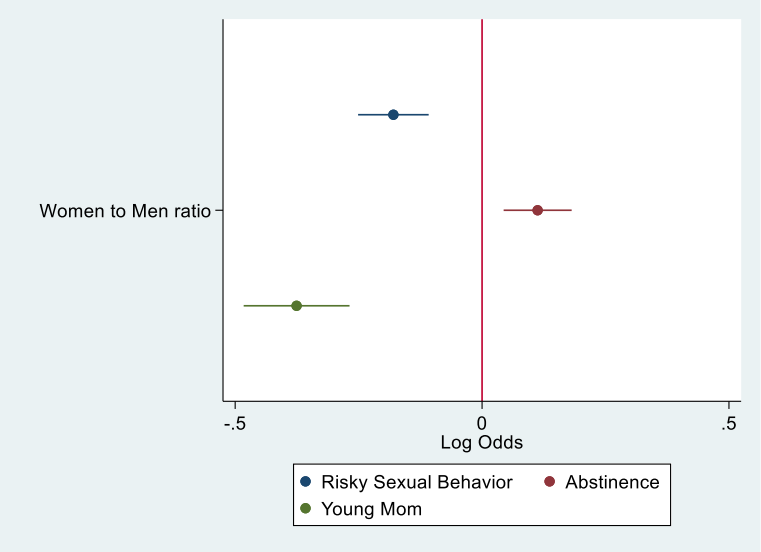
Effect of Exposure to Men in the HH



Effect of Exposure to Additional Women in the HH

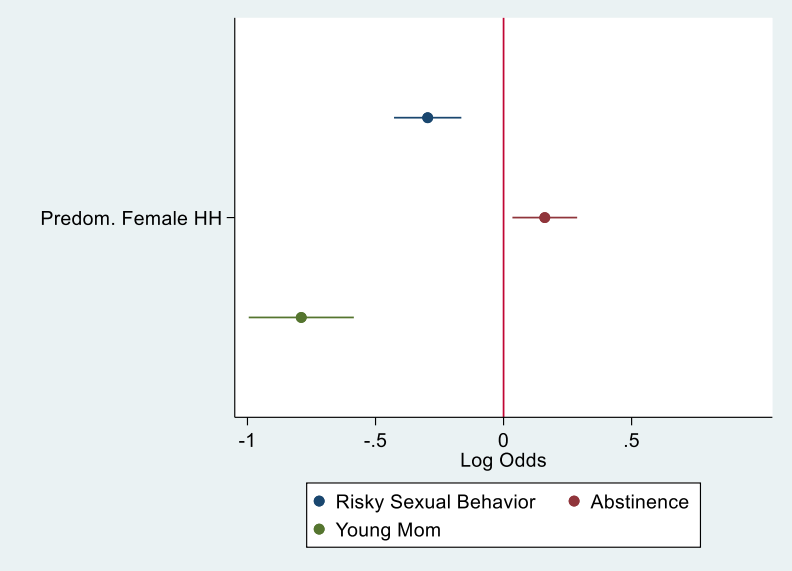


Appendix B2: The effect of the women-to-men ratio in the household on the sexual behavior of co-residing young women.



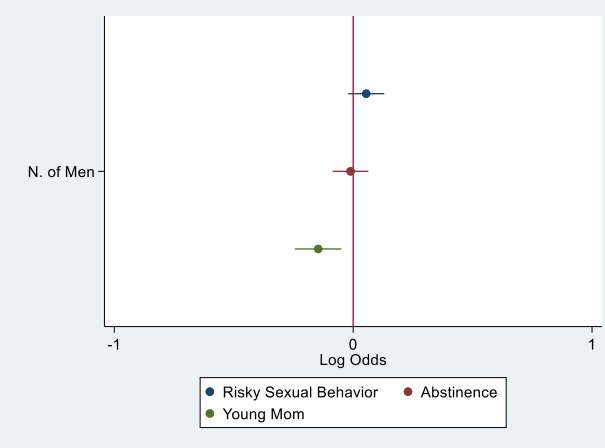
Appendix B3: Main results using multiple Imputation on missing covariates

B3.1: The effect of a predominantly female household on the sexual behavior of co-residing young women using multiple imputation on missing covariates

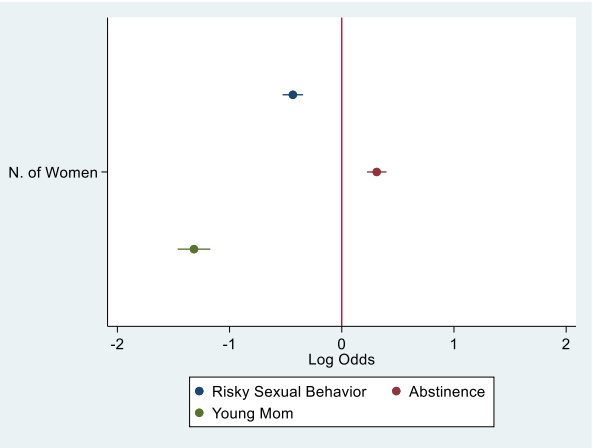


B3.2: The effect of men and additional women in the household on the sexual behavior of co-residing young women using multiple imputation on missing covariates

Effect of Exposure to Men in the HH



Effect of Exposure to Additional women in the HH



Appendix C

Appendix C1: The effect of SHS policies on BW across countries excluding mothers that claim to smoke cigarettes

	Model 1 DD	**Model 2 DDD**
VARIABLES	BW	BW
PostxTreated	52.73**	83.64***
	(17.26)	(12.99)
Trend	-0.0408	8.864
	(3.331)	(4.234)
Birth order	18.46***	-43.24
	(2.498)	(34.21)
Constant	2,901***	3,224***
	(33.51)	(114.3)
Observations	48,281	12,774
R-squared	0.027	0.720
Controls for:		
Maternal Characteristics	X	
Country FE	X	X
Month-Year FE	X	X
Mother FE		X
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1		