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The Impact of Armed Conflict on Maternal Health in Colombia

An Honors Paper for the Department of Economics

By Madeleine Squibb

Bowdoin College, 2020

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The Impact of Armed Conflict on Maternal Health in Colombia

Abstract

This study combines data from the 2010 Demographic and Health Survey and the Conflict Analysis Resource Center (CERAC) to examine the impact of conflict on maternal health service utilization and outcomes in Colombia. The primary results indicate a significant, negative relationship between conflict level and antenatal and postnatal care utilization. Conflict is insignificant in determining the use of professional assistance at delivery. Although rural women are, overall, less likely to access maternal health services, further analysis along rural-urban lines reveals that the negative effect of violence on prenatal and postnatal care is stronger among urban women. Secondary estimation of the occurrence of complications during or after delivery employs a Two-Stage Residuals Inclusion model to address potential endogeneity in service use. Estimated results show that conflict levels are insignificant, but that Indigenous women and women in lower wealth quintiles are significantly more likely to experience complications, even after controlling for service use. The conclusions of this paper suggest that Colombia's universal healthcare system has been successful in reducing economic barriers to prenatal care and professional delivery, but that significant wealth-related inequalities remain in maternal health outcomes. Additionally, Indigenous and women with lower levels of education are less likely to access services and more likely to experience complications. The primary contribution of this paper is the inclusion of a conflict measure. The significant, negative impact on prenatal and postnatal care utilization, especially for urban women, warrants further study to better inform policy to increase service use and reduce maternal mortality and morbidity.

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I. Introduction

In addition to improving the lives of millions of girls and women across the world, quality maternal health advances the health and development of society as a whole (Muchabaiwa 2012, Onarheim 2016). Healthy mothers are better able to care for children, leading to improved health and education opportunities and greater human capital accumulation for future generations (Onarheim 2016). Furthermore, women's labor production and consumption levels are important drivers of economic expansion (Onarheim 2016). For these reasons, reducing maternal mortality and morbidity is crucial to generating sustainable, long-term poverty alleviation for individuals and societies. Currently, rates of maternal mortality and morbidity, defined as death or long-lasting health problems during delivery or in the weeks after, are disproportionately concentrated among poor, uneducated, or otherwise disadvantaged women, revealing inequalities both within and between countries (Muchabaiwa 2012, United Nations 2015, Arradon 2018). This pattern underscores the relationship between inequality and maternal health and emphasizes that improving health will enhance the lives of countless women and families and has the potential to lift people and societies out of poverty, creating a more just and equitable world.

Awareness of the importance of maternal health has increased in recent decades, and, in 2000, it became a central focus of the United Nations Millennium Development Goals. The MDGs comprised eight objectives to improve health, development, and equality by 2015, which were agreed to by all 191 member states (United Nations 2015). Goal number five, improving maternal health, had two targets: to "reduce by three quarters, between 1990 and 2015, the maternal mortality ratio" and to "achieve, by 2015, universal access to reproductive health". Despite progress, including reducing the maternal mortality rate by half worldwide, many countries fell far short of both goals in 2015 (United Nations 2015). Additionally, progress was

often uneven, exacerbating or failing to minimize pre-existing inequalities. As of 2013, maternal mortality remained one of the most extreme examples of health inequality; the risk of death during or soon after birth for women in developing countries was 19 times higher than for those living in developed countries (Onarheim 2016). This inequality can largely be attributed to unequal provision of maternal health services. The vast majority of maternal deaths are preventable with adequate medical intervention (WHO 2015). Increasing access to health services, particularly antenatal care, professional assistance at delivery, and postnatal checkups, can significantly decrease worldwide maternal mortality and morbidity (United Nations 2015).

Among those who struggle most to access sexual and reproductive health information and services are those living in fragile states (McKay 1998, Arradon 2018). Violence often weakens health systems, as health facilities are destroyed and health workers forced to flee or serve militant groups (McKay 1998). Conflict also puts women and girls at increased risk of sexual violence and often intensifies other gender related issues including intimate partner violence and transactional sex (Arradon 2018). As disadvantaged populations are most vulnerable, conflict serves to deepen pre-existing inequalities (WHO 2015). Overall, over half of all maternal deaths occur in conflict areas (Arradon 2018). To examine to these important effects, this study focuses on Colombia, where dynamics of inequality have been exacerbated by over fifty years of internal armed conflict.

As a region, Latin America and the Caribbean has a relatively low maternal mortality rate compared to other developing areas, at 77 deaths per 100,000 live births in 2013 (United Nations 2015). Colombia's rate is even lower, at approximately 53 maternal deaths per 100,000 live births, in 2014 (PAHO 2017). However, the rate is significantly higher than any of the other OECD member countries. It is nearly 30 percent higher than Mexico, which has the next highest

rate within the OECD (World Bank Group 2019). Additionally, the rate varies drastically within the country; while the capital, Bogotá, was on track to achieve MDG Number Five, the Pacific department of Chocó, home to a large Afro-Colombian population, had rates of maternal mortality similar to Haiti, Ethiopia and Ghana as of 2010 (Cárdenas-Cárdenas *et al* 2015, Lamprea and García 2016). These evident inequalities in maternal health reflect economic disparities; in 2012, Colombia was ranked the 12th most unequal country in the world (ABColombia 2013). Nearly 50 years of armed conflict has disproportionately affected poor, rural areas as well as Afro-Colombian and Indigenous people, exacerbating these inequalities (Svallfors and Billingsley 2019, ABColombia 2013, PAHO 2017).

This study uses data from the 2010 Demographic and Health Surveys to estimate demand for prenatal care, for professional assistance at delivery, and for postnatal care, all of which have been strongly recommended by the United Nations (2015) to decrease maternal mortality and morbidity worldwide. Secondary analysis examines the impact of each service on the occurrence of complications during and after delivery. Despite recommendations, few studies on this subject have been conducted in Colombia. More research must be done, as not examining the impact of health services on maternal health underestimates the benefits of care to policymakers and mothers, leading to less support and underutilization (Conway and Kutinova 2006). Furthermore, literature looking at the particular impact of conflict on maternal health is scarce in all regions of the world. This study employs municipal-level violence data from the Conflict Analysis Resource Center (CERAC) is used to estimate the impact of conflict in each equation. The resulting analysis adds to that small body of economic literature on maternal health and makes a unique contribution by focusing attention on the role of conflict in determining health service use and complications related to pregnancy in Colombia.

The paper begins with a brief contextualization of Colombia, particularly its health system and history of conflict. Section three contains a literature review of previous economic and interdisciplinary studies on maternal health service utilization and outcomes around the world, with a focus on Colombia. A description of previous studies on conflict and maternal health is also included. Section four includes an overview of the data, theoretical framework, and empirical specifications. Results are presented in section five and section six contains the analysis and conclusions.

II. Context of Colombia

II. a. Geography and Demography of Colombia

Geography has played an integral role in shaping Colombia's history, economic and political organization, and demographic distribution (LaRosa and Mejía 2017). Although it may seem unrelated to maternal health, understanding the context and location of this study is critical to proper analysis of the determinants of service utilization. Colombia is a geographically diverse country, including the rugged cordillera of the Andes and two oceans and the Amazon jungle (Kline *et al* 2020). The mountains divide the middle of the country, and historically restrict transportation, connection, and the flow of information between different regions. The resulting separation between regions, which were already climactically distinct, resulted in significant economic and cultural differences between regions, and often sharp rural and urban divides within (Kline *et al* 2020, LaRosa and Mejía 2017).

Colombia's two coasts serve as important trading ports (LaRosa and Mejía 2017). The north of the country is primarily agricultural lowlands and port cities on the Caribbean Sea. The largest ports, such as Cartagena and Barranquilla, are located there and serve as major sources of

economic activity. In contrast, Pacific coast is covered largely by rainforest and is far less densely populated than the Caribbean (Kline *et al* 2020). Both regions contain a large proportion of the Afro-Colombian population (DANE 2006). Colombia has the third largest population of Afro-Descendants in the Americas, after Brazil and the United States (LaRosa and Mejía 2017).

The cordillera of the Andes runs through the center of the country and the majority of the population resides in the Andean foothills of the interior, which includes the three largest cities––Cali, Medellín and Bogotá (Kline *et al* 2020). As of 2016, approximately 79 percent of Colombians lived in urban areas (PAHO 2017). Bogotá, the capital, is the economic and political center of the country and is home to over seven million people (DANE 2019, Kline *et al* 2020). The high proportion of people living in cities is a result of decades of rapid urbanization as people searched for higher wages and better living conditions and sought to avoid guerilla groups and drug-related violence (Kline *et al* 2020).

Historically, the largest economic sector has been agriculture, but in recent years the industry and service sectors have been growing. This industry shift has especially impacted the east and southeast regions of the country, which are rural and poor and rely primarily on agriculture. Both regions border the Amazon Rainforest to the far east and across the south. The Amazon is sparsely populated, and was almost solely inhabited by Indigenous populations until coca growers and guerilla groups established a presence there in the 1990s (Kline *et al* 2020). Indigenous populations are largely concentrated through the Amazon and along the eastern border with Venezuela (DANE 2006).

These regional and ethnic differences are correlate with uneven economic development across the country. Colombia is one of the most economically unequal countries in the world. In 2015, 27.8 percent of the population lived in poverty, a reduction from 42 percent in 2008, even

though its GDP qualifies it as a middle-income country (LaRosa and Mejía 2017, Radinger *et al* 2018). Additionally, wealth in Colombia is highly correlated with ethnicity; the marginalized and working classes are primarily Indigenous and Afro-Colombian, while the wealthy elite are of pure or mixed Spanish descent (Kline *et al* 2020).

II. b. Healthcare System

In order to fully analyze the factors determining healthcare utilization, it is important to understand the system in which these decisions are made, including its main challenges and structural implications for quality and equity of services.

Since the early 1990s, Colombia's healthcare system has undergone significant transformations towards universal healthcare. The foundation of change was Law 100 in 1993, which mandated that all people are entitled to health insurance coverage, and instituted two plans of provision based on income level. Formally employed workers and their families who are above a certain income level pay approximately 11 percent of their income to finance the Contributory Regime, ensuring them access to a benefit package called the Plan Obligatorio de Salud (POS) which covers all levels of care (Giedion and Uribe 2009). Those below the designated income status belong to the Subsidized Regime, whose benefit plan, called Plan Obligatorio de Salud Subsidiado (POSS), is financed by a 1.5 percent tax or "solidarity contribution" from workers in the Contributory Regime as well as national and local tax revenues (Giedion and Uribe 2009). In addition to the poorest parts of the population, priority access to the Subsidized Regime is given to vulnerable populations including displaced people, indigenous populations, people in the witness protection program and minors who left armed groups (PAHO 2017).

The financing is pooled together and distributed by different types of insurers, know was Entidades Promotoras de Salud (EPS) in the Contributory regime and Administradora del Regimen Subsidiado (ARS) in the Subsidized Regime. These purveyors can be private or public companies or nonprofit, community-based organizations (Giedion and Uribe 2009). Providers cover costs of all services for individuals who have the POS, but only fully cover primary and catastrophic care for people with the POSS. With regard to this study, the critical comparisons are that all obstetric services are covered in both, but maternity leave is not under POSS (Giedion and Uribe 2009). Uninsured women—primarily informal or short-term contract workers, people who are in the process of applying to insurance, or those who are uninterested or deterred by the application process—receive primary and some high-level care from public hospitals, with coverage from local governments (Vecino-Ortiz 2008, Lamprea and García 2016).

The prices related services, including obstetric care, are determined by the government, so the only competition between providers is related to quality (Giedion and Uribe 2009, Lamprea and García 2016). Uninsured patients and those belonging to the Subsidized Regime attend public hospitals, where they face longer wait times and lower quality of service. Members of the Contributory Regime are able to seek care at some private clinics, though not all, prompting 58% percent to purchase additional private insurance to access the high-quality care and short wait times in private clinics (Prada and Chaves 2018). This fact provides compelling evidence that the quality of healthcare provided by public hospitals, and accessed by women at lower incomes, is poor, and the ability to access private insurance creates a gap in quality that is correlated with wealth.

Furthermore, issues of quality often exacerbate and reinforce other forms of preexisting inequalities (Prada and Chaves 2018). Colombia struggles to provide healthcare to vulnerable

groups such as Indigenous and Afro-Colombian populations who often live in remote areas affected by conflict (PAHO 2017). This problem has prompted the formation of non-profit insurance organizations made up of workers or minority groups which now cover 20 percent of the total Colombian population, from both the subsidized and contributory systems (Prada and Chaves 2018). These non-profit agencies often provide social services such as education and housing in addition to health and are community based with the intention of representing historically marginalized groups (Prada and Chaves 2018, Mignone and Vargas 2015). Lastly, the decentralized nature of the health system and the stratification of insurance schemes means that quality of care can vary dramatically across regions of the country even when insurance coverage is largely the same, and can be seen in dramatically different maternal and infant mortality rates (Lamprea and García 2016).

Finally, one of the primary targets to improve the quality of care is communication between primary care and specialists (The World Bank Group 2019). This factor is especially relevant in the case of maternal healthcare to ensure that women at risk of potential complications can be properly identified and monitored before birth. The results of a study by Vecino-Ortiz (2008) on prenatal care use in Colombia, suggests this problem could be particularly pertinent to women in the Subsidized Regime. They conclude that, because providers did not follow up with women sufficiently after their first prenatal visit, women in the Subsidized Regime were no more likely than those without insurance to attend an adequate number of prenatal visits (Vecino-Ortiz 2008).

II. c. History of Conflict

For the last half a century, Colombia has been embroiled in complex political conflict. Left-wing guerilla groups, right-wing paramilitaries and government-backed forces have all contributed to the violence, which has left more than 220,000 dead (Felter and Renwick 2017). The civilian population has suffered critically in the conflict; approximately 5.7 million people have been internally displaced and far more were victims of violence including disappearances, kidnappings, mines, forced recruitment and sexual violence (Felter and Renwick 2017, LaRosa and Mejía 2017). However, the impact differs among the population as intensity and prevalence have varied across time and place (Franco *et al* 2006, Vallejo *et al* 2018). The number of actors, the pervasive and diverse nature of violence and the length of conflict make it difficult to easily explain or categorize (Franco *et al* 2006). It is important to understand the evolution and origin of the conflict as well as its state during the period examined in this study in order to explain its impact on maternal health.

The origins of conflict are largely rooted in the historic weakness of the central government, the lack of unity among regions and differences between urban and rural areas. During Spanish rule, Colombians were under an extraordinarily unequal power system in which a few Spanish families controlled all the land and political power. When Colombia achieved independence in 1810, it was left with significant inequality and wariness of a single, centralized power structure. Geographic isolation and the difficulties of transportation and travel over the cordillera meant regions had developed unique cultures and government systems. Policy-makers in Bogotá were out of touch with the reality of rural life and struggled to enforce rules in far reaches of the country. Thus, the central government had little contact with people who, in turn, had little incentive to listen (LaRosa and Mejía 2017).

Spanish rule also left significant ideological gaps between the two leading political parties, the liberals and the conservatives. The conservatives were highly traditional, supporting the interests of the powerful families and upholding the social systems left by colonization. The liberal party represented the working classes and rural farmers and sought to equalize socioeconomic hierarchies. Tensions between the parties came to a head in 1948 when Jorge Eliécer Gaitán, a liberal presidential candidate, was assassinated in Bogotá. This incident began a fourteen-year period of violence, primarily in rural areas, known as *La Violencia.* Though *La Violencia* officially began with Gaitán's assassination in 1948, some historians argue that it began in the1930s in rural areas, unbeknownst to urban elites. As a whole, *La Violencia* demonstrated the vast tensions between rich and poor, liberal and conservative, and urban and rural. It ended in 1958 with the ratification of a mandate called the National Front, a power sharing agreement between the liberal and conservative parties. Every four years, the two parties would alternate control of the presidency and hold intra-party elections. While the agreement ended *La Violencia,* it caused significant dissatisfaction among those, mainly workers and students, who felt that neither party fully represented their interests, but no longer had alternatives, as all other parties were essentially excluded from the presidency (LaRosa and Mejía 2017).

One of the most influential alternatives was the communist movement, born out of historic inequality and inhumane working conditions for many Colombians. The National Front agreement excluded communist groups from formal political power, partly leading to the formation of two militant groups. The National Liberation Army, known by ELN, its Spanish acronym, was founded in the early 1960s by students in the Santander department, in the north of Colombia. Inspired by Fidel Castro's revolution in Cuba in 1959, the group attracted primarily

intellectuals and left-wing Catholics (LaRosa and Mejía 2017). The second group, the Revolutionary Armed Forces of Colombia (FARC, in Spanish), was founded in 1964. It was largely composed of militant communists and rural farmers fighting for self-defense (Felter and Renwick 2017). The two groups share similar ideologies, including support of the rural poor and an opposition to the privatization of natural resources (Felter and Renwick 2017). However, the ELN is generally thought to be more ideologically driven, while the FARC is more militant (LaRosa and Mejía 2017).

The conflict between guerilla groups and the government was intensified and complicated by the emergence of other actors, such as paramilitary groups and narco-traffickers in the 1980 and 90s. In response to communist guerilla groups, wealthy landlords began coalescing support around paramilitary groups, particularly the United Self-Defenders of Colombia (known as AUC, its Spanish acronym) (Felter and Renwick 2017). Drug trafficking began around the same time and, by the early 2000s, Colombia supplied nearly 90 percent of the world's cocaine (Felter and Renwick 2017). Drug trafficking introduced incredible amounts of money, which fueled and sustained the existing conflict. The AUC and the FARC both relied drug trafficking to fund their operations. By the late 2000s, the FARC's drug trafficking operations were so large that, according to the United States Government, they were responsible for approximately 60 percent of the cocaine exported to America (Felter and Renwick 2017). Even the ELN, which initially did not participate in the drug trade for ideological reasons, became involved in order to sustain their campaign (Felter and Renwick 2017). Competition over land and smuggling routes sparking additional violence between groups and with traffickers, citizens and the government (Felter and Renwick 2017).

The time period analyzed in this study, between 2005 and 2010, is largely characterized by a decline in conflict from peak levels as the government gained its combative footing. Violence spiked in the early 2000s, and nature of the war degraded significantly, with all sides turned to terror tactics and civilian harm (LaRosa and Mejía 2017). The Colombian Government, with aid from the United States, cracked down on violent groups beginning in 2002 (Felter and Renwick 2017). By 2005, the AUC had formally disbanded and, by 2010, the number of FARC members had been reduced by more than half (LaRosa and Mejía 2017). Over this period, homicides fell by 40 percent and kidnappings by 80 percent. However, casualty numbers were extremely high and the government has been accused of human rights abuses and of joining forces with paramilitary groups (Felter and Renwick 2017).

When, in 2012, the FARC formally agreed to begin peace talks, the country had been at war for nearly 50 years. However, the first peace agreement, reached in 2016 was narrowly voted down in a vote almost completely split by area of the country (Felter and Renwick 2017). It was approved in a landslide in rural areas and Bogotá, while people in regions farther removed from the conflict thought the proposal did not punish the FARC sufficiently (Idler 2016). The agreement was quickly rewritten, and later that same year, the FARC agreed to disarm and hand over all assets, in return for political representation and amnesty for members who did not commit significant crimes (Felter and Renwick 2017). Despite the resolution, this end reflects the origins of the conflict: deep economic and political inequality and intense urban-rural tensions, sewed during Spanish colonial rule, which resulted in disparate realities and experiences in different parts of the country.

III. Literature review

III. a. Maternal Health Service Utilization and Outcomes

Significant medical study of the causes of maternal death suggests that the vast majority are preventable with quality intervention including prenatal care, professional assistance at delivery and postnatal care (United Nations 2015). Women around the world continue to lack access to services; understanding the factors that shape access and demand for healthcare is crucial to attaining universal access. A large portion of the economic literature on maternal health focuses on Sub-Saharan Africa and Southeast Asia, as these are the areas that are most critically affected (United Nations 2015). Though economically and culturally distinct from Colombia, results show that there are certain factors, such as education, that are likely to remain constant across countries. Though there are far fewer studies based in Latin America or Colombia specifically, they display important consistencies with studies in other regions, as well as revealing key differences. Ultimately, the literature reveals persistent, global, inequalities in access and outcomes, and numerous demographic and socioeconomic factors that can inform policy recommendations, but also significant gaps to be filled by future study.

The majority of the literature studying demand for maternal health services focuses on antenatal care. Most studies considered factors impacting both the timing of the first prenatal care visit and the number of visits attended in addition to basic utilization (Vecino-Ortiz 2008, Alexandre *et al* 2015, Jewell 2009, Guliani *et al* 2014, Gage and Guirléne Calixte 2006). Several common environmental-, household-, and individual-level factors that affect utilization were identified in studies across the world. For example, higher rates of regional poverty and rural location were found to negatively impact utilization of antenatal services in low-income countries in Latin America, Sub-Saharan Africa and Southeast Asia (Guliani *et al* 2014).

Interestingly, the study found that these two factors had a lower impact in the Latin American countries than in Southeast Asia or Sub-Saharan Africa (Guliani *et al* 2014). Several other studies based in Latin America and the Caribbean concluded that rural women utilized antenatal care services at a lower rate than urban women (Guliani *et al* 2014, Alexandre *et al* 2015, Gage and Guirléne Calixte 2006, Jewell 2009, Trujillo *et al* 2013). Community and household poverty amplified the negative effect among rural women in Haiti (Gage and Guirléne Calixte 2006). However, there were conflicting results on the significance of living in a rural place in Colombia. Jewell (2009) and Trujillo *et al* (2013) concluded that rural location was negative and significant, while Vecino-Ortiz (2008) found that living in a rural area had no effect on prenatal care utilization.

There were several individual and household characteristics that were consistent across nearly every study. Women with higher education levels, older women, and married or cohabiting women were all more likely to utilize prenatal care (Vecino-Ortiz 2008, Alexandre *et al* 2015, Jewell 2009). Additionally, across world regions, wealthier households were substantially more likely to use maternal health services and to attend a higher number of visits (Guliani *et al* 2014, Jewell 2009, De La Torre *et al* 2018). Both the direct and indirect costs of healthcare, including transportation and opportunity costs, impacted the quantity demanded. No studies controlled specifically for direct costs, but some used insurance variables as a proxies, and found generally positive effects that differed slightly depending on the structure of the insurance system (Jewell 2009, Vecino-Ortiz 2008). Distance to a health facility, in some cases approximated by rural residence, available public transportation methods and road density were used to approximate travel costs (Price and Bohara 2013, Jewell 2009).

Nearly all studies considered factors related to the pregnancy and previous pregnancy experiences, such as wantedness of last pregnancy and birth order. Women who desired the pregnancy were more likely to seek prenatal care and attend the recommended number of visits, while previous experience had the opposite effect (Guliani *et al* 2014, Jewell 2009, Vecino-Ortiz 2008, Alexandre *et al* 2015). The vast majority of studies did not consider the partner's level of education, a factor that seems likely to impact healthcare decisions and health stock before pregnancy. The two studies that did, reached differing conclusions. For both rural and urban women in Haiti, the partner's level of education was significant and positive in determining utilization of antenatal visits and number of visits (Alexandre *et al* 2005). In Colombia, Vecino-Ortiz (2008) concluded that the father's years of formal education was insignificant in predicting both utilization and number of visits for antenatal care.

Other key differences between studies in different parts of the world were largely demographic and highly country specific, namely ethnicity and religion. In their study of rural and urban Haiti, Alexandre *et al* (2015) found that rural Catholic or Protestant women and urban Protestant women were more likely to utilize antenatal care than their atheist counterparts. Religion was a determining factor in antenatal care usage in Zimbabwe, where traditionalists and apostolic women were found to be 19 percent less likely to access antenatal services than others (Muchabiawa *et al* 2012). In Ghana, Muslim women were more likely than Christian women to seek antenatal care services, while traditionalists and those with no religion were less likely (Adu *et el* 2018). In Colombia, Vecino-Ortiz (2008) did not consider religion, most likely because the vast majority of the country is Catholic.

Conclusions on the impact of race and ethnicity are similarly mixed. Looking specifically at Colombia, Rivillas *et al* (2018) concluded that race or ethnicity was significantly associated

with departmental inequalities in maternal healthcare. However, Trujillo *et al* (2013) found that ethnicity was not significant in determining individual use of antenatal services or professional assistance at delivery in Colombia. To complicate matters further, Jewell (2009) found that ethnicity was a significant indicator of prenatal care use in Bolivia and Peru, but the ethnicity variable was excluded for Colombia. These results suggest that ethnicity is sensitive to study design and identification methods in data collection. Furthermore, results cannot be extrapolated between studies because ethnicity is defined differently across countries and cultural contexts.

The body of literature examining demand for professional assistance at delivery and postnatal care is considerably smaller than that for prenatal care. However, the few sources include many of the same variables identified in studies of prenatal care demand. Wealthier, urban, and well-educated mothers were more likely to access professional delivery (Trujillo *et al* 2013, Muchabaiwa *et al* 2012, Adu *et al* 2018). Women who had fewer previous births were more likely to choose a facility delivery, and particularly those having their first birth (Trujillo *et al* 2013, Adu *et al* 2018). Older women were also more likely to choose facility delivery (Trujillo *et al* 2013, Adu *et al* 2018). However, sufficient differences in magnitudes and significance of results indicates that findings cannot be assumed to apply to utilization of all three services in the same way (Muchabaiwa 2012). For example, in Zimbabwe, education level had a greater impact on delivery in a health facility than on utilization of other health services (Muchabaiwa *et al* 2012).

Differences across study locations appeared more pronounced with access to professional delivery than with antenatal care usage. Older women in Colombia and Ghana were found to be more likely to have professional assistance at delivery according to results from Trujillo *et al* (2013) and Adu *et al* (2018), respectively. However, Muchabaiwa *et al* (2012) found that age

was not a significant determinant in Zimbabwe. Women who wanted the pregnancy were more likely to have a facility-based delivery in Zimbabwe, while the effect was not statistically significant in Colombia (Muchabaiwa *et al* 2012, Trujillo *et al* 2013). Societal and cultural factors such as marital status, employment, ethnicity, and religion were particularly region-specific. Employed women were less likely to have a facility-based delivery in Ghana, likely because the majority are self-employed women who tend to be poorer and have lower education levels (Adu *et al* 2018). In countries where more women work in the formal sector, this result would likely not apply, which might be why it was not considered in the study of Colombia by Trujillo *et al* (2013). Married women were more likely to have professional assistance at delivery in Colombia (Trujillo *et al* 2013), while marital status did not have a significant impact in Ghana (Adu *et al* 2018). In Zimbabwe, it was not marriage, but the type of marriage—polygamous or not—that was significant (Muchabaiwa *et al* 2012). Marital and family structures are also important when considering who makes the healthcare decision. A study in Mexico found that the decision on where the birth should take place often depends on husbands or extended families, indicating that successful policy must target other members of the family or increase women's decision-making power (Urquieta *et al* 2009). These results indicate that when cultural institutions differ across societies, results cannot be neatly extrapolated. In addition, religion was significant in predicting utilization in Zimbabwe (Muchabaiwa *et al* 2012) and Ghana (Adu *et al* 2018), where traditionalists were less likely to have professional assistance, but was not considered in the model by Trujillo *et al* (2013) in Colombia. Ethnicity was only a significant indicator in Ghana (Adu *et al* 2018). Finally, regional indicators are obviously country-specific and can be highly influential. One of the most significant determinants of professional delivery

in Colombia is region; women in all other regions have a lower utilization of maternal health services than those in Bogotá (Trujillo *et al* 2013).

The literature on postnatal care is even more sparse. Studies often do not focus on postnatal care specifically, but often treat it as a component of maternal health services in general. When they do focus on postnatal care, results are often limited. For example, Muchabaiwa *et al* (2012) identified only two factors, antenatal care utilization and access to daily radio programs, as significant indicators of postnatal care use in Zimbabwe. When compared to antenatal care, professional delivery and c-section, postnatal care was found to be the most inequitable intervention across wealth quintiles in both Brazil and Colombia (De La Torre *et al* 2018). However, to the best of my knowledge, no study on demand for postnatal care in Colombia exists. This conclusion emphasizes the need for more research particularly on postnatal care, especially because postnatal care has significant power to prevent maternal mortality and morbidity (United Nations 2015).

Recommendations and guidelines from medical sources clearly state that all three services—adequate antenatal care, skilled birth attendance, and postnatal care—are critical to improving maternal health (United Nations 2015, WHO 2015). However, very few economic studies on the subject exist. Furthermore, studies that do exist often exclusively examine maternal mortality, leaving out the vast number of women who experienced complications or morbidity related to pregnancy or delivery and potentially missing key nuances (Conway and Kutinova 2006). There is no standard, agreed-upon metric to measure maternal health other than death, which also means the majority of studies of maternal health outcomes are descriptive rather than analytical (Reichman *et al* 2010, Conway and Kutinova 2006). One exception is a study based in the United States by Conway and Kutinova (2006) which concludes that prenatal

care increases the probability of maintaining a healthy body weight after pregnancy and shortens hospitalization. They also found that black women were more likely than white women to be hospitalized, regardless of prenatal care utilization (Conway and Kutinova 2006). This result suggests the ability of other variables, such as demographics, to influence maternal health outcomes.

There is a large, and tangential, body of literature which examines the production of infant health, given inputs such as maternal behavior during pregnancy and antenatal care. Because many maternal health behaviors, such as smoking and drinking alcohol, which impact fetal health, have significant impacts on maternal health as well, some information can be gleaned from their conclusions (Reichman *et al* 2010). The main conclusion reached by Reichman *et al* (2010) is that early and adequate prenatal care—defined as four visits, the first of which is in the first trimester—has a negative impact on the chance of a woman smoking after delivery. Additionally, prenatal care can have long-term impacts of maternal health by increasing their awareness of behavior as it impacts health and by connecting them to the healthcare system (Reichman *et al* 2010, Conway and Kutinova 2006).

Importantly, Reichmann *et al* (2010) frames maternal health as a joint production with child health, given inputs of maternal health endowment, pre- and postnatal actions and healthcare service use (Reichman *et al* 2010). More will be examined on the details of health production in the following sections, but numerous studies have theorized how individual-, household-, and environmental-level characteristics impact the production of health, a framework that can easily be applied to maternal health. For example, Wolfe (2006), hypothesized that maternal characteristics such as age, poverty level, marital status, belonging to a minority group, education, diet, and employment impact both the health endowment and

pregnancy actions, which determine maternal health. For example, women who are unaware of their current pregnancy could be more likely to engage in actions that hurt maternal and child health and less likely to attend prenatal care (Reichman *et al* 2010, Wolfe 2006). Conversely, married and older women are more likely to have been planning the pregnancy and thus more likely to realize they are pregnant early on. However, Wolfe's study (2006) is descriptive, so there is no analysis of causality.

Because most of the literature focuses on fetal and infant health, which is jointly produced with maternal health during pregnancy, there are significantly fewer studies that examine professional assistance at delivery or postnatal care. However, professional delivery and postnatal care have been shown in medical studies to reduce the risk of mortality and morbidity, such as muscle injury, fever or fistula, through monitoring of health and emergency obstetric care (United Nations 2015, WHO 2015, McKay 1998).

Finally, to best of my knowledge, there are no studies on the impacts of healthcare utilization on individual maternal health outcomes in Colombia. However, Cárdenas-Cárdenas *et al* (2015) concluded that maternal mortality rates at the departmental level were highly associated with departmental poverty levels in Colombia. Municipalities with higher percentages of rural populations were also estimated to have slightly higher maternal mortality rates. The study also indicated that departments with the highest maternal mortality rates were often areas with high concentrations of ethnic minorities, though this factor was not included formally in the analysis (Cárdenas-Cárdenas *et al* 2015). Though not at the individual level, these findings suggests that wealth, area of residence, and potentially ethnicity, could be important determinants of experiencing a complication.

This study aims to turn attention to the role of health service use in producing maternal health by adding to the body of knowledge on demand for prenatal care and professional delivery in Colombia and filling the current gap in research on postnatal care demand and maternal health outcomes. Additionally, by examining Colombia, this study contributes to the small number of analyses of maternal health in middle-income countries. This information is important as maternal mortality decline has stagnated well above goal levels in many middle-income countries (United Nations 2015). Even in the United States, many women do not receive sufficient antenatal care (Yan 2016, Wolfe 2006). Evidence from Brazil suggests that other middle-income countries also have significant wealth-related inequalities, even with near-universal coverage (De La Torre *et al* 2018). The lack of studies could result in underestimation of the benefits of healthcare, leading to underutilization by women and less attention at the policy level (Conway and Kutinova 2006). In addition, there are few studies centered on Latin America and only a handful in Colombia; the vast majority of the literature focuses on Sub-Saharan Africa and Southeast Asia. While findings may be extrapolated between countries or regions, caution is critical as specifics often vary (Guliani *et al* 2014). More research needs to be conducted in countries in other regions of the world to generate specific, effective policy to increase service utilization and reduce the global maternal mortality rate.

III. b. Conflict and Healthcare Utilization

Literature on the impact of conflict on health and healthcare provision is more substantial. Studies conducted across disciplines—medicine, sociology, history, economics—conclude unequivocally that conflict negatively affects health (Price and Bohara 2013). Its impacts are particularly detrimental to women, who, even in the absence of conflict, are at higher

risk of illness and often lack the resources and power to access health services ((McKay 1998, Rivillas *et al* 2011). Despite these clear implications, the body of literature related specifically to conflict's effect on maternal health is quite small. The majority of relevant sources focus instead on child and infant health or access to contraception. There are a few sources that focus on maternal health, yet, to the best of my knowledge, there is no study on the impact of conflict on demand for maternal health in Colombia, in particular.

Conflict both worsens health and limits access to services, intensifying pre-existing risks (McKay 1998). Women and girls are more likely to face sexual exploitation and gender-based violence during periods of conflict than in peace (McKay 1998, Svallfors and Billingsley 2019). These situations can lead to an increased number of complicated pregnancies, especially in young girls and women with sexually transmitted diseases (McKay 1998). Forced displacement may also reduce demand for health services in some areas and increase it in others, as people flee conflict zones and relocate (Price and Bohara 2013). On the supply side, health facilities are often destroyed and personnel targeted or recruited by armed groups (McKay 1998, Svallfors and Billingsley 2019). Additionally, the dangers of traveling to seek health care increase, making women less likely to go (McKay 1998, Price and Bohara 2013).

These effects are evident in empirical results of the effect of conflict on maternal health services. In Nepal, instances of armed conflict correlated with a reduction in the number of antenatal visits attended (Price and Bohara 2013). In a study of 31 countries in Sub-Saharan Africa, Østby *et al* (2018) found that women were significantly less likely to give birth in a health facility if they had experienced proximity to violence, both temporally and geographically. In particular, urban women and poorer, less-educated mothers were more affected by conflict

(Østby *et al* 2018). In addition to immediate violence, perceived threat of future violence has been shown to also decrease maternal health service utilization (Badiuzzaman *et al* 2018).

Though no study looks at how conflict impacts the demand for health services in Colombia specifically, Rivillas *et al* (2011) found that unmet needs in antenatal care and professional delivery was higher in areas with more victims of armed conflict. Additionally, Rivillas *et al* (2011) identified multidimensional inequality along racial lines where Afro-Colombian and Indigenous women have been impacted more heavily by armed conflict and suffer higher rates of unmet needs in maternal health services. Other studies in related areas also had relevant conclusions. Svallfors and Billingsley (2019) find that conflict intensity reduces contraceptive use, across all socioeconomic groups. They also conclude that some of that change could be due to increased fertility demand resulting from concern about losing a partner (Svallfors and Billingsley 2019).

Finally, with regard to complications, a study on birth weights based in Colombia, Camacho (2008) found that landmine explosions were significantly correlated with lower birth weight babies. That conclusion suggests that high stress levels during pregnancy can have negative impacts on health. Though Camacho (2008) focused exclusively on infant health rather than maternal health, medical research has shown the stress during pregnancy negatively affects maternal health as well (Coussons-Read 2013). Thus, it is likely that women in high conflict areas are more likely to experience a complication during or after pregnancy. Bernal and Cardenas (2005) also state that stress related to armed conflict has a detrimental impact on health, and could thus disproportionally affect women in regions affected by conflict, though their model does not control for conflict level explicitly.

IV. Data and Methodology

IV. a. Theoretical Framework

The theory of health demand created by Grossman (1972), and explained by Jewell (2009), provides a framework through which to conceptualize the demand for prenatal care, professional assistance at delivery, and postnatal care in this study. Health is the product of a series of inputs, including healthcare use, chosen to maximize utility. The following utility function (*U)* for the *i*th woman is defined by the optimal consumption of maternal health (*M*), and all other goods (*Z)*, and is shaped by individual characteristics (*X)* which do not produce utility directly, but influence it through individual preferences and needs:

$$Utility_i = U(M_i, Z_i; X_i) \tag{1}$$

Within that equation, maternal health (*M*) is produced using a series of inputs:

$$M_i = f(A_i, D_i, P_i, H_i, C_i; X_i) \tag{2}$$

where *A* is defined as antenatal care utilization, *D* as professional delivery, and *P* as postnatal care. *H* is a vector of all other health inputs. *X* is the vector of individual-, household-, and environmental- level characteristics that influence health production efficiency. In this study, *C* is the level of conflict present in the individual's municipality. Conflict can have direct, negative effects on maternal health, external to service use, through factors including stress levels, restricted access to food, and sexual violence (Camacho 2008, McKay 1998).

Together, equations (1) and (2) form a utility function:

$$Utility_i = U(M(A_i, D_i, P_i, H_i, C_i, X_i), Z_i; X_i) = U(A_i, D_i, P_i, Y_i, C_i; X_i) \tag{3}$$

where Y is a vector of Z and H, defined as all other goods that determine utility. X is the vector of individual characteristics that impact both preferences for health and efficiency at producing health.

The use of each healthcare service and of consumption of other goods, Y, is constrained by price and time. Each individual faces a budget constraint:

$$I_i = P_A A_i + P_D D_i + P_P P_i + P_Y Y_i \tag{4}$$

which shows that expenditure on health services and all other goods cannot exceed the individual or household income. *A* refers to antenatal care, *D* to professional delivery and *P* to postnatal care. *Y* refers to all other health and non-health related goods. In each case, the price comprises the monetary cost of the good or health service, the cost of transportation, and the opportunity cost of forgoing other goods (Jewell 2009).

Monetary prices are not the only, nor the primary, constraint on service use. Accessing service requires time dedicated to transportation and visit duration as well as the opportunity cost of forgoing other responsibilities. To illustrate time allocation decisions, it is useful to draw on the Khandker (1988) model, in which a woman's time spent producing a good (in this case health) is constrained by other activities. In this model, a woman's time (T_i) is split between taking care of children (T_K), working outside the home (T_E) and producing maternal health (T_M)*:*

$$T_i = T_K K_i + T_E E_i + T_M M_i \tag{5}$$

Time spent on the production of maternal health can be further decomposed into utilization of maternal health services, antenatal care, professional assistance at delivery and postnatal care, where each *T* refers to the time per unit of health service and is multiplied by the quantity of service utilized to yield the total time allocation:

$$T_M = T_A(C_i) * A_i + T_D(C_i) * D_i + T_P(C_i) * P_i \tag{6}$$

and combined with equation (5) to yield a composite equation:

$$T_i = T_K K_i + T_E E_i + T_A(C_i) * A_i + T_D(C_i) * D_i + T_P(C_i) * P_i \tag{7}$$

C_i indicates the level of conflict, which impacts the time needed for transportation to health services as well as wait times for care. Infrastructure damage may increase transportation times and attacks on health clinics could decrease the supply of practitioners, increasing waiting times (Østby *et al* 2018). Combining these equations results in a demand for maternal health services that maximizes utility through the production of maternal health and is constrained by budget and time allocation.

$$U(A_i, D_i, P_i, Y_i, C_i; X_i) \text{ subject to}$$

$$T_i = T_K K_i + T_E E_i + T_A(C_i) * A_i + T_D(C_i) * D_i + T_P(C_i) * P_i \tag{8}$$

$$I_i = P_A A_i + P_D D_i + P_P P_i + P_Y Y_i$$

From the contraint equations, one can see that the full cost per unit of health service consumption is a shadow price, including both the direct price of the service and the time cost—the expense of transportation and the monetary value of time lost. The direct price of a service is set by the government according to insurance benefits (Giedion and Uribe 2009), and thus can be assumed to be independent of conflict. The cost of time is augmented by conflict, which increases transportation and wait times. Thus, the shadow price of health services increases at higher conflict levels, reducing the quantity of health services demanded. Conflict also directly influences utility through the production of maternal health. Maximizing utility subject to the constraints yields first order conditions, represented as demand for each health service below:

$$A_i = f(P_A, I_i, T_A(C_i), C_i, T_i, Y_i; X_i) \tag{9}$$

$$D_i = f(P_D, I_i, T_D(C_i), C_i, T_i, Y_i; X_i) \tag{10}$$

$$P_i = f(P_P, I_i, T_P(C_i), C_i, T_i, Y_i; X_i) \tag{11}$$

The equations display that, for each service, the derivative with respect to time would yield a partial derivative of service time with respect to conflict. As conflict increases, so does the time

cost per unit of health service utilization, which would lower healthcare demand. Additionally, conflict is present on its own in the demand function, reflecting its direct impact on utility. In summary, an increase in conflict increases the cost of health services through time allocation, lowering demand, while simultaneously decreasing the stock of maternal health.

This study analyzes both the effect of conflict on service use and on maternal health outcomes. The primary focus is demand for health services, shown by Equations 9, 10, and 11. The second stage of the model estimates Equation 2, the production of maternal health. The following sections contain discussion of the variables used, including conflict and individual-, household- and environmental-level characteristics, and their mechanisms of shaping demand.

IV. b. Data

This study uses data from the 2010 Demographic and Health Survey, conducted in Colombia by Profamilia. 51,447 households were visited, resulting in a primary sample size of 53,521 women between the ages of 13 and 49. Households were chosen using a random sampling method that identifies several clusters of households in 258 municipalities. Sampling is done such that the municipalities included represent a range of demographics, living conditions, and sizes with an even rural-to-urban divide. The subsection of the survey used in this study is a dataset of the full birth history of every woman between the ages of 13 and 49 interviewed, yielding 91,399 observations. From that, this paper analyzes the information of 17,747 births that occurred in the five years preceding the survey to minimize recall bias on detailed questions related to the birth and health service use.

The working dataset merges information on conflict from the Conflict Analysis Resource Center (CERAC) and on the supply of medical services in each department. The CERAC

database assigns a cumulative measure of conflict to each municipality. The two measures assessed are intensity, determined by the number and type of conflict-related events, and persistence of conflict, referring to the presence of armed groups, in the years 2000 to 2012. The scale ranges from 1 to 7, from no conflict to highest intensity and persistent conflict.[1] Though this format lacks temporal specificity and details on the types of violence, a cumulative measure of conflict was deemed most appropriate for this study because it includes many dynamics of the conflict rather than choosing a particular type or metric of violence. The CERAC dataset is highly detailed and contains more inclusive measures of conflict, such as attacks solely targeting civilians and paramilitary activity, which are excluded from many larger datasets. Such details are essential to the complex story of the conflict (Restrepo *et al* 2006). Most importantly, the formation of the scale, including decisions on how different types of violence impact intensity and persistence, was done by conflict experts who have a far deeper understanding of the effects and dynamics of conflict than I do. Moreover, the births included in the sample occurred over a span of five years. Decisions to related to the birth and service utilization would likely have been impacted by conflict levels in the years before birth as well, so it would not have made sense to use a measure rooted in one particular moment in time.

To account for the supply of medical services, a variable was constructed using the database of the Departmental and District Health Entities from the Colombian Ministry of Health (REPS 2020) and population data from the National Administrative Department of Statistics (DANE 2019). The number of health providers in each department was divided by the

[1] The scale of 1 to 7 for CERAC data is based on four categories of presence and two of intensity. The presence of armed groups is persistent, interrupted, finalized, or not present. Interrupted presence means there were years without armed groups in the municipality, and finalized means there were no armed groups for the last eight years of the study period. Intensity is rated as above or below the national average. In the database, level 1 refers to the most conflict and 7 is no conflict, but the order has been switched in this study to facilitate interpretation of results. All discussion in this paper is with the reordered levels. Definitions of each level are available in Section A of the Appendix.

population to generate a variable representing the number of medical providers per 1,000 people in each department. Thus, conflict is evaluated at level of the municipality, while the supply of medical providers is measured at the departmental level for each birth observation in the dataset.

IV. c. Descriptive Statistics

Table 1, below, displays selected descriptive statistics for the dependent variables and the primary regressor, conflict. Average values of the outcome variables and conflict are also reported for urban and rural women separately. Important socioeconomic determinants, such as education and age, are not included in the table, but are discussed below to lend a clearer picture of the sample and the demographic landscape of Colombia before analyzing the multivariate estimation results. A full table of descriptive statistics can be found in Table B of the Appendix.

Table 1: Descriptive Statistics
Total observations: full sample, n=17,747; urban, n=11,325; rural, n=6,421

Variable	Full Sample Mean	Full Std. Dev.	Urban Mean	Rural Mean
Complication	0.3939	0.4886	0.3980	0.3868
Health Services				
Prenatal care	0.5653	0.4957	0.6430	0.4282
Professional delivery	0.8931	0.3090	0.9647	0.7669
Postnatal care	0.6638	0.4724	0.4407	0.5370
Conflict	4.7409	1.6474	5.1266	4.0607

Fifty-six percent of the full sample accessed adequate prenatal care, defined as a minimum of four visits, the first one occurring within the first trimester, and all with a doctor or trained nurse or midwife. This percentage is far lower than the national rate reported by sources such as the Pan American Health Organization (2017) and the percentage of full DHS sample who accessed any professional prenatal care (93.86 percent). The discrepancy is the result of the

other stipulations on quality within the chosen definition of prenatal care. Only 59 percent of births for which the mother received professional prenatal care also had the first visit within the first trimester. Sixty-nine percent of the observations had four prenatal visits with a trained provider. Because the definition of the variable contains three requirements, only women who met all three were included. Prenatal care had the lowest attendance of the three services considered in this study. Sixty-six percent of women received postnatal care and 89 percent were assisted by a professional at delivery. Only 39 percent of the sample reported experiencing a complication before or after delivery.

The mean level of conflict was 4.7, indicating that the average woman lived in a municipality with average to above-average intensity and an inconsistent or interrupted presence of conflict. The standard deviation of approximately 1.7 indicates considerable spread between no conflict (level 1) and persistent, intense violence (level 7). Additionally, the mean is close to the median, indicating that observations in the sample do not significantly over-represent high conflict areas.

With regard to socioeconomic characteristics, the women in the sample had, on average, 8.11 years of formal education compared with 9.52 for their partners.[2] Colombian schooling goes for 11 years, transitioning from lower secondary to upper secondary after the ninth year (Radinger *et al* 2018). Only 17 percent of the sample was currently married, while the majority (58 percent) was living with a partner, but not married. The mean age is 27.45 and women had, on average, 2.7 children. This rate is slightly higher than the national average, which was 2.1

[2] Women who had never been married had missing values for partner's education. As marital status has an important effect on service use, it was deemed necessary to include them, so the missing values were recoded as five. Five years was chosen because descriptive statistics of the full sample indicated a concentration of observations at that level of education, and a partner with a lower education level was more consistent with the hypothesized negative effect of not having a partner.

over the sample years, 2005 to 2010 (PAHO 2017). Almost 73 percent of the sample is categorized as white or mestizo and not identified with a minority group, while 11 percent is Afro-Colombian and less than one percent is Gitiano, Panelquero de San Basilio or Raizal del Archipeílago. These proportions are consistent with national numbers (PAHO 2017). However, 15 percent of the sample identifies as Indigenous, even though the 2005 Census reported that only 3.43 percent of Colombia's population is Indigenous (PAHO 2017). The DHS reports that 4 percent of women in the total sample identified as Indigenous, yet 13.3 percent of all births in the birth history sample, not just those that occurred in the preceding five years, were categorized as Indigenous (Ojeda *et al* 2011). Indigenous communities are not reported to have higher fertility rates than other ethnic groups, so that cannot explain this over-representation (DANE 2006). The sample is slightly skewed towards poorer wealth quintiles; 37 percent is in the poorest and the rate decreases sequentially to just under 7 percent in the richest quintile. Thirty percent of the sample lives in rural areas, compared to the 2016 national percentage, 21 percent (PAHO 2017). Though this could be a result of shifting demographics over six years, but it could also mean the rural women are slightly over-represented.

Approximately 46 percent of births were reported as desired at the time of pregnancy while 28 percent were wanted later and 26 percent were not wanted at all. The number of medical providers per 1,000 inhabitants ranges between 0.1857 and 1.967 across the 33 departments and Bogotá, with an average of approximately 1.02. Each of the six regions contains between approximately 13 and 23 percent of the observations with the exception of Bogotá, which only accounts for 5.4 percent of the sample.

IV. d. Empirical Specifications

i. First Stage Model: Healthcare Demand

The primary dependent variables in this study are prenatal care utilization, professional assistance at delivery and postnatal care use for each birth in the five years preceding the survey. Each dependent variable is a dummy variable defined such that one indicates the use of the service. Where possible, service use is defined in order to maximize detail on quality. Colombia has high service use, especially for prenatal care and professional delivery but has seen slow progress in reducing maternal mortality (Ojeda *et al* 2011). Even though women are accessing healthcare, the services are not dramatically improving health, which underscores the importance of comprehensive measures of quality. Therefore, only antenatal care that meets WHO recommendations is included (WHO 2015). The resulting definition is at least four visits, the first of which is at or before the third month, all conducted by a health professional, in this case a doctor, midwife or nurse. Professional assistance at delivery is defined as attendance by a doctor and/or a nurse or midwife, per WHO (2015) guidelines. Postnatal care is taken directly from the DHS survey and defined simply as "after discharge/delivery at home anyone checked on respondent's health" (DHS Program 2010). This definition is vague, and unfortunately the survey did not allow for generation of a more detailed variable.

Given that the three dependent variables are indicator variables, a linear OLS model is inefficient, and instead a probit model is used. Thus, the estimated outcome variables are interpreted as the probability of a woman utilizing health services, regressed against a series of individual-, household-, and environmental-level characteristics, the presence of conflict at the municipal level, and the supply of medical providers at the departmental level. Each equation is estimated with robust standard errors clustered at the household level to account for unobserved

heterogeneity resulting in correlation across observations, in this case births, from the same household in the disturbance term. This step is critical, as births from the same household likely come from the same mother and thus have similar unobservable characteristics, such as trust in the health system, which are correlated service use.

Individual-, household-, and environmental-level characteristics impact maternal healthcare utilization in two primary ways. First, through preferences for maternal health, as shown by vector X in the utility function (Equation 1), and secondly through efficiency at producing health (Equation 2). The selection of explanatory variables in the study is informed by the literature review as well as the history and context of Colombia. Discussion of the regressors begins with the X's, before turning to the primary variable, conflict.

Individual-level characteristics in this study include the mother's age, ethnicity, years of formal education, whether she is formally employed, as well as pregnancy-related variables such as wantedness of pregnancy, number of children ever born, and who makes health care decisions. The majority of those variables impact health through both mechanisms. More educated women, for example, are likely to have a greater preference for good health and be more efficient at producing it, due to better habits resulting from greater knowledge of health production (Wagstaff 1986). If both these effects occur, education would increase demand for health and increase utilization of services, while simultaneously making those services more effective and reducing the amount needed to generate the same health outcome. Thus, the impact is inconclusive and must be tested empirically. Other variables, such as wantedness of pregnancy, may only function in one way. A woman is likely to have a lower preference for health if the pregnancy is unwanted, decreasing her utilization of health services. Very young or very old mothers have greater healthcare needs to have a safe birth, and older mothers may have a greater

preference for health due to greater experience (Guliani *et al* 2013). Ethnicity may impact preferences as well as access to healthcare, but theory does not define a certain hypothesis. Because there is a household wealth variable included, the impact of employment is likely to be distinct from the income effect. In fact, the impact may be negative as employed women are likely to have less time to allocate towards medical visits (Wolfe 2006). However, given the organization of the health system in which people in formal sector jobs have access to health insurance in the Contributory Regime, employed women may be more likely to be insured, allowing them to access services and potentially improving their health stock pre-pregnancy (Lamprea and García 2016). A higher number of previous births represents more experience, increasing the efficiency of maternal health production and decreasing the utilization of health services. However, this effect may be indiscernible because women who had quality experiences with health services in previous pregnancies or were treated for complications, would likely seek services again. Finally, women who control their own healthcare decisions likely have a higher preference for their own health than husbands or other people, which would increase their demand for health services.

Household variables include marital status, the number of people living in the household, the number of children under five, husband's years of formal education, and household wealth. Different marital or cohabiting statuses may impact healthcare demand through cultural mechanisms, but having a partner in the house would likely allow women to share childcare responsibilities and provide more income, increasing time and monetary resources and raising demand for maternal health services. If there are many children under five living in the household, a woman is likely to spend more time dedicated to child care and less to healthcare. However, if the number of people in the household includes many adults, such as grandparents

or aunts and uncles, there may be more people to share childcare tasks (Vecino-Ortiz 2008). Unfortunately, the survey structure did not allow for a household breakdown by age, so this could not be studied closely. Additionally, more children under five or people in the household would decrease the share of income the woman would be able to spend on healthcare and thus reduce her consumption. Much like the woman's education, husbands or partners with higher education levels are likely to have higher preference for maternal healthcare and be more efficient at producing it. Finally, the DHS survey divides households into five wealth quintiles represented by a cumulative measure of socioeconomic status based on criteria developed by the World Bank (Ojeda *et al* 2011). Wealthier households likely have more income to spend on healthcare and may have higher preferences for health, both of which increase consumption. However, healthier living conditions and potentially more access to other forms of healthcare may increase efficiency and decrease utilization.

Lastly, environmental factors include rural residence, years spent living in current residence and region. Rural women may have greater transportation and time costs to access health services, decreasing demand (Alexandre *et al* 2015). Women who have spent many years in the same community likely have more information about how to access services and a larger network of people to help with childcare, also increasing demand (Vecino-Ortiz 2008). Regions may have different cultures impacting preference for health, or common transportation issues that limit access. However, like ethnicity, regional variables are country specific and the impact cannot be inferred from theory. The geographical distinctiveness of regions within Colombia, as well as their historic political and economic individuality, suggests there are likely to be regional differences, positive or negative (Vecino-Ortiz 2008, Trujillo *et al* 2013). Finally, this study also includes a variable for the supply of healthcare, represented by the number of medical providers

per 1,000 people in each department. A greater supply likely increases service attendance by reducing the time and monetary barriers to accessing care. The supply of medical providers and rural residence both function as proxies of transportation costs, which negatively impact service use (Jewell 2009).

The key explanatory variable in this study is conflict. Armed conflict likely decreases efficiency in producing health by worsening living conditions and raising stress levels, increasing demand for health services. Additionally, physical violence and homicides have largely impacted young men (Vallejo *et al* 2018). Preference for maternal health may increase if more women become sole caretakers of children. Violence could also increase perception and awareness of death and bodily harm, increasing preference for health of all forms, especially preventative healthcare such as prenatal care, professional assistance at delivery and postnatal care. However, as violence increases, the perceived risk of accessing health services, as well as transportation and wait times, likely increases, raising the shadow price and causing the quantity demanded to decrease (Østby *et al* 2018). Additionally, as other family members are affected by violence, the demand for other forms of healthcare would increase and families may choose the health of children or husbands over the health of mothers.

ii. Second Stage Model: Complications

The secondary focus of this study is the impact of prenatal care, professional assistance at delivery, and conflict on the chance of experiencing complications during or soon after delivery. Because postnatal care utilization could not logically impact complications experienced during birth, it is not included in the model. Mothers experience the highest risk of death during delivery and 24 hours postpartum, so this time is crucial to reducing maternal mortality (De La Torre *et al*

2018). The dependent variable, “complications”, is a dummy variable in which women who have experienced one or more of a variety of complications were assigned a 1. The DHS survey includes questions on specific types of complications; those that could potentially be life threatening were merged into the new composite variable, including prolonged labor, excessive bleeding, fever with vaginal discharge, convulsions and “other” during labor, and excessive bleeding, loss of consciousness or fever postpartum (WHO 2015).

However, complications cannot be estimated with a simple probit equation because the use of health services is a choice, and thus likely endogenous (Conway and Kutinova 2006, Reichman *et al* 2010). Some of the same unobserved characteristics are likely to impact both service use and the chance of complications. For example, low trust in the health system could cause women to be less likely to seek maternal health services, and be at higher risk of complications due to not treating other health issues. The model is estimated using a Two-Stage Residual Inclusion model to correct for potential endogeneity (Terza *et al* 2007).

In the first stage, the endogenous variables, prenatal care and professional delivery, are estimated in simple probit equations. The predicted values are then subtracted from the true value to obtain the residuals. The second stage model includes both the residuals and the actual observation, in addition to other variables. The residuals can be consistently estimated, meaning the unknown portion of the error term that was correlated with the endogenous variable is identified and separated from the error term. Thus, the endogeneity in the model is removed (Terza *et al* 2007).

A key element however, is that the first stage must contain regressors that are significant in predicting the endogenous variables, but do not belong in the second stage (Terza *et al* 2007). In this study, three variables related to the media, having heard of family planning on the radio,

in the newspaper, or on television in the 12 months preceding the survey, were the primary identifiers. Zamawe *et al* (2016) found that a community-level media campaign on maternal health increased prenatal care usage. Other research suggests that even media not directly related to reproductive or maternal health could increase antenatal care attendance, as concluded by Acharya *et al* (2015) in a study in Nepal. In Zimbabwe, women with access to the media, including radio programming, were more likely to access both antenatal and postnatal care (Muchabaiwa 2012). Media likely increases the accessibility of services as women know how to navigate the system, as well as potentially heightening the desire for good health (Zamawe *et al* 2016, Muchabaiwa 2012). However, information on family planning is unlikely to impact the experience of complications once healthcare attendance has been controlled for, and can thus be left out of the second stage of the model. Additionally, the first stage estimates of prenatal care and professional delivery use include a variable for the supply of medical providers as increased supply likely increases utilization by reducing transportation and time costs. However, in the second stage of the model the use of maternal health services is already accounted for, so including the supply of medical providers is unnecessary. Availability of health services is a commonly used identifier in two-stage models for health outcomes (Reichman *et al* 2010).

All individual, household, and environmental characteristics included in the first stage of the model (discussed above) are regressed on "complications" in the second stage. Such characteristics impact the probability of experiencing life-threatening complications during and after delivery through the woman's preexisting quality of health and biological factors, essentially the efficiency at producing health. For example, very young or very old mothers are biologically at higher risk of complications, lowering their health outcomes even given the same level of healthcare usage (Guliani *et al* 2013, WHO 2015). Like the estimation of the first stage,

errors in the second stage of the model are clustered at the household level to correct for unobserved heterogeneity resulting from the inclusion of more than one birth from the same mother.

The breadth and specificity of questions in the Demographic and Health Survey allowed for a large number of secondary characteristics to be included, controlling for most potential sources of bias. However, the survey does not contain information on the direct price of health services and lacks a broad question of whether individuals had insurance, a common proxy for price (Jewell 2009). There are questions on whether insurance paid for prenatal services, delivery and postnatal care, but only women who had accessed that care answered these questions. Additionally, it was not specified what type or regime of insurance was used.

V. Results

V. a. Determinants of Maternal Health Service Utilization

The three primary models in this study individually estimate the probability of the mother attending adequate antenatal care, having professional assistance at delivery, and receiving postnatal care for the sample of births that occurred in the five years preceding the survey, conducted in 2010. Each model includes the same series of individual, household, and environmental characteristics, as well as a variable representing the intensity and persistence of conflict in each municipality. A probit model with robust standard errors clustered at the household level is used to estimate the use of each service. The significance of the chi-squared test for goodness of fit was equal to 0 when rounded to four decimal places for each model. For the purposes of interpretation, the estimated coefficients have been converted into marginal

effects. They are shown with their significance in Table 2, below. The estimated coefficients and standard errors are reported in Table C of the Appendix.

Table 2: Service Demand *** p<0.01, ** p<0.05, * p<0.1	**Prenatal Care**	**Professional Delivery**	**Postnatal Care**
Variables	Marginal Effects	Marginal Effects	Marginal Effects
Conflict	-0.0049***	0.0027	-0.0092***
Wantedness of Pregnancy			
Wanted Later	-0.0281***	-0.0065	-0.00498
Not Wanted	0.00135	-0.0087**	-0.0278***
Healthcare decisions			
Individual	0.017**	0.0161***	0.013
Other and Individual	0.0094	0.0102	0.014
Age	0.0132***	0.0032***	0.0064***
Ethnicity			
Indigenous	-0.0762***	-0.061***	-0.0482***
Other	-0.0729*	0.0066	0.1534***
Afro-Colombian	-0.0161	-0.036***	-0.0557***
Employed	0.0102	-0.0225***	0.0103
Marital Status			
Never Married	-0.0985***	0.0264**	-0.0156
Living Together	-0.0182**	-0.0006	-0.0303***
Formerly Married	-0.01618	-0.0097	-0.0375
Not Living Together	-0.0339***	-0.00058	-0.0408***
Education	0.00696***	0.0078***	0.0117***
Partners's Education	0.00178***	0.0027***	0.0028***
Household Members	0.013***	0.0013	-0.0034
Children Five and Under	-0.1348***	-0.0148***	0.0022
Children Ever Born	-0.0651***	-0.0152***	-0.0162***
Wealth Quintile			
Poorest	-0.0679***	0.0019	-0.1403***
Poorer	-0.01699	0.0269	-0.0962***
Middle	-0.00989	0.0328	-0.0833***
Richer	-0.00957	0.0256	-0.0237

Years in Residence	0.0003***	-0.00007*	0.00002
Rural	-0.028***	-0.0519***	-0.0199**
Supply of Medical Providers	0.0508***	0.0632***	0.1769***
Region			
Atlantic	0.0719***	0.0417*	0.0099
East	0.0524***	0.007	0.0468***
Central	0.0748***	-0.0131	0.104***
Pacific	0.0836***	-0.0258	0.0774***
Territories	0.0397**	-0.0075	0.0884***
Media			
Family Planning on Radio	0.01	0.006	0.0464***
Family Planning on TV	0.0369***	0.0186***	0.0386***
Family Planning in Newspaper	0.01899**	0.0101*	0.0259***
Observations	17,747	17,747	17,747

Before discussing the key variable, conflict, I will summarize the individual-, household-, and environmental-level control characteristics. Numerous individual level variables related directly to the pregnancy and medical information are significant at the one percent level and consistent with theoretical hypotheses. One would expect that desiring a pregnancy would increase the utility gained from good health, both maternal and fetal, thus increasing the demand for health and the utilization of health services. The empirical results are consistent with this thinking; women who wanted to delay their pregnancy are less likely to access antenatal care and women are significantly less likely to access professional delivery and postnatal care for an unwanted pregnancy. Women who have individual control over their healthcare decisions are more likely to attend antenatal care and get professional assistance at delivery than women whose healthcare usage was primarily decided by their husband or another person. Additionally, access to media has positive impacts, though the significance varies across the three services and method of dissemination—radio, television, or newspaper. These results are consistent with

expectations that women with more decision-making power and more information have higher preference for maternal health and a greater ability to act on such preferences by seeking services (Wagstaff 1986). The same logic can be applied to explain the impact of education and age. Older women are found to be more likely to access each of the three services. Both the individual's education years and their partner's are significant at the one percent level and positive across the three services, though the estimated marginal effect of women's education is consistently larger.

In addition to the partner's level of education, several other household variables are significant. Women who had never married, were not living with their partner, or were living with a partner but were not married, were all less likely to attend antenatal care than married women. Women with a partner, whether they are living with them or not, are less likely to attend postnatal care than married women. Married women are likely to have more support within the household to assist with childcare and other tasks during medical visits. Additionally, marriage might raise the preference for infant and maternal health for the partner, causing them to encourage health service use. Interestingly, women who had never married were more likely than currently married women to have professional assistance at delivery. The alternative to professional assistance is generally a traditional midwife or family member and women who are not married may have less access to those services through community networks. More people in the household increases the chances of accessing antenatal care, perhaps because there are more people to mitigate childcare and housework, leaving more time to allocate to healthcare. By this logic, one would expect the number of children ever born and the number of children under five, which increase childcare time, to have negative impacts on utilization, particularly for antenatal care, which requires multiple visits. The results are consistent with this hypothesis; the estimated

coefficients of both variables are significantly negative for antenatal care and professional delivery use at the one percent level. The number of children ever born also decreases postnatal care usage. Experience could also explain these results, especially the effect on professional delivery, which is less likely to be affected by time allocation. Women with more children might feel more comfortable with the process of pregnancy and birth, and thus, less likely to seek services.

Various environmental-level impacts were also important. The supply of medical providers had a large positive impact on all three services. More providers in a given area suggests shorter transportation and wait times, both of which decrease the shadow price of health services, increasing utilization. However, the supply of medical providers variable is at the departmental level. Each department contains a range of urban and rural settings and rural women are likely farther from the given medical providers and may face issues such as less public transportation and worse road conditions (Trujillo *et al* 2013). Additionally, wait times for medical appointments are consistently and substantially longer in rural areas. For example, urban women waited an average of eight days for a gynecology visit, while rural women waited approximately 16.3 days according to a 2016 report (World Bank Group 2019). Therefore, the estimated coefficient on the variable indicating rural residence is likely to be negative even when including medical service supply. Indeed, the results presented here show that rural women are significantly less likely to access all three services.

The number of years spent in the current residence slightly increased the chance of attending prenatal care, but had no significant impact on the other services. Women who have spent longer in their community may be more familiar with health systems and available services or feel more comfortable with their doctors, and thus, are inclined to attend visits earlier in

pregnancy and more regularly. Alternatively, women who have recently moved might not have the connections to access prenatal care or could face hurdles entering a new health system. Finally, the regional impact was highly significant to the use of prenatal and postnatal care services. Women from all regions outside Bogotá, and all except Atlántico, were more likely to access prenatal care and postnatal care, respectively, than their counterparts in the capital. In contrast, none of the regional variables were significant in predicting the use of professional assistance at delivery. This finding contrasts with conclusions by Trujillo *et al* (2013) and Vecino-Ortiz (2008), who found that women from the Pacific region were less likely to access professional delivery and prenatal care, respectively and no other regions were significant. A possible explanation for this discrepancy is that neither of their models control for conflict, which could have biased the regional coefficients down. More generally, the positive effects could be a result of wait times, which are more likely to impact prenatal and postnatal care. Bogotá has some of the longest wait times in the country, averaging three days for general medicine. Wait times are likely to impact antenatal and postnatal visits but not hospital delivery. However, although Bogotá has some of the longest wait times, other departments, especially in the central region, do as well. So, this explanation is unlikely to account for the full difference.

Two variables which yield interesting results are wealth and ethnicity. Wealth was found to be significantly related with service utilization in numerous other studies (Guliani *et al* 2013, Jewell 2009), including those based in Colombia (De La Torre *et al* 2018, Trujillo *et al* 2013). One would expect the women from wealthier households would demand more health and be better positioned to access and pay for services. However, the results of this study indicate that the impact of wealth depends specifically on the service in question. Women from lower wealth quintiles are not significantly less or more likely to be assisted by a professional at delivery than

their counterparts in the richest wealth quintile, the reference category. However, women in the poorest quintile are much less likely to access antenatal care and postnatal care. Women in the poorer and middle quintile are also less likely to access postnatal care compared to the richest women, with consistently larger impacts at lower quintiles. A possible explanation for the variability between services is that antenatal and postnatal visits are more affected by costs of transportation and carry higher opportunity costs in the form of foregone wages. In contrast, delivery happens biologically, regardless of time allocation, and thus the opportunity cost might not factor into the choice between professional and non-professional assistance. Additionally, *Resolución 412 de 2000,* public health guidelines signed in 2000, mandated that prenatal care be covered by insurance—from the Subsidized or Contributory Regimens—or by local governments for uninsured women. Prenatal visits were exempted completely from copays that same year, under *Resolución 3384 de 2000* (Vecino-Ortiz 2008). Without a direct price of services, household wealth likely has a lower impact on demand.

The results also show that women who identified themselves as Indigenous were significantly less likely to access each service. Specifically, Indigenous women were 7.6 percent, 6.1 percent, and 4.8 percent less likely to attend antenatal care, be assisted by a professional at birth, and receive postnatal care, respectively, than women who were categorized as white, mestizo or unidentified with a minority group. Additionally, though there was no significant effect on antenatal care, Afro-Colombian women had a lower chance of accessing professional delivery and postnatal care than their white or unidentified counterparts. The strength of these results is in direct contrast with Trujillo *et al* (2013), who found that ethnicity was insignificant in predicting antenatal care and facility-based delivery in Colombia, and Bernal and Cardenas (2005), who concluded that ethnicity is not a significant predictor of health outcomes in

Colombia after controlling for socioeconomic discrepancies. However, there is qualitative evidence that supports these results. Theoretically, such discrepancies could be due to cultural impacts on preferences. Traditional midwives are an important part of many Afro-Colombian and Indigenous communities and thus women may be more likely to turn to them than to medicalized providers (Martínez 2010, Mignone and Vargas 2015). The percentage of births attended by a skilled health professional was around ten to fifteen percentage points lower for Indigenous women than non-Indigenous women in Mexico and Peru in 2012 (United Nations 2015). The effects of historic trauma to Indigenous communities at the hands of the conquistadors and modern development have persisted in attitudes towards health systems today (Montenegro and Stephens 2006). Additionally, Indigenous and Afro-Colombian populations have lower rates of insurance coverage, a variable not included in this model (Bernal and Cardenas 2005). If the impact of insurance is significant and positive, as it is in other studies, it could overpredict the negative estimated coefficients of ethnicity variables (Jewell 2009, Vecino-Ortiz 2008).

Finally, the primary variable of interest is conflict. The estimated coefficient is negative and significant at the one percent level for both antenatal and postnatal care. These results indicate that women living in areas with more intense, persistent conflict are less likely to utilize those maternal health services, holding all included individual, household, and environmental characteristics constant. These findings are consistent with the hypothesis that violence is likely to increase the price of services, including time allocation and opportunity costs (Price and Bohara 2013). Furthermore, infrastructure destruction could impede access by reducing the number of health centers and increasing transportation times. Additionally, the threat of violence would make women wary of leaving the house to seek preventative care (Østby *et al* 2018).

However, the impact of conflict on professional delivery is insignificant, indicating that it is not statistically significantly different from zero. This result could mean that there is no relationship between professional delivery and conflict, or that there are competing effects. While some violence would increase transportation times and risk to personal safety for accessing professional delivery in the same way as antenatal and postnatal services, other effects could be much smaller. Infrastructure damage could more intensely affect small medical providers, who are more likely to do prenatal and postnatal care, than large hospitals, which handle professional deliveries. Longer wait times would not have an effect on delivery time, which is biological. These two reasons might suggest that there is no significant relationship between professional delivery and conflict. However, Ostby *et al* (2018) found that women in Sub-Saharan Africa who had experienced violence were significantly less likely to have professional assistance at delivery, which suggests competing effects could be the cause of the insignificant result in this study. Professional assistance differs from the other two services in that it happens at the moment of delivery, when awareness of complications is highest. Though many deaths occur after delivery, birth is arguably the most intense moment. Violence increases the perception of harm, increasing risk aversion and potentially spurring the use of professional assistance. Conflict might also decrease overall health, raising the importance and impact of maternal health services (McKay 1998). Additionally, if a woman does not attend sufficient preventative services due to conflict, such a prenatal care, they might be more inclined to choose professional delivery. Prolonged exposure to stress, as would happen during conflict such as this, has direct, biological impacts on health by increasing production of Corticotropin Releasing Hormone (CRH). This can trigger preterm delivery and other birth complications which require medical intervention (Camacho 2008). Lastly, the result could be caused by insufficient variation

in the measure, as over 89 percent of the sample was attended by a professional at delivery. In contrast, only approximately 50 percent of births were professionally assisted in the sample examined by Østby *et al* (2018)

Interaction terms with ethnicity and with wealth, two factors often linked to the Colombian conflict in other literature (ex. Rivillas *et al* 2018), were considered, but did not yield significant results. However, a rural and conflict interaction term increased the significance of the conflict variable, while the interaction term itself was insignificant. The inclusion of an interaction term meant that the coefficient on conflict referred only to its effect in the urban sample, indicating that conflict was significant in urban areas, but not in rural locations. The rural variable remained significant which indicated that its impact was separate from that of conflict. To further analyze these results, the sample was divided into urban and rural subsamples, discussed in the next section.

V. b. Analysis of Urban/Rural Divisions

The Colombian conflict is known to have affected urban and rural areas in very different ways. Much of the military occupation was of rural areas and the FARC and ELN controlled large swaths of rural territory (Franco *et al* 2006). Additionally, homicide rates indicate that violence was higher in rural areas for nearly all of the 50-year conflict, and that it followed slightly different patterns in the two settings. In rural areas, homicide rates spiked in the years 1997-2002, in conjunction with a rise in massacres, civilian deaths and combat between armed groups and government forces. Urban rates exceeded rural rates only in the early 1990s and again slightly after the year 2012 (Vallejo *et al* 2018). These facts suggest that conflict could have differing and complex effects in urban and rural contexts. Furthermore, a foundational

element of the conflict was urban-rural tension and disconnect stemming from both the geography of the country, as well as its political and economic history. Such divisions have persisted in the present day, which justifies splitting the sample to evaluate the differing effects of individual, household, and environmental characteristics and conflict, in particular.

The urban and rural subsamples were estimated separately for each service using probit equations with errors clustered at the household level. The samples included 11,250 urban women and 6,384 rural women. The significance of the chi-squared test for goodness of fit was equal to 0 when rounded to four decimal places for each model. The discussion in this section focuses on the effects of conflict and the estimated marginal effects of the conflict variable for each service are displayed in Table 3 below. Full results with estimated coefficients and standard errors are available in Tables D-F of the Appendix.

Table 3: Impact of Conflict on Service Use *** p<0.01, ** p<0.05, * p<0.1 **Variables**	**Urban** Marginal Effects	**Rural** Marginal Effects
Conflict on Antenatal Care	-0.0051***	-0.0039
Conflict on Professional Delivery	0.0012	0.0056
Conflict on Postnatal Care	-0.0084***	-0.0077
Observations	11,325	6,421

The empirical results of Table 3 indicate clearly distinct dynamics of conflict between rural and urban places. Despite more intense and more consistent conflict levels in rural areas, the estimated effect is insignificant for all three services. This result indicates that women in high conflict rural areas are not significantly more or less likely to utilize antenatal care, professional

assistance at delivery, or postnatal care than women in low conflict rural areas. While this result is somewhat unexpected, it is consistent with the findings of Østby *et al* (2018) in their study of conflict and maternal health in Sub-Saharan Africa. Unfortunately, though they report being surprised by the finding, they do not include an interpretation of the result. However, there are multiple possible explanations for this finding in the context of this study and Colombia.

Because rural residence is significant at the one percent level and negative in the combined equation, rural women are clearly less likely to access maternal health services. Thus, the findings indicate the level of conflict does not matter for rural women; all rural women are uniformly disadvantaged across conflict levels. One potential explanation is that conflict levels might be more uniform across rural areas. A cross tabulation of conflict and rural indicates that the majority, approximately 70 percent, of rural observations are in municipalities with conflict level four. The standard deviation of conflict level is also slightly lower in rural areas then in urban ones, further supporting this hypothesis. Additionally, rural municipalities are generally larger, which could mean women are not physically close to every occurrence of violence within the municipality, diminishing the effect of such events on the perceived risk of accessing services. Østby *et al* (2018) did find that physical proximity to events of conflict was significant and negative in predicting the use of professional assistance at delivery.

Conflict was negative and significant at the one percent level for both antenatal and postnatal care in urban settings. Women in urban areas with persistent, high intensity conflict are less likely to access antenatal and postnatal care than their counterparts in areas with no conflict. Though urban women are not traveling as far to health centers as rural women, damage to public transportation and road quality could still impede access to services. Additionally, the perceived

risk of traveling outside the home or through crowded areas would likely prevent seeking preventative care.

The question of why conflict has a more significant impact in urban areas is complex. The categorization of urban and rural within the DHS is related to the immediate surroundings of the household rather than to broad, regional classifications. Thus, women in urban settings in rural regions, such as municipal seats, would be classified as urban. The DHS survey structure did not allow for more specification on the level of urban residence or delineation between large cities and towns. Military presence and events of violence could likely be greater in the center of small cities than in truly rural areas. In fact, violence in small cities actually increased in the years leading up to the survey period (Franco *et al* 2006). Additionally, the nature of violence also shifted; terror events increased in the period of the early 2000s through approximately 2005, when they began to decline (LaRosa and Mejía 2017). The births from the sample occurred between the years 2005 and 2010, and women very likely could still have been influenced by the lingering fear of terror tactics, which likely would have targeted urban areas and small cities more than sparsely populated areas categorized at rural by the DHS.

The explanation of the empirical result that the impact of conflict on professional delivery is insignificant for both urban and rural women, is similar to the discussion in the previous section. Increased use due to risk aversion and lower health stock going into delivery could counter the negative effects of infrastructure destruction and violent threat. Damage to infrastructure which impacts transportation and time allocation is expected to have less impact on professional delivery, which only requires one visit, the time of which is determined biologically. Lastly, because birth is necessary, both rural and urban contexts women are likely

to have made arrangements for their birth, with professional or nonprofessional assistance, and follow through regardless of conflict level.

V. c. Determinants of Complications

The secondary results of this study estimate the chance of experiencing potentially life-threatening complications during or after birth using a Two-Stage Residual Inclusion model (Terza *et al* 2007). The estimated values of service use from the demand equations, explained in section V.a. and displayed in Table 2, are used in the first stage. The estimated value for each service is subtracted from the observed value to obtain residuals, which are then included in the second stage of the model alongside the observed service utilization values. This effectively separates the error term of the service variables from the error term of the model, removing the endogeneity concern.

The results presented below in Table 4, are from the model including both antenatal care and professional assistance at delivery. Models including each one individually were also estimated and are quite similar, indicating that the results are robust to these specification changes. A Wald test for joint significance of the three identifiers, having heard of family planning on the radio, in the newspaper, or on tv in the last 12 months, yielded test statistics of 60.59 and 71.88, in the models for prenatal care and professional delivery, respectively. These statistics reject the null hypothesis that the coefficients of the identifiers are jointly zero in each model. The significance of the chi-squared test for goodness of fit was equal to 0 when rounded to four decimal places. As with previous models, the results are presented as marginal effects to facilitate interpretation. Full results of estimated coefficients and standard errors are presented in Table G of the Appendix.

Table 4: Determinates of Complications *** p<0.01, ** p<0.05, * p<0.1	
Variables	**Marginal Effects**
Maternal Health Services	
Basic Prenatal Care	0.6079***
Residual Basic Prenatal Care	-0.4501***
Professional Delivery	0.0501
Residual Professional Delivery	-0.0001
Conflict	0.0015
Wantedness of Pregnancy	
Wanted Later	0.0482***
Not Wanted	0.0835***
Healthcare Decisions	
Individual Decides	-0.0394***
Other and Individual Decide	-0.0396***
Age	-0.0264***
Age-Squared	0.0003***
Ethnicity	
Indigenous	0.1125***
Other	-0.0623*
Afro-Colombian	-0.0015
Employed	0.0129**
Marital Status	
Never Married	0.0641***
Living Together	0.0033
Formerly Married	0.0363
Not Living Together	0.0263**
Education	-0.0086***
Partner's Education	-0.0024***
Number of Household Members	0.0077***
Children Five and Under	-0.0218*
Children Ever Born	0.0089*

Wealth Quintiles	
Poorest	0.1275***
Poorer	0.0757***
Middle	0.0687***
Richer	0.0617***
Years in Residence	-0.0002**
Rural	0.0112
Region	
Atlantic	0.0225
East	0.0117
Central	0.0376**
Pacific	0.01159
Territories	0.0089
Observations	17,747

The discussion of the results begins with a short summary of the individual-, household- and environmental-level characteristics, followed by deeper analysis of the estimated marginal effects of prenatal care, professional assistance at delivery, and conflict.

Each significant coefficient can be interpreted as having an effect on experiencing complications, holding antenatal care and professional assistance use constant. Thus, rather than impacting demand for health services through price and preference, these results represent the efficiency or ability to produce health *given healthcare utilization*. The output, complications, is analogous to maternal health in Equation 2 of the theoretical framework (Section IV. a).

With this in mind, one would expect that certain variables, notably those impacting price and time allocation, would not impact complications when holding service use constant. Indeed, the results indicate that the number of children five and under in the household and the total number of children ever born are both only significant at the 10 percent level in the second stage. Rural was also insignificant, indicating that this variable primarily affects access to service rather than efficiency in producing health.

Other individual and household level variables impact maternal health directly, and thus their impacts are evident in the second stage of the model when holding service use constant. Both never married and not living together, are significant and negative in the second stage model. Women who have no partner or are not living with their partner may have less support at home to facilitate health production. The empirical results show that both are significant and positive, indicating increased risk of complications. The individual's and their partner's years of education are statistically significant at the one percent level, which is consistent with the hypothesis that people with higher education levels are more efficient at producing health (Wagstaff 1986). Having complete or shared control over health decisions reduces the risk of complications. This is an interesting finding because it implies that, holding service use constant, women with more decision-making power are better able to produce good health outcomes, likely through lifestyle factors such as food and living conditions. The estimated coefficients on variables age and age-squared reflect the U-shaped relationship in which very old and very young mothers are biologically at higher risk of complications (Guliani *et al* 2013, WHO 2015).

Interestingly, several variables related directly to the pregnancy and health services are significant in the model for complications. Both wishing to delay the pregnancy and not wanting it at all are significant at the one percent level and positive. Women who do not want the pregnancy might have lower desire for maternal health and thus input fewer other health inputs including primary care and healthy lifestyles. They also might not realize they are pregnant at first, which would decrease resource allocation to producing maternal health (Wolfe 2006). Additionally, it could reflect an unmet need for family planning, which implies a lack of sufficient healthcare prior to pregnancy. Finally, women might have wished to delay their pregnancy due to preexisting health conditions which, in turn, could cause complications.

The impacts of Afro-Colombian and non-white other are both insignificant, indicating that, after controlling for service usage, ethnicity does not have an impact on the experience of complications. However, the estimated marginal effect indicates that Indigenous women are over 11 percent more likely to experience complications, at a one percent significance level. There are several possible explanations for this. First, the quality of services available in Indigenous communities could be lower (Bernal and Cardenas 2005). Indigenous women might also struggle to navigate the health system or to advocate for themselves due to language or cultural barriers or even face discrimination and disrespect (Montenegro and Stephens 2006).

Women in every wealth quintile are significantly more likely to experience complications during or after delivery than those in the richest quintile, with the largest effect for those in the lowest quintile. This result indicates that, even when women do have access to health services, poorer women are at a higher risk. Poorer women likely have lower stocks of health going into delivery due to limited access to quality food and substandard living conditions. Chronic stress also has detrimental effects on health and increases consistently at lower socioeconomic levels (Marmot 2006). They could also be less likely to attend primary care visits or to seek medical treatment for chronic diseases or other ailments due to cost. Finally, the healthcare they do access could be of lower quality due to underfunding of public hospitals (Prada and Chaves 2018).

Finally, the variables of interest, conflict, antenatal care, and professional delivery, yielded highly interesting results. The estimated coefficient of conflict was insignificant in predicting complications. This result is unsurprising given that conflict primarily disrupts the provision of healthcare and may not have a physical or direct impact on health, especially when

controlling for service utilization.[3] The direct impacts of conflict on health discussed in previous literature on the subject (for example: McKay1998, Camacho 2008, Bernal and Cardenas 2005), such as restricting access to food and increasing stress levels, could be absorbed by other variables in the model. For example, the impact on food access is likely to be absorbed by the wealth variables, as this factor most seriously affects poorer women (McKay 1998). A more specific measure of conflict that perhaps captures different types and events of violence or is more geographically specific might be more illustrative and indicates that further analysis is needed.

The estimated marginal effects of antenatal care and professional delivery are both positive in predicting complications, though only the effect of antenatal care was significant. This result suggests prenatal care use *increases* the risk of complication, a conclusion that is not only illogical, but directly contrary to theory and medical evidence (United Nations 2015). However, many studies have found weak or no impact of prenatal care on infant health outcomes such as low birthweight, though this is often attributed to inadequate prenatal care resulting from too few visits or a late first visit (Reichman *et al* 2010). The prenatal care variable defined in this study mandates four visits, attended by a professional with the first visit within the first trimester. However, the definition was unable to control for the actual quality of the visit which, if low, could have as weak an influence on maternal health as inadequate care. Prenatal care might also be better at screening for and noticing potential complications than preventing them, especially if the quality of care is low. This could cause the estimated coefficient to be positive in predicting complications, as women who had attended prenatal care would both be more aware of smaller

[3] A model of complications without controlling for service use was also tested. The estimated effect of conflict remained insignificant, indicating that it is robust to specification changes and that there is no significant relationship between conflict and the chance of experiencing complications during or after delivery. The estimated effects of many other determinates remained the same, including the effect of wealth, ethnicity, and education.

complications and more likely to report all complications on the survey. Perhaps the most compelling explanation however, is that women with underlying conditions, the source of most complications, are more likely to seek prenatal care. Women who have underlying conditions that put them at risk of complications often detect them in the first visit and are thus much more likely to return throughout the pregnancy, increasing their chances of attending four visits and being coded as having received care. Conversely, women with no concerns may not see the merit of attending the first or further visits. Unfortunately the survey did not allow for the control of underlying conditions such as heart problems or diabetes. Including such variables would be an interesting consideration for future studies and would likely decrease the positive impact of prenatal care on complications.

In a similar way, the coefficient on professional delivery is likely be positive, though insignificant, because women who begin to experience a complication during labor may rush to the hospital. Thus, a complication would necessitate the use of emergency care even if they intended to not to use professional assistance. Furthermore, the use of emergency obstetric services could result in a form of sample selection bias. Only women who had survived childbirth could be interviewed in the survey. Because the majority of women who die in childbirth could have been saved by health services, women in this sample who faced life-threatening complications but survived, likely received emergency obstetric care in the form of professional assistance at delivery (WHO 2015). Given that the estimated coefficient is insignificant, there could be a countering, negative impact on complications, which would indicat that professional delivery does have preventative power. Alternatively, as explained previously, it could be caused by insufficient variation in the measure, given that 89 percent of the sample was assisted by a professional at delivery.

VI. Discussion and Conclusions

To the best of my knowledge, this is the first study that uses multivariate analysis to examine how conflict influences the use of maternal health services, specifically prenatal care, professional assistance at delivery, and postnatal care, in Colombia. I used data from the 2010 Demographic and Health Survey, the Conflict Analysis Resource Center and the Colombian Ministry of Health to construct a sample of 17,747 births that had occurred in the years 2005-2010. Given robust estimation results, I conclude that conflict has a significant, negative impact on utilization of both prenatal and postnatal care, and is not significant in predicting professional delivery use. Splitting the sample into urban and rural subsamples reveals that these effects are primarily concentrated in the urban sample, where conflict is significant and negative for both prenatal and postnatal care utilization. A secondary estimation of the experience of complications during and after delivery indicates that conflict has no significant effect. The estimated coefficients on various individual, household and environmental characteristics demonstrate influences on both service demand and the risk of complications, indicating that policy to increase service use and improve maternal health must be consider socioeconomic and cultural effects. By examining such factors in a conflict setting while controlling for and focusing on the role of conflict, this study adds to a growing and interdisciplinary body of literature focused on improving health in conflict settings.

The conclusions of this study reinforce the importance of variables such as education and age, which were of primary importance in previous studies in Colombia and around the world (for example: Vecino-Ortiz 2008, Guliani *et al* 2013, Muchabaiwa 2012). Both variables were significant and positive in predicting healthcare usage across the three services in the general equation and in the urban-rural subsamples, indicating a broad impact. The estimated coefficients

of marital status, number of children, and wantedness of the pregnancy were all significant predictors of service use in this study, as they had been in many other studies (for example: Vecino-Ortiz 2008, Trujillo *et al* 2013, Guliani *et al* 2013, Muchabaiwa 2012).

In particular, this study raises interesting points when compared with two previous studies from Colombia, by Vecino-Ortiz (2008) and Trujillo *et al* (2013), on the determinants of prenatal care and professional delivery, respectively. All three studies found similar results for the variables discussed in the previous paragraph. However, this study concludes that rural women are less likely to access all three services and that the models for urban and rural subsamples are notably different for each service. Trujillo *et al* (2013) also found a negative relationship between rural and prenatal care and professional delivery use. Both studies stand in contradiction to Vecino-Ortiz (2008) who found the variable to be insignificant. Trujillo *et al* (2013) used data from the 2010 DHS, as does this study, while Vecino-Ortiz (2008) used the 2005 DHS. This discrepancy could indicate that rural-urban disparities widened in the intervening five years. This would be an interesting finding considering that the conflict, which primarily impacted rural areas, declined in those years. Neither study considered the impact of conflict, which, given the results of this study, would have a greater impact on urban observations, possibly explaining the insignificant result in Vecino-Ortiz (2008).

Another important deviation from previous studies is the impact of household wealth. Studies based internationally (Guliani *et al* 2013, Muchabaiwa 2012) and those based in Colombia (De La Torre *et al* 2018, Vecino-Ortiz 2008) conclude there are pronounced pro-rich inequalities in outcomes and that household wealth is very important in determining utilization of various services. My results indicate that the impact of wealth is specific to the service in question. Only the poorest quintile is significantly less likely to access antenatal care and no

wealth levels are significant in predicting professional assistance at delivery. The poorest three quintiles are all less likely to access postnatal care than their counterparts in the richest quintile, with the largest impacts at lower quintiles. In the second stage of the model, women from all wealth quintiles are more likely than those from the richest quintile to experience complications, and women from the lowest quintile face a much larger risk than those in the second, third, and fourth quintiles. These results indicate, firstly, that the impact of wealth is highly specific to the service or outcome variable in question. Secondly, Colombia's efforts at universal health insurance appear to have been successful at reducing economic inequality in access, at least for prenatal care and professional delivery. However, the persistent wealth inequalities that remain in outcomes demonstrate that inequality does not disappear with universal health insurance. Poorer women are likely still at higher risk, likely because of factors external to service utilization, such as living conditions, or due to the quality of care they receive. In both cases, further study is necessary to understand how policy can address wealth related inequality in a more comprehensive manner.

Additionally, the findings of this study indicate that Indigenous women are less likely to utilize all three services and more likely to experience complications. The estimated coefficient is consistently negative and significant across the urban-rural subsample estimations as well. This finding contradicts that of Trujillo *et al* (2013) who found ethnicity to be insignificant in determining both antenatal care and facility-based delivery in Colombia. More research is clearly needed in this area, especially as other sources highlight the influence of ethnicity on health related inequality and the particular impact the conflict has had on Colombia's ethnic minorities (Rivillas *et al* 2018, Svallfors and Billingsley 2019, PAHO 2017).

Most importantly, despite similarities or differences with previous papers, the unique contribution of this study is that it includes a conflict variable. No previous study based in Colombia concerning the determinants of maternal health service use at the individual level controlled for such a variable (Vecino-Ortiz 2008, Trujillo *et al* 2013). Results show conflict is significantly negative in predicting both prenatal and postnatal care. These findings suggest that women in high conflict areas throughout the country, are less likely to access antenatal and postnatal services. However, when divided into urban and rural subsamples, conflict was found to be a significant predictor of access only in the urban sample. This is an interesting finding considering that the majority of the conflict in Colombia took place in rural areas, but the majority of Colombians live in urban areas (Vallejo *et al* 2006, Franco *et al* 2018, PAHO 2017). Though much of the literature on the Colombian conflict focuses on rural dynamics, the conclusion is consistent with that of Østby *et al* (2018), indicating that more attention should be paid to the impacts on urban women in future studies and in policy creation. Future studies should consider the effect of a more complex conflict variable, especially one that is more geographically specific with relation to urban and rural divisions, to further analyze the distinction. Additionally, the predominant type of violence, which varied across areas of the country, could have differing effects and magnitudes of impact on service use and health outcomes. For example, terror tactics generate far more stress than some other forms of violence (Camacho 2008). A metric that considers the specific nature of conflict or a study that compares effects across forms of violence could potentially discern important nuances.

This study has several limitations. Firstly, the structure of the DHS did not allow for the inclusion of an insurance variable or a direct price of services and, theoretically, price is an important determinant of demand. However, as of 2014, healthcare was quasi-universal;

approximately 96.6 percent of Colombians were insured under the Contributory or Subsidized programs (PAHO 2017). Additionally, as of 2000, uninsured women must be seen for prenatal care visits in public hospitals and their costs are covered completely by local governments. Therefore, the impact of price could be low as most women are not struggling to pay the direct price of the service (Vecino-Ortiz 2008). Secondly, the positive estimated coefficients on antenatal care and professional delivery in the model of complications are directly contrary to medical literature. It is highly unlikely that accessing antenatal care increases the risk of complications, so there is certainly a third, unobserved variable that is biasing those estimates. Including a variable on pre-existing conditions such as diabetes or hypertension likely would have mitigated this problem.

Finally, there is a question of potential sample selection bias because only women who have had births in the five years preceding the survey are included, and those who died in childbirth were excluded. However, this is unlikely to be a significant problem because the subsample used is representative of the full DHS sample containing the birth history of all women interviewed. Important characteristics such as wealth, ethnicity, and region remained very similarly distributed in the two samples. Women who had births in the five years preceding the survey had slightly higher levels of education than women in the full sample of birth history, approximately 8.1 and 6.9, respectively. However, this discrepancy is likely due to differences in age, which the model controls for, as younger women are more likely to have had a birth and education levels for women are increasing in Colombia (Radinger *et al* 2018). The percentages of the sample that identified as Afro-Colombian or Indigenous both increased by around one percentage point in the subsample, a trend that may reflect slightly higher birth rates in minority communities (DANE 2006). Most importantly, the distribution of conflict levels was nearly

identical in the full sample and subsample. The evident similarities between women who have had births in the previous five years and those in the full sample makes a compelling argument against a significant influence of sample-selection bias in this study.

The results of this study, including the effect of conflict and individual and environmental factors, demonstrate how deeply maternal health is tied to socioeconomic, political, and cultural factors. The study design emphasizes that such factors impact maternal health, both through the demand for services and directly, outside of service use. The results present a multifaceted analysis of the dynamics of maternal health, and reveal multiple policy targets. First, even when wealth has been removed as a barrier to access, poorer women may still face higher risk of complications. Furthermore, the significant impacts of variables such as education and ethnicity, indicate that other factors remain as barriers to access. Particular attention should be paid to increasing access and outcomes for Indigenous women. Initiatives such as non-profit, minority-run insurance collectives could provide key examples of potential solutions to improve access and outcomes for ethnic minorities (Mignone and Vargas 2015, Prada and Chaves 2018). Media could be a powerful mechanism to increase access, especially for vulnerable and hard to reach populations. The significant, positive effects of media on service utilization demonstrate that mass media has potential to influence preference for maternal health and disseminate critical information to facilitate access to health services. Finally, the rural and urban division of the sample reveals important dynamics that are masked when the samples are combined. Despite lower overall rates of service use in rural areas, the level of conflict is a significant determinant of both antenatal and postnatal care use only in urban settings. More attention must be paid to the unique effect of conflict on urban women, while simultaneously reducing barriers for rural women, who are significantly less likely to access maternal health services.

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VII. Appendix

VII. a. Variable Definitions

Table A

Variable	Definition/Question	Coding
Complications	Respondent experienced prolonged labor, excessive bleeding, fever with vaginal discharge, convulsions or "other" during labor; Respondent experienced excessive bleeding, loss of consciousness or fever postpartum	1: experience of any complication; 0: no complication
Prenatal Care	Sufficient prenatal care, defined as four or more visits, the first one in the first trimester, attended by a trained doctor or nurse/midwife	1: meets all three requirements; 0: insufficient or no prenatal care
Professional Assistance	Delivery attended by a trained doctor or nurse/midwife	1: yes; 0: no
Postnatal Care	After delivery, someone checked on respondent's health	1: yes; 0: no
Wanted Then *Wanted Later* *Not Wanted*	Time wanted pregnancy at the time of pregnancy	1: yes; 0: no for each variable
Individual *Individual and Other* *Partner or Other*	Who makes decisions about the respondent's healthcare?	1: yes; 0: no for each variable
On the Radio *On Television* *In the Newspaper*	In the last 12 months, did the respondent hear of family planning in the media?	1: yes; 0: no for each variable
Age	Respondent's age at time of survey	Years, 13 to 49
Employed	Respondent currently working at the time of survey	1: yes; 0: no
Education	Respondent's completed years of education at the time of survey	Years, 0 to 23

Partner's Education	Partner's completed years of education at the time of survey	Years, 0 to 23
Currently Married *Formerly Married* *Never Married* *Living with Partner* *Not Living with Partner*	What is the respondent's marital status at the time of survey?	1: yes; 0: no for each variable "formerly married" includes both divorced and widowed
Number of Household Members	How many people are currently living in the household?	
Children Five and Under	How many children ages five and under are currently living in the household?	
Children Ever Born	Respondent's total number of live births	
Afro-Colombian *Indigenous* *Other* *White*	Respondent is or identifies as a member of an ethnic group according to their culture, community or physical features	1: yes; 0: no for each variable "other" includes Gitiano, Panelquero de San Basilio and Raizal del Archipeílago
Poorest *Poorer* *Middle* *Richer* *Richest*	Household wealth quintile based on principal component analysis of assets including consumer goods and characteristics of home	1: yes; 0: no for each quintile
Rural	Respondent lives in a rural area	1: rural; 0: urban
Years in Current Residence	For how many years has respondent lived in their current residence?	Years, 0 to 95 (indicating always)
Conflict	What is the conflict level in the respondents municipality between 2000 and 2012? Presence of Armed Groups: Constant Interrupted: Year period(s) without armed groups Finalized: Last 8 years or more without armed groups	1: Without conflict 2: Below average intensity, finalized presence of armed groups 4: Below average intensity, interrupted presence

	None Intensity: Below or Above the National Average	5: interrupted presence and above average intensity 6: persistent presence and below average intensity 7: persistent presence and intense violence
Supply of Medical Providers	Number of medical providers per 1,000 residents in respondent's department	
Bogotá *Atlantic* *Pacific* *East* *Central* *National Territories*	In what region of Colombia does the respondent live?	1: yes; 0: no for each region

VII. b. Descriptive Statistics

Table B: Descriptive Statistics, total observations for each variable: 17,747.				
Variable	Mean	Std. Dev.	Minimum	Maximum
Complication	0.3939257	0.4886325	0	1
Health Services				
Prenatal care	0.5652786	0.4957344	0	1
Professional delivery	0.8931087	0.3089837	0	1
Postnatal care	0.6637742	0.4724305	0	1
Pregnancy Characteristics				
Wanted the pregnancy:				
Then	0.4614864	0.4985285		
Later	0.2789204	0.4484809	0	1
Not at all	0.2595932	0.4384238	0	1
Decisions on women's healthcare by:				
Individual only	0.7490844	0.4335523	0	1
Individual and husband or other	0.114949	0.3189694	0	1
Husband or someone else	0.1359666	0.3427628	0	1
Family planning on radio	0.5399786	0.4984132	0	1
Family planning on television	0.7126838	0.4525231	0	1
Family planning in newspaper	0.4008565	0.4900858	0	1
Individual & Household Charactaristics				
Age	27.44943	6.882977	13	49
Employed	0.4547811	0.4979651	0	1
Education	8.105821	4.062992	0	23
Partner's education	9.520708	5.608851	0	19
Marital Status:				
Currently married	0.1718037	0.3772204	0	1
Formerly married	0.0095791	0.0974056	0	1
Never married	0.0953401	0.2936923		
Living with partner	0.5819012	0.4932605		
Not living with partner	0.141376	0.3484188		
Number of household members	5.584888	2.427802	1	21
Number of children 5 and under	1.57559	0.8209936	0	7

Number of children ever born	2.730561	1.802453	1	15
Race:				
Afro-Colombian	0.1146109	0.3185608	0	1
White	0.7266017	0.4457161	0	1
Indigenous	0.1498845	0.3569682	0	1
Nonwhite other	0.0089029	0.0939369	0	1
Wealth:				
Poorest	0.3700344	0.4828272	0	1
Poorer	0.2633121	0.4404427	0	1
Middle	0.1844255	0.3878418	0	1
Richer	0.1144419	0.3183562	0	1
Richest	0.0677861	0.2513856	0	1
Environmental Charactaristics				
Rural	0.361864	0.4805533	0	1
Years lived in current residence	47.08621	43.83774	0	95
Conflict	4.740914	1.647389	1	7
Supply of medical providers	1.018016	0.4579088	0.1857	1.967
Region:				
Bogotá	0.05415	0.2263198	0	1
Atlantico	0.2367161	0.4250785	0	1
Oriental	0.1521384	0.3591651	0	1
Central	0.2038654	0.4028815	0	1
Pacific	0.1355722	0.3423434	0	1
Terrirorios Nacionales	0.2175579	0.4125967	0	1

VII. c. Full Results for Healthcare Demand

Table C, below, displays the estimated coefficients and standard errors for prenatal care, professional assistance at deliver and postnatal care utilization.

Table C: Service Demand	**(1) Prenatal Care**	**(2) Professional Delivery**	**(3) Postnatal Care**
Conflict	-0.0155***	0.0218	-0.0298***
	(0.00418)	(0.0132)	(0.00638)
Wantedness of Pregnancy			
Wanted Later	-0.0890***	-0.0531	-0.0162
	(0.0227)	(0.0451)	(0.0288)
Not Wanted	0.00427	-0.0713**	-0.0902***
	(0.0281)	(0.0341)	(0.0296)
Healthcare Decisions			
Individual	0.0539**	0.131***	0.0421
	(0.0258)	(0.0432)	(0.0402)
Other and Individual	0.0296	0.0834	0.0456
	(0.0339)	(0.0680)	(0.0486)
Age	0.0419***	0.0260***	0.0208***
	(0.00268)	(0.00399)	(0.00235)
Ethnicity	-0.241***	-0.497***	-0.156***
Indigenous			
	(0.0327)	(0.0490)	(0.0318)
Other	-0.230*	0.0539	0.501***
	(0.135)	(0.360)	(0.151)
Afro-Colombian	-0.0509	-0.293***	-0.181***
	(0.0410)	(0.0405)	(0.0378)
Employed	0.0323	-0.183***	0.0333
	(0.0268)	(0.0437)	(0.0269)
Marital Status			
Never Married	-0.312***	0.215**	-0.0508
	(0.0538)	(0.0973)	(0.0563)
Living Together	-0.0576**	-0.00489	-0.0982***
	(0.0266)	(0.0689)	(0.0298)
Formerly Married	-0.0512	-0.0794	-0.122
	(0.126)	(0.214)	(0.110)
Not Living Together	-0.107***	-0.00468	-0.132***
	(0.0307)	(0.0667)	(0.0377)
Education	0.0220***	0.0632***	0.0378***
	(0.00345)	(0.00683)	(0.00335)

Partner's Education	0.00563***	0.0224***	0.00907***
	(0.00186)	(0.00456)	(0.00320)
Number of Household Members	0.0412***	0.0109	-0.0111
	(0.00642)	(0.00790)	(0.00812)
Children Five and Under	-0.426***	-0.120***	0.00714
	(0.0171)	(0.0233)	(0.0218)
Children Ever Born	-0.206***	-0.124***	-0.0527***
	(0.0144)	(0.0134)	(0.0105)
Wealth Quintile			
Poorest	-0.215***	0.0157	-0.456***
	(0.0733)	(0.154)	(0.0586)
Poorer	-0.0537	0.219	-0.312***
	(0.0568)	(0.151)	(0.0580)
Middle	-0.0313	0.267	-0.270***
	(0.0577)	(0.165)	(0.0526)
Richer	-0.0303	0.209	-0.0769
	(0.0487)	(0.174)	(0.0745)
Years in Current Residence	0.00106***	-0.000529*	7.45e-05
	(0.000204)	(0.000279)	(0.000187)
Rural	-0.0886***	-0.423***	-0.0648**
	(0.0224)	(0.0437)	(0.0289)
Supply of Medical Providers	0.161***	0.515***	0.574***
	(0.0256)	(0.0530)	(0.0280)
Region			
Atlantic	0.228***	0.339*	0.0322
	(0.0505)	(0.198)	(0.0628)
East	0.166***	0.0568	0.152***
	(0.0522)	(0.217)	(0.0581)
Central	0.236***	-0.107	0.338***
	(0.0524)	(0.218)	(0.0592)
Pacific	0.264***	-0.210	0.251***
	(0.0683)	(0.203)	(0.0654)
Territories	0.126**	-0.0610	0.287***
	(0.0490)	(0.215)	(0.0682)
Heard of Family Planning			
On the Radio	0.0317	0.0487	0.151***
	(0.0261)	(0.0466)	(0.0290)
On Television	0.117***	0.151***	0.125***
	(0.0225)	(0.0405)	(0.0276)
In the Newspaper	0.0601**	0.0819*	0.0840***
	(0.0262)	(0.0480)	(0.0238)

Constant	-0.450*** (0.119)	0.105 (0.275)	-0.689*** (0.110)
Observations	17,747	17,747	17,747

VII. d. Full Results for Urban/Rural Subsamples

Each service, antenatal care, professional delivery and postnatal care, was estimated individually with a split sample to compare urban-rural differences. In addition to the discussion of the particular impact of conflict given in section (V. c.), the full results including estimated coefficients and standard errors are presented below in Tables D-F.

Table D: Prenatal Care **Variables**	**(1)** **Urban**	**(2)** **Rural**
Conflict	-0.0165***	-0.0119
	(0.00603)	(-0.0119)
Wantedness of Pregnancy		
Wanted Later	-0.0909***	-0.0804*
	(0.0259)	(0.0421)
Not Wanted	-0.00791	0.0294
	(0.0329)	(0.0450)
Healthcare Decisions		
Individual	0.0550*	0.0358
	(0.0331)	(0.0422)
Individual and Other	-0.0136	0.0581
	(0.0538)	(0.0384)
Age	0.0443***	0.0381***
	(0.00366)	(0.00293)
Ethnicity		
Indigenous	-0.273***	-0.200***
	(0.0535)	(0.0405)
Other	0.0219	-0.617***
	(0.169)	(0.190)
Afro-Colombian	-0.0156	-0.0915**
	(0.0492)	(0.0446)
Employed	0.0661**	-0.0104
	(0.0302)	(0.0332)
Marital Status		
Never Married	-0.355***	-0.235***
	(0.0696)	(0.0750)
Living Together	-0.0940**	-0.00241
	(0.0418)	(0.0554)
Formerly Married	-0.126	0.0970

	(0.161)	(0.141)
Not Living Together	-0.144***	-0.0464
	(0.0425)	(0.0640)
Education	0.0165***	0.0269***
	(0.00423)	(0.00660)
Partner's Education	0.00780***	0.00277
	(0.00256)	(0.00358)
Number of Household Members	0.0391***	0.0399***
	(0.00600)	(0.0114)
Children Five and Under	-0.455***	-0.375***
	(0.0173)	(0.0299)
Children Ever Born	-0.224***	-0.183***
	(0.0187)	(0.0140)
Wealth Quintile		
Poorest	-0.174**	-0.421**
	(0.0845)	(0.209)
Poorer	-0.0699	-0.204
	(0.0672)	(0.231)
Middle	-0.0240	-
	(0.0628)	
Richer	-0.0168	-
	(0.0504)	
Years in Residence	0.00134***	0.000757**
	(0.000324)	(0.000379)
Supply of Medical Providers	0.0192	0.370***
	(0.0462)	(0.0437)
Region		
Atlantic	0.0507	0.188***
	(0.0602)	(0.0492)
East	0.0236	0.0346
	(0.0666)	(0.0493)
Central	0.148**	0.0266
	(0.0629)	(0.0617)
Pacific	0.209***	0.0501
	(0.0697)	(0.0849)
Territories	-0.00413	-
	(0.0755)	
Heard of Family Planning		
On the Radio	0.0428	0.0214
	(0.0303)	(0.0320)
On Television	0.0802**	0.160***
	(0.0338)	(0.0360)
In the Newspaper	0.0725**	0.0365

	(0.0297)	(0.0553)
Constant	-0.0959 (0.189)	-0.490** (0.228)
Observations	11,325	6,421

Table E: Professional Delivery VARIABLES	(1) Urban	(2) Rural
Conflict	0.0200	0.0248
	(0.0205)	(0.0155)
Wantedness of Pregnancy		
Wanted Later	0.0300	-0.105
	(0.0592)	(0.0675)
Not Wanted	-0.0275	-0.101*
	(0.0570)	(0.0562)
Healthcare Decisions		
Individual	0.218***	0.0747
	(0.0787)	(0.0669)
Individual and Other	0.251**	0.00431
	(0.116)	(0.0924)
Age	0.0224***	0.0275***
	(0.00689)	(0.00504)
Ethnicity		
Indigenous	-0.406***	-0.502***
	(0.0712)	(0.0538)
Other	-	-0.169
		(0.398)
Afro-Colombian	-0.385***	-0.210***
	(0.0683)	(0.0605)
Employed	-0.0467	-0.235***
	(0.0600)	(0.0490)
Marital Status		
Never Married	0.179	0.228**
	(0.167)	(0.109)
Living Together	0.111	-0.0553
	(0.114)	(0.0642)
Formerly Married	-0.0312	-0.126
	(0.202)	(0.315)
Not Living Together	0.0475	-0.0251
	(0.111)	(0.0822)
Education	0.0545***	0.0681***
	(0.00817)	(0.00899)
Partner's Education	0.0220***	0.0215***
	(0.00630)	(0.00575)
Number of Household Members	-0.000865	0.0148*
	(0.0152)	(0.00789)
Children Five and Under	-0.0317	-0.170***

	(0.0338)	(0.0348)
Children Ever Born	-0.135***	-0.118***
	(0.0193)	(0.0156)
Wealth Quintile		
Poorest	-0.00411	-0.354***
	(0.165)	(0.0803)
Poorer	0.0699	-
	(0.163)	
Middle	0.217	-
	(0.170)	
Richer	0.188	-
	(0.179)	
Years in Residence	0.00145**	-0.00140***
	(0.000583)	(0.000325)
Supply of Medical Providers	0.403***	0.581***
	(0.0963)	(0.0733)
Region		
Atlantic	0.248	0.393***
	(0.209)	(0.0642)
East	0.0113	0.0399
	(0.224)	(0.0801)
Central	-0.0858	-0.168*
	(0.211)	(0.0952)
Pacific	-0.188	-0.258***
	(0.212)	(0.0946)
Territories	-0.234	-
	(0.226)	
Heard of Family Planning		
On the Radio	0.00175	0.0804
	(0.0801)	(0.0592)
On Television	0.104	0.162***
	(0.0717)	(0.0463)
In the Newspaper	0.00209	0.141**
	(0.0756)	(0.0596)
Constant	0.207	0.0781
	(0.344)	(0.221)
Observations	11,250	6,384

Table F: Postnatal Care VARIABLES	(1) Urban	(2) Rural
Conflict	-0.0296***	-0.0225
	(0.00899)	(0.0152)
Wantedness of Pregnancy		
Wanted Later	-0.0457	0.0304
	(0.0360)	(0.0337)
Not wanted	-0.125***	-0.0411
	(0.0391)	(0.0497)
Healthcare Decisions		
Individual	0.0258	0.0565
	(0.0548)	(0.0512)
Individual and Other	0.0881	-0.0119
	(0.0668)	(0.0700)
Age	0.0159***	0.0279***
	(0.00306)	(0.00352)
Ethnicity		
Indigenous	-0.241***	-0.0579
	(0.0516)	(0.0410)
Other	0.551***	0.382*
	(0.203)	(0.219)
Afro-Colombian	-0.141***	-0.231***
	(0.0441)	(0.0662)
Employed	0.0503	0.0238
	(0.0331)	(0.0452)
Marital Status		
Never Married	-0.108	0.0606
	(0.0789)	(0.0895)
Living Together	-0.129***	-0.0513
	(0.0492)	(0.0372)
Formerly Married	-0.153	-0.0811
	(0.114)	(0.179)
Not Living Together	-0.143***	-0.129**
	(0.0468)	(0.0586)
Education	0.0403***	0.0331***
	(0.00512)	(0.00524)
Partner's Education	0.0110***	0.00530
	(0.00302)	(0.00477)
Number of Household Members	-0.0224**	0.00113
	(0.00987)	(0.0110)
Children Five and Under	0.00807	0.0114

	(0.0281)	(0.0292)
Children Ever Born	-0.0236*	-0.0848***
	(0.0143)	(0.0155)
Wealth Quintile		
Poorest	-0.517***	-0.0292
	(0.0835)	(0.256)
Poorer	-0.361***	0.0923
	(0.0657)	(0.239)
Middle	-0.288***	-
	(0.0545)	
Richer	-0.0794	-
	(0.0755)	
Years in Current Residence	0.000538**	-0.000649
	(0.000246)	(0.000418)
Supply of Medical Providers	0.437***	0.778***
	(0.0522)	(0.0491)
Region		
Atlantic	-0.0756	-0.229***
	(0.0744)	(0.0539)
East	0.00864	-0.0661
	(0.0786)	(0.0722)
Central	0.265***	0.0117
	(0.0781)	(0.0578)
Pacific	0.104	0.0658
	(0.0778)	(0.0600)
Territories	0.218***	-
	(0.0830)	
Heard of Family Planning		
On the Radio	0.164***	0.124***
	(0.0355)	(0.0426)
On Televisions	0.0864*	0.159***
	(0.0445)	(0.0524)
In the Newspaper	0.0722**	0.108**
	(0.0341)	(0.0431)
Constant	-0.282	-1.294***
	(0.185)	(0.234)
Observations	11,325	6,421

VII. e. Full Results for Complications

Table G, below, includes the estimated coefficients and standard errors for the second stage of the model, estimating complications.

Table G: Complications Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1	
Variables	**Complications**
Maternal Health Services	
Basic Prenatal Care	1.681***
	(0.211)
Resididual Basic Prenatal Care	-1.245***
	(0.213)
Professional Delivery	0.139
	(0.0949)
Residual Professional Delivery	-0.000312
	(0.106)
Conflict	0.0041
	(.00629)
Wantedness of Pregnancy	
Wanted Later	0.133***
	(0.0209)
Not Wanted	0.231***
	(0.0314)
Healthcare Decisions	
Individual Decides	-0.109***
	(0.0270)
Other and Individual Decide	-0.109***
	(0.0411)
Age	-0.0731***
	(0.00933)
Age-Squared	0.000799***
	(0.000137)
Ethnicity	
Indigenous	0.311***
	(0.0357)
Other	-0.172*
	(0.0980)
Afro-Colombian	-0.00423
	(0.0334)

Employed	0.0358**
	(0.0182)
Marital Status	
Never Married	0.177***
	(0.0444)
Living Together	0.00909
	(0.0243)
Formerly Married	0.1002
	(0.0907)
Not Living Together	0.0728**
	(0.0340)
Education	-0.0238***
	(0.00339)
Partner's Education	-0.00676***
	(0.00224)
Number of Household Members	0.0212***
	(0.00483)
Children Five and Under	-0.0602*
	(0.0356)
Children Ever Born	0.0246*
	(0.0137)
Wealth Quintiles	
Poorest	0.353***
	(0.0624)
Poorer	0.209***
	(0.0437)
Middle	0.190***
	(0.0405)
Richer	0.171***
	(0.0524)
Years in Residence	-0.00054**
	(0.000216)
Rural	0.0311
	(0.0326)
Region	
Atlantic	0.06213
	(0.0502)
East	0.03235
	(0.0507)
Central	0.1040**
	(0.0469)
Pacific	0.03205
	(0.0559)

Territories	0.02457 (0.0486)
Constant	-0.223 (0.183)
Observations	17,747