FAMILY PLANNING AND MATERNAL HEALTH:
The Effects of Family Planning on Maternal Health in the Democratic Republic of Congo

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by
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ABSTRACT

This study investigates the effect of family planning on maternal health in the Democratic Republic of Congo, using data from the 2007 Demographic and Health Survey to understand the relationship between family planning knowledge, use of modern contraceptives, maternal health, and maternal mortality in a developing country. The results find that the use of modern family planning methods reduces the probability of death related to maternal causes and increases the likelihood of women experiencing positive maternal health levels. The results illustrate a relationship between wanted pregnancies and both increased likelihood of positive maternal health and reduced probability of maternal death. The results also highlight the importance of a number of indeterminate factors of maternal health and maternal mortality, including educational attainment, age, number of children per women, access to health care facilities, and access to safe drinking water supplies. Based on these results, family planning programs have the potential to reduce maternal mortality and improve maternal health by empowering women to control fertility choices and expanding access to health care facilities. The Democratic Republic of Congo could benefit from improved family planning programs as well as broader development in the areas of health care and education. International policy decisions should reflect the important role of family planning as a component of international economic and social development while continuing to promote overall educational attainment and health care improvements including access to health facilities, quality of care, and supply of safe drinking water.
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CHAPTER I.

INTRODUCTION

Maternal mortality is one of the leading causes of death in the world. The United Nations Children’s Fund (UNICEF) refers to maternal mortality as “in scale and severity the most neglected tragedy of our time” (DCAF, 2005). This tragedy disproportionately affects developing countries, with 99 percent of maternal mortalities occurring in economically underdeveloped nations (Hogan et al., 2010). The most dreadful aspect of this global phenomenon is its avoidable nature. Family planning is one recognized way to mitigate the risks associated with maternal mortality through reducing overall fertility in regions with an “unmet need” for modern family planning programs and lack of access to modern contraceptive commodities. Preventative health care procedures, technical expertise and medical solutions exist, and for the most part are simple, but a dearth of political support and financial contributions continues to hinder progress toward reducing maternal mortality worldwide.

Recent reports highlight decreases in maternal mortality rates since the 1990s; however, this is not a universal reduction (Hogan et al., 2010). Particularly in Africa and southern Asia, maternal mortality rates remain extremely high (United Nations, 2010). The United Nations Development Fund for Women (UNIFEM) estimates that over half a million women still die each year from preventable complications and childbirth (UNIFEM, 2008).

Specifically, the Democratic Republic of Congo (hereafter referred to as “the DRC” or “the Congo”) remains one of the worst countries in the world in which to be a pregnant woman. The Congolese population, consisting of approximately 70 million people, experiences a total fertility rate of 6.3 (the average number of children to be born to a woman in her lifetime). The region has one of the highest maternal mortality ratios in the world, with recent estimates ranging from 500 to 700 maternal deaths per 100,000 live births, compared to rates in developed countries falling under 20 deaths per 100,000 live births (USAID, 2010; World Bank, 2010). This ratio remains
substantially high due to rapid increases in population growth during a period of severe, on-going internal conflict and violence (UNDP, 2007).

Access to appropriate family planning resources could potentially reduce the high incidence of maternal death. The “unmet need” for contraceptive services remains high throughout countries with staggering maternal mortality ratios. UNIFEM recently argued, “one in three maternal deaths related to pregnancy and childbirth could be avoided if women who wanted effective contraception had access to it” (UNIFEM, 2008). Estimates from the UNFPA’s current country program for the DRC demonstrate a low contraceptive usage rate of approximately 13 percent despite high knowledge levels – approximately 96.3 percent – of modern contraceptive practices (UNFPA, 2008). Therefore, family planning education, accessible health care services, and the supply of contraceptive commodities remain critical aspects for reducing maternal mortality in the developing regions, such as the DRC.

This study seeks to explore the relationship between knowledge and use of modern family planning practices, maternal health, and maternal mortality. A specific focus on knowledge of and use of contraceptives in the DRC will fill a gap in the current literature on maternal mortality and family planning in a developing country where maternal mortality remains a severe problem

**BACKGROUND**

Research analysis since the 1980s has acknowledged a link between family planning and prevention of maternal mortality (Trussell & Pebley, 1984; Winikoff & Sullivan, 1987; Keonig et al., 1988; Maine, 1991). The Safe Motherhood Initiative in 1987 first highlighted the need for modern policy intervention to reduce maternal mortality (WHO, 2007). Since the launch of this initiative at the first international conference dedicated solely to the health of women, global attention has increased regarding methods to prevent and reduce the incidence of maternal mortality (Maine, 1991). A global commitment to reducing maternal mortality was reaffirmed by the 1994
International Conference on Population and Development (ICPD) and Programme of Action, which institutionalized universal reproductive health rights for women (United Nations, 1994).

Modern global policy further emphasized the severity of maternal mortality with the adoption of the Millennium Development Goals (MDGs) in 2000. The MDGs include eight international development goals with specific targets that all United Nations’ member states are committed to achieving by 2015. MDG #5 focuses on the improvement of maternal health with targets specifying a three-fourths reduction in maternal mortality ratios from 1990 levels and achievement of universal access to reproductive health services by 2015 (United Nations, 2010). In addition, the Obama administration’s 2010 Global Health Initiative (GHI) put forth an action plan to prevent 54 million unintended pregnancies by increasing the modern contraceptive usage rate of targeted developing countries to 35 percent. The GHI incorporates improving the health of women through specific programs for infectious diseases, nutrition, maternal health, and safe water (U.S. State Department, 2010).

In spite of these international commitments, progress continues to be minimal (Women Deliver, 2010). Global populations lack appropriate tools and necessary funding to tackle the persistent challenges causing maternal mortality. Current research shows an unmet need for safe and effective family planning practices and contraceptive access – the desired fertility rate falls lower than the actual fertility rate (Prata, 2007; Singh et al., 2009). For example, one in four women of reproductive age in Sub-Saharan Africa express a desire to use contraceptives in order to limit or space births, but remain unable to access necessary products and services (United Nations, 2010). According to 2007 Demographic and Health Survey (DHS) data, women in the DRC express a high unmet need for family planning, with approximately 24 percent of married women of reproductive age desiring to limit or time the spacing of childbirth but only 6.7 percent utilizing modern contraceptives (USAID, 2010).
Recent research conducted by UNFPA and the Guttmacher Institute indicates that significant commitments to reducing maternal mortality could achieve the 2015 Millennium Development Goal #5 targets, and thus increase development benefits for the poorest and most marginalized populations around the world (Singh et al., 2009). In the DRC, the current unmet need for family planning contributes to a high total fertility rate and persistently high maternal mortality ratios. Fulfilling the need for family planning programs and contraceptive commodities has been acknowledged by international development agents as a cost-effective method to directly reduce maternal mortality (Cincotta & Haddock, 2006; Prata 2007; Singh, et al., 2009; USAID, 2010). Ultimately, developing countries, such as the Congo, face higher financial and social costs due to repercussions of high maternal and childbirth risks, including maternal and infant mortality, long-term disabilities and high-risk pregnancy care (Koenig et al., 1988; Singh et al., 2009).
LITERATURE REVIEW

Concepts and Causes

In order to assess the impacts of family planning on maternal mortality it is important to clearly define relevant concepts. Maternal mortality is defined in the 2008 Lancet report, Maternal Survival, as the “death of a woman during pregnancy, childbirth, or in the 42 days after delivery” (Campbell et al., 2006). This definition is widely accepted and often used in conjunction with maternal morbidity—the loss of years of a woman’s life to pregnancy or childbirth-related disability (UNFPA, 2004; McCarthy & Maine, 1992).

It is important to distinguish between maternal mortality ratio and maternal mortality rate, as it is critical to discussing the effects of family planning on reproductive health. It is widely accepted that “maternal mortality ratio” relates the number of maternity-associated deaths to the number of live births, with “live birth” being a proxy for pregnancy (Winikoff & Sullivan, 1987; Fortney, 1987). In contrast, “maternal mortality rate” relates the number of maternity-associated deaths to the number of women of reproductive age, ages 20-49 (Trussell & Pebley, 1984; Fortney, 1987). The United Nations’ Millennium Development Goals target a significant reduction in the maternal mortality rate by 2015, clearly defining this concept as:

“The maternal mortality ratio (MMR) is the annual number of female deaths from any cause related to or aggravated by pregnancy or its management (excluding accidental or incidental causes) during pregnancy and childbirth or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, for a specified year (expressed per 100,000 live births).” (United Nations, 2008).

Family planning is more difficult to define as it often exists in a variety of methods. The 1994 International Conference on Population and Development (ICPD) Programme of Action defines the aim of family planning as, “to enable couples and individuals to decide freely and responsibly the number and spacing of their children and to have the information and means to do so and to ensure informed choices and make available a full range of safe and effective methods” (United Nations, 1994). Research accepts family planning services to include: information and
counseling about modern contraceptive methods, provision of these methods, and access to alternatives to illegal abortions (Trussell & Pebley, 1984; Koenig et al., 1988; Singh et al., 2009). In some cases, direct health benefits are included as provisions of family planning, such as screening and testing for sexually transmitted infections (including HIV), cervical cancer, and breast cancer (Singh et al., 2009).

Widespread research identifies both direct and indirect medical causes of maternal mortality, sometimes referred to as “the long road to death” (McCarthy & Maine, 1992). The most common direct causes of maternal death are hemorrhage (excessive bleeding), hypertension, infection, and obstructed labor. Unsafe abortions are another major cause of maternal death, with the Guttmacher Institute reporting over 20 million unsafe abortions performed in 2008 contributing to high maternal mortality rates (Singh et al., 2009). The indirect causes of maternal death include malaria, HIV/AIDS, anemia, malnutrition, and heart disease. The majority of deaths caused by direct and indirect factors are avoidable (United Nations, 2010).

Research studies further classify distant and intermediate determinants of maternal mortality (Maine, 1991; McCarthy & Maine, 1992). A major intermediate factor is access to reproductive health services. Access depends on availability of service, knowledge of service, financial accessibility, quality of care, or physical location (Maine, 1991; Prata, 2007; McCarthy & Maine, 1992). Additional intermediate determinants include (1) reproductive behavior, such as age, number of pregnancies per woman, spacing between births, and “wantedness” of pregnancy; (2) health status, such as incidence of disease and age factors; and (3) unknown or unpredictable factors, for instance birth complications for women at low risk (Maine, 1991; McCarthy & Maine, 1992). Distant determinants consist of factors related to a woman’s socioeconomic, family household, and community status (Maine, 1991; McCarthy & Maine, 1992).
Research Conclusions

Quantitative research illustrates the importance of a region's status in the “demographic transition” for determining the impact of family planning services (Fortney, 1987; Cincotta & Haddock, 2008). A demographic transition refers to the development of a society from one composed of large families with short life spans to one composed of small families with longer life spans. If countries remain in the first phase of the demographic transition, parents may desire large families, creating a high total fertility rate, and potentially diminishing the impact of family planning programs in the region on maternal mortality (Cincotta & Haddock, 2006). Correspondingly, increased prevalence of contraceptives is unlikely to significantly affect fertility, and therefore maternal mortality, if fertility rates are already low (Fortney, 1987). However, if fertility and maternal mortality (especially due to unsafe abortions) are high, there likely exists a substantial unmet need for contraceptive services. As a result, family planning services and commodities can have high potential to avert deaths related to pregnancy (Fortney, 1987).

In the case of sub-Saharan Africa, the region remains in the initial stages of the demographic transition. As articulated by the Economic Commission for Africa, a regional body within the United Nations, “In the absence of a significant decline of fertility, Africa is the last region of the world to have embarked on the demographic transition” (Economic Commission for Africa, 2002). Within the demographic transition, the DRC exhibits this regional trend with the persistence of high fertility levels and low life expectancy (USAID, 2010; World Bank, 2008).

Evidence is conclusive that family planning – including increased availability of contraceptives and access to reproductive health services – contributes to an overall decline in fertility, through a reduction in overall pregnancies. Therefore, family planning is capable of paying a demographic dividend to societies by reducing maternal mortality (Prata, 2007; Phillips et al., 1982; Fortney, 1987; Winikoff & Sullivan, 1987; Shiffman, 2000; Koenig et al., 1988). Deborah Maine (1991), using Chilean data from 1964 to 1985, a period directly following a presidential
decree for public contraceptive provisions through the National Health Service, illustrated a direct positive correlation between contraceptive use and reduced birth rates.

However, evidence diverges on whether family planning alone can reduce the maternal mortality ratio, or only lower the maternal mortality rate. Some research links family planning to direct reductions in maternal mortality risks (Rosenfield & Maine, 1985; Koenig et al., 1988; Maine 1991). Access to reproductive health information and contraceptives can increase the capacity to prevent high-risk pregnancies, and therefore maternal mortality by reducing the total fertility rate (Prata, 2007; Cincotta & Haddock, 2006). In Maine’s (1991) Chilean study, a direct positive correlation was illustrated between use of contraceptives and maternal deaths due to abortions. Additional research presented increased contraceptive availability as directly correlated with increased access to family planning programs (Prata, 2007). By reducing the number of overall pregnancies and unwanted pregnancies, family planning may reduce the incidence of unsafe abortions, a leading cause of maternal death (Prata, 2007; Chowdhury et al., 2007).

An extensive study by James Trussell and Anne Pebley suggested, in concurrence with Ndola Prata’s conclusions in *The Need for Family Planning*, that maternal mortality can be lowered because family planning decreases the number of deaths per birth and decreases the number of overall births (Trussell & Pebley 1984; Prata, 2007). Trussell & Pebley (1984) maintained that, although family planning does not necessarily affect reproductive behavior, increased contraceptive use is capable of lowering the maternal mortality ratio. This is possible by (1) reducing the proportion of births occurring to the youngest and oldest women, (2) reducing the proportion of births at high parity (greater than or equal to 6 births per one woman), and (3) lengthening the intervals between births. (Trussell & Pebley, 1984).

The bulk of research evidence over the past 30 years identifies another conclusion. While family planning can alter reproductive health patterns in a way that reduces the number of total pregnancies, including unwanted pregnancies, and total fertility rates, it does not cause a
substantial reduction in the risks associated with pregnancy (Winikoff & Sullivan, 1987; Fortney, 1987; Koenig et al., 1988; Maine 1991; Hale et al., 2006). Therefore, family planning is unlikely to change maternal mortality ratios, except in reducing the proportion of pregnancies to high-risk women, and more likely to reduce maternal mortality rates (Fortney, 1987).

The Matlab Study

The prominent research program used for analytical studies of fertility rates occurred in Matlab, Bangladesh over a 30-year period, during 1976 – 2005 (Chowdhury et al., 2007). Data were simultaneously collected from both a treatment group, receiving services from the International Center for Diarrheal Disease Research, Bangladesh (ICDDR, B) and a control group, receiving standard government services. In 1978, contraceptive access was introduced in the treatment region, followed over the next twenty years by socioeconomic improvements, such as investment in midwives, emergency obstetric care, safe abortion services and female education. During this period, maternal mortality fell by 68 percent in the treatment group and 54 percent in the control group (Chowdhury et al., 2007). Results illustrated that over time family planning reduced fertility rates, but the incidence of maternal mortality remained highest for the poorest households, the least educated women, the youngest pregnant women, the oldest pregnant women, first time pregnancies, and high parity pregnancies (Chowdhury et al., 2007).

Further research conducted using Matlab data supports the theory that contraceptive services can have a demographic impact by changing fertility because a latent demand exists for efficient birth planning methods (Phillips et al., 1982). A study on Matlab maternal mortality in 1988 by Michael C. Koenig et al. determined a moderate but significant reduction in maternal mortality rates in the treatment area, relative to the control area, due primarily to a reduction in overall pregnancies. The major source of the impact of fertility is through increased contraceptive usage and subsequent fertility decline (Koenig et al., 1988).
**High-Risk Births**
Research concludes family planning most efficiently reduces maternal mortality when targeted at previously identified high-risk groups (young mothers, older mothers, first time mothers, and mothers with high birth rates). Targeted family planning programs are increasingly effective when combined with total fertility reduction and access to abortion services (Winikoff & Sullivan, 1987; Prata, 2007; Koenig et al., 1988).

Some research emphasizes the greatest impact of family planning is changing the profile of pregnant women (Chen et al., 1983; Winikoff & Sullivan, 1987). Beverly Winikoff and Maureen Sullivan (1987) concluded that family planning is capable of changing the age structure of fertility. They noted that the age structure of the population, age at marriage, and age-specific fertility rates will determine the impact of reproductive health programs (Winikoff & Sullivan, 1987).

Pregnant women under the age of 20 and over the age of 39 are also at greater risk (Koenig et al., 1988). Likelihood of maternal mortality increases for these age groups, with young pregnant women facing risks associated with first-time births and older pregnant women facing risks associated with high parity births. Family planning can reduce maternal mortality by targeting the proportion of pregnant women at both ends of the age spectrum (Koenig et al., 1988; FHI Research Center, 1995).

**The Need for A Twofold Approach**
Two of the four most powerful drivers of maternal mortality, cited by *The Lancet* in 2010, include (1) total fertility rates and (2) skilled medical attendance during childbirth (Hogan et al., 2010). *Adding It Up*, a joint report issued in 2009 by the Guttmacher Institute and UNFPA, presents sophisticated research modeling the impact of simultaneously investing in family planning services and maternal and child health. Taken separately, these two areas of investment yield positive results, but concurrent investment produces a 70 percent decrease in maternal deaths – falling from the current average of 550,000 deaths per year to 160,000 deaths per year (Singh et al., 2009).
While it is important to note the shortcomings of an exclusively family planning-based approach, research highlights the difficulty of improved health services in many of the worst regions suffering maternal mortality. Judith A. Fortney (1987) asserts good obstetric care preceded modern contraceptives by 20 years in developed countries, but developing countries do not have the resources to make a similar transition. Institutionalization of adequate obstetric care is limited in many regions while implementation of family planning programs may be relatively easy, even in remote or rural areas (Fortney, 1987).

Based on the multitude of factors related to maternal mortality and health, this study will further analyze the relationship between family planning methods and maternal health and maternal mortality in the Congo, a region where limited research on this topic has been undertaken. By focusing on family planning knowledge and use of modern contraceptive practices, this study hopes to assess the potential influence international family planning programs may have on reducing maternal mortality in developing and conflict-ridden regions.
CHAPTER II.

DATA AND METHODOLOGY

Hypotheses

This study will test the following two hypotheses regarding access to information about modern family planning and use of modern family planning practices on maternal health in the Democratic Republic of Congo.

**Hypothesis 1:** Increased knowledge of family planning, which includes education of modern methods, contraceptive commodities and health service programs, is associated with an increase in maternal health OR a decrease in probability of maternal mortality.

**Hypothesis 2:** Increased usage of family planning, including community health service programs, modern methods or contraceptive commodities, is associated with an increase in maternal health OR a decrease in probability of maternal mortality.

A logit multi-linear regression model will be used for analyses involving maternal health as a dependent variable. Another multi-linear regression model will employ a maternal death probability variable constructed from sibling survey data for the probability of maternal death as the dependent variable. Both models will look at the effects of modern family planning knowledge and use of modern family planning practices in order to assess the impact of family planning programs and access for the DRC. Chart 1 illustrates the current low level of modern contraceptive use at 20.63 percent in 2007, while Chart 2 illustrates the high level, at 77.03 percent, of knowledge regarding modern family planning practices in the Congolese population.

**Chart 1:** 2007 Levels of Modern Contraceptive Use, Democratic Republic of Congo (DRC)

![Pie Chart: Modern Contraceptive Method Use Levels in DRC, 2007]

- **Currently Using:** 79.37%
- **Not Currently Using:**

*Source: DHS Data, DRC, 2007*
Data Source

All data for this study come from the 2007 Demographic and Health Survey (DHS) conducted by the U.S. Agency for International Development (USAID) and its local partners in the Democratic Republic of Congo. The DHS is an international survey conducted in 85 countries by the U.S. government, which has provided technical assistance to the international community since 1984. Specific to family planning, DHS surveys collect data on knowledge and use of contraceptive methods, including traditional and modern methods (DHS, 2010).

The DHS survey provides insight into a variety of factors for the DRC including social and health indicators. This subset of data utilized analyzes individual female respondents, and will be limited to women of reproductive age (15 – 49). The strength of the data involves its inclusion of indicators on the knowledge, practices and use of modern contraceptives for individual female respondents, as well as socioeconomic factors, in the Congo (Ministère du Plan et Macro International, 2008).

Based on these indicators, Chart 3 illustrates that knowledge of modern contraceptive methods in the DRC in 2007 was higher for woman who attained higher educational levels. For example, nearly all those individuals with higher education had knowledge of modern contraceptive methods compared to only about 50 percent for those individuals with no formal
education. Similarly, Chart 4 shows a positive relationship between use of modern contraceptive methods and increased level of educational attainment level, with a two-fold increase in reported modern contraceptive use for individuals with a primary school education when compared to individuals with a higher-level education.


![Contraceptive Knowledge by Education Level in DRC, 2007](chart3.png)

Chart 4: Women’s Use of Contraceptive Practices Compared to Educational Attainment in DRC, 2007

![Use of Modern Contraceptive Methods by Education Level, in DRC 2007](chart4.png)

**Dependent Variables**

The following models are based on various analyses of maternal mortality, specifically the work done by James McCarthy and Deborah Maine (1992) for the models employing maternal health, and the work done by Kenneth Hill (2001) for the models employing the probability of death due to maternal causes.
International estimates, such as the Maternal Mortality World report produced by the World Health Organization (2005), rely on the sisterhood method – an indirect measurement technique used to estimate multiple demographic variables including maternal mortality. However, limitations exist for this method (UN Statistics Division, 2010). The sisterhood method relies on interview responses about the survival of respondents’ adult sisters and any relationship between death and pregnancy per each sibling (Hill et al., 2001; WHO, 2005). Based on this methodology, incomplete information is almost certainly a factor, especially due to the method’s heavy reliance on recall of past-events (Bhat et al., 1995; Hill et al., 2001). Specifically, the WHO emphasizes the following weaknesses: (1) reduced sample size, (2) retrospective estimation, (3) ineffective measures where total fertility rates are low (<4), and (4) wide confidence intervals (WHO, 2005).

Furthermore, academic research indicates the weakness of this method for national maternal mortality ratios (Ministère du Plan et Macro International, 2008; Hogan et al., 2010). The sisterhood estimation produces more robust unbiased estimates of the probability of dying from maternal causes, if the risk of death is identical for all sisters, which is often not the case due to additional demographic factors (Ministère du Plan et Macro International, 2008). This weakens estimation of individual-level maternal mortality probability. The 2010 *Lancet* study, which provided the most recent maternal mortality country-level estimates, explicitly excluded data calculated with the sisterhood method (Hogan et al., 2010).

Due to these limitations in predicting maternal mortality ratios, it is prudent to use a model (Model 1), which employs a maternal health indicator variable as the dependent variable. This maternal health indicator variable is based on hemoglobin levels of female respondents tested during the survey conducted in the Democratic Republic of Congo (DHS, 2007). International research, including Demographic and Health Surveys, recognizes blood testing for hemoglobin measures as an analysis of anemia in women – a condition that can significantly contribute to maternal mortality (Brabin et al., 2001; van den Broek, 2003; DHS, 2010). DHS states that anemia in
women, especially in developing regions, “places them at risk for poor pregnancy outcomes including increased risk of maternal mortality, perinatal mortality, premature births and low birth weight” (DHS, 2010). A quantitative analysis by Bernard Brabin et al. (2001) concluded that a strong correlation exists between severe anemia and maternal mortality; however the effects of mild anemia in pregnant women remained inclusive.

Furthermore, USAID and the WHO recognize a relationship between high levels of anemia and increased maternal mortality, emphasizing that approximately 45 percent of pregnant women in developing regions are anemic (USAID, 2006). Thus, maternal health, using the normal range of hemoglobin levels of 10 – 30 for women of reproductive age, will be employed as the dependent variable in Model 1 (DHS, 2010; CDC, 2010). Table 1 illustrates the relationship between healthy and unhealthy hemoglobin levels and a selection of relevant socioeconomic factors related to maternal mortality. It can be seen that the majority of women in the DRC suffer from anemia according to these results.

<p>| Table 1: The distribution of females, 15-49 years by health status (anemic or not anemic), age, number of children, education, ever married, and location of residence levels. Democratic Republic of Congo (DRC), 2007 |
|----------------|----------------|----------------|----------------|</p>
<table>
<thead>
<tr>
<th>Category</th>
<th>Total</th>
<th>Healthy</th>
<th>Unhealthy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>9,995</td>
<td>2,217</td>
<td>7,778</td>
</tr>
<tr>
<td>15-19 yrs</td>
<td>2,163</td>
<td>25.8%</td>
<td>74.2%</td>
</tr>
<tr>
<td>20-29 yrs</td>
<td>3,748</td>
<td>19.0%</td>
<td>81.0%</td>
</tr>
<tr>
<td>30-39 yrs</td>
<td>2,329</td>
<td>21.5%</td>
<td>78.5%</td>
</tr>
<tr>
<td>40-49 yrs</td>
<td>1,755</td>
<td>25.4%</td>
<td>74.6%</td>
</tr>
<tr>
<td>Number of children</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>3,069</td>
<td>74.6%</td>
<td>25.4%</td>
</tr>
<tr>
<td>1-4</td>
<td>4,278</td>
<td>15.7%</td>
<td>84.3%</td>
</tr>
<tr>
<td>5-9</td>
<td>2,224</td>
<td>27.1%</td>
<td>72.9%</td>
</tr>
<tr>
<td>10+</td>
<td>424</td>
<td>62.0%</td>
<td>38.0%</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>1,669</td>
<td>18.1%</td>
<td>81.9%</td>
</tr>
<tr>
<td>Primary</td>
<td>3,646</td>
<td>28.0%</td>
<td>72.0%</td>
</tr>
<tr>
<td>Secondary</td>
<td>4,444</td>
<td>18.9%</td>
<td>81.1%</td>
</tr>
<tr>
<td>Higher</td>
<td>236</td>
<td>19.9%</td>
<td>80.1%</td>
</tr>
<tr>
<td>Ever Married</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>2,908</td>
<td>25.0%</td>
<td>75.0%</td>
</tr>
<tr>
<td>No</td>
<td>7,087</td>
<td>21.0%</td>
<td>79.0%</td>
</tr>
<tr>
<td>Residential Location</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>4,818</td>
<td>25.1%</td>
<td>74.9%</td>
</tr>
<tr>
<td>Urban</td>
<td>5,177</td>
<td>19.5%</td>
<td>80.5%</td>
</tr>
</tbody>
</table>

*Source: DHS Data, DRC, 2007*
Despite its weaknesses, analysis of the DHS respondent’s sibling data is potentially useful to develop an understanding of the direct effects of modern family planning on maternal mortality. This method, with its limitations, is employed by international organizations at the forefront of policy and programming on maternal health and mortality, including the WHO and UNFPA, as well as academic research in this field (World Health Organization et al., 2007). Thus, the probability of death for women of reproductive age due to maternal causes, using data collected on respondents’ sisters to formulate a probability indicator, is employed as the dependent variable used in the Model 2 (Hill, 200; WHO, 20070). (See Appendix A for methodology of Maternal Death variable).

**Approaches Used to Measure Maternal Health**

**Model 1:**

Maternal Health = Family Planning Knowledge & Family Planning Use

Level of Maternal Health on Modern Family Planning Knowledge to Not having
Knowledge of Modern Family Planning and Level of Maternal Health on using Modern
Family Planning to Not using Modern Family Planning.

\[ \text{MHealth} = \text{Family Planning Knowledge} + \text{Family Planning Use} + \text{Ever Married} + \text{Age} + \text{Education} + \text{Working} + \text{Rural} + \text{Number of Children} + \text{Wantedness of Pregnancy} + \text{Locality of Health Facility} + \text{Health of Individual} + \text{Age of First Sexual Experience} + \text{Access to Safe Water} + \epsilon \]

**Model 2:**

Probability of Maternal Death = Family Planning Knowledge & Family Planning Use

Level of Probability of Maternal Death on Modern Family Planning Knowledge to Not having Knowledge of Modern Family Planning and Level of Probability of Maternal Death on using Modern Family Planning to Not using Modern Family Planning

\[ \text{MDeath} = \text{FP Knowledge} + \text{FP Use} + \text{Ever Married} + \text{Age} + \text{Education} + \text{Working} + \text{Rural} + \text{Number of Children} + \text{Wantedness of Pregnancy} + \text{Locality of Health Facility} + \text{Health of Individual} + \text{Age of First Sexual Experience} + \text{Access to Safe Water} + \epsilon \]

Although knowledge of modern contraceptives in the Democratic Republic of Congo was high at approximately 77 percent in 2007, use of modern contraceptives was only approximately 20 percent (DHS, 2007). It is thus important to look at the effects of both of these variables on maternal mortality (USAID, 2010). Model 1 will analyze the association between knowledge of modern contraceptive practices, use of modern contraceptive practices, and maternal health while
Model 2 will analyze the association between knowledge of modern contraceptive practices, use of modern contraceptive practices and maternal mortality. Chart 5 shows that among respondents, the overwhelming majority of individuals using modern contraceptive methods employ male condoms.

*Chart 5: Modern Contraceptive Type Employed by Respondents Currently Using Modern Contraceptive Methods in DRC, 2007*

Furthermore, in order to garner an understanding of the implications of modern contraceptive use on maternal health and maternal death, the models include variables related to direct and indirect causes of maternal mortality, illustrated in Chart 6, as evidenced by previous research studies, and described in Exhibit 1 and Exhibit 2 (Maine, 1991; McCarthy, 1992; Ahmed & Mosley, 1997; Rush, 2000; Buor, 2004). (See Appendix B for a description of variables employed in both models).
Chart 6: Direct and Indirect Determinants of Maternal Mortality and Morbidity

Source: "A Framework for Analyzing the Determinants of Maternal Mortality" (McCarthy, 1992)
<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Definition</th>
<th>Predicted Relationship</th>
<th>Rationale for Usage</th>
</tr>
</thead>
</table>
| Y2 Maternal Health | Dependent Variable  
Maternal Health* – Indicator variable of mother’s hemoglobin level. 0= Inappropriate levels (<110 and >115); 1=Appropriate levels (≥110 or ≤115)* | n/a | Center for Disease Control, 2010; Rush, 2000.  
*Includes normal levels for Pregnant and Non-Pregnant Women. |
| X1 Family Planning Knowledge (fpknowledge) | Respondent had knowledge of modern contraceptive methods where 1 = Yes, 0 = No. | Positive | McCarthy, 1992 |
| X2 Family Planning Use (fpuise) | Respondent was using a modern contraceptive method where 1 = Yes, 0 = No. | Positive | McCarthy, 1992 |
| X3 Marriage (evermarried) | Marital Status of Respondent where 1 = Ever Married, 0 = Never Married. | Positive | McCarthy, 1992 |
| X4 Age (age) | Age of Respondent in Years, continuous. | Positive | Maine, 1991; McCarthy, 1992; Rush, 2000 |
| X5 Education Level (noeduc, primaryeduc, secondaryedu, highered) | Dummy Variables for Highest level of Education Attainment where Primary = at least Primary level, Secondary = at least Secondary level, Higher = Higher educational attainment. | Positive | McCarthy, 1992; Rush, 2000 |
| X6 Employment (working) | Occupation Status where 1 = Working, 0 = Not Working. | Positive | Buor, 2004; McCarthy, 1992; Rush, 2000 |
| X7 Residence (rural) | Residence Location where 1 = Rural, 0 = Urban. | Negative | McCarthy, 1992 |
| X8 Number of Children (bparity) | Number of Children of Respondent, continuous. | Negative | McCarthy, 1992 |
| X9 Antenatal visits (antevisits) | Antenatal Visit Status, number of visits during last pregnancy, continuous. | Positive | Buor, 2004; McCarthy, 1992; Rush, 2000 |
| X11 Locality of Health Facility (farhealthfacility) | Distance to Health Facility where 1=Far Distance to Health Facility, 0=Proximity to Health Facility. | Negative | Maine, 1991; McCarthy & Maine, 1992 |
| X13 Age of First Sexual Experience (firstsexage) | Age of Respondent in Years at First Sexual Experience. | Positive | Ahmed & Mosley, 1997 |
## Exhibit 2: Variables in Model 2, Definitions and Predicted Relationships

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Definition</th>
<th>Predicted Relationship</th>
<th>Rationale for Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y2</td>
<td>Maternal Death</td>
<td>Alternate Dependent Variable</td>
<td>n/a</td>
</tr>
<tr>
<td>X1</td>
<td>Family Planning Knowledge (fpknowledge)</td>
<td>Respondent had knowledge of modern contraceptive methods where 1 = Yes, 0 = No.</td>
<td>Negative</td>
</tr>
<tr>
<td>X2</td>
<td>Family Planning Use (fpuse)</td>
<td>Respondent was using a modern contraceptive method where 1 = Yes, 0 = No.</td>
<td>Negative</td>
</tr>
<tr>
<td>X3</td>
<td>Marriage (evermarried)</td>
<td>Marital Status of Respondent where 1 = Ever Married, 0 = Never Married.</td>
<td>Negative</td>
</tr>
<tr>
<td>X4</td>
<td>Age (age)</td>
<td>Age of Respondent in Years, continuous.</td>
<td>Positive</td>
</tr>
<tr>
<td>X5</td>
<td>Education Level (noeduc, primarieduc, secondaryeduc, highered)</td>
<td>Dummy Variables for Highest level of Education Attainment where Primary = at least Primary level, Secondary = at least Secondary level, Higher = Higher educational attainment.</td>
<td>Negative</td>
</tr>
<tr>
<td>X6</td>
<td>Employment (working)</td>
<td>Occupation Status where 1 = Working, 0 = Not Working.</td>
<td>Negative</td>
</tr>
<tr>
<td>X7</td>
<td>Residence (rural)</td>
<td>Residence Location where 1 = Rural, 0 = Urban.</td>
<td>Positive</td>
</tr>
<tr>
<td>X8</td>
<td>Number of Children (bparity)</td>
<td>Number of Children of Respondent, continuous.</td>
<td>Positive</td>
</tr>
<tr>
<td>X9</td>
<td>Antenatal visits (antevisits)</td>
<td>Antenatal Visit Status, number of visits during last pregnancy, continuous.</td>
<td>Negative</td>
</tr>
<tr>
<td>X11</td>
<td>Locality of Health Facility (farhealthfacility)</td>
<td>Distance to Health Facility where 1=Far Distance to Health Facility, 0=Proximity to Health Facility.</td>
<td>Positive</td>
</tr>
<tr>
<td>X13</td>
<td>Age of First Sexual Experience (firstsexage)</td>
<td>Age of Respondent in Years at First Sexual Experience.</td>
<td>Negative</td>
</tr>
</tbody>
</table>
CHAPTER III.

ANALYSIS

Baseline Characteristics of the Female Population, DRC

The discussion begins with the simple relationships between the surveyed female population and relative factors, including maternal health, probability of maternal death, birth parity, residence location, antenatal visits and wantedness of pregnancy.

It is important to note that the majority of the female population surveyed can be characterized as unhealthy, according to hemoglobin levels for anemia in women of reproductive age (CDC, 2010).

Total: 100.0 percent
   Healthy: 6.2 percent
   Unhealthy: 93.8 percent

It is also important to note the levels of probability of maternal death established in this analysis. Using the sisterhood method, the probability of maternal death was constructed based on the probability that the survey respondents’ sisters died due to pregnancy related causes. Table 2 illustrates the percent distribution of siblings who died and whose death was related to maternal causes, illustrating that over 25 percent of female siblings’ total deaths were related to maternal causes in the Democratic Republic of Congo in 2007.

Table 2: Percent Distribution of Sisters of Respondents, aged 15-49 years, who died due to maternal Causes in DRC, 2007

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100.0</td>
</tr>
<tr>
<td></td>
<td>(1,907)</td>
</tr>
<tr>
<td>Death related to</td>
<td>26.2</td>
</tr>
<tr>
<td>Maternal Causes</td>
<td>(499)</td>
</tr>
<tr>
<td>Death unrelated to</td>
<td>73.8</td>
</tr>
<tr>
<td>Maternal Causes</td>
<td>(1,408)</td>
</tr>
</tbody>
</table>

Regarding levels of modern family planning use, it can be seen that usage varies based on residence location. Table 3 illustrates that women residing in rural regions are more likely to not to
use modern contraceptives than women residing in urban areas, 64 percent versus 36 percent, respectively.

**Table 3**: Percent Distribution of Women, aged 15-49 years, using a modern family planning method by location of residence in DRC, 2007

<table>
<thead>
<tr>
<th>Location of Residence</th>
<th>Total</th>
<th>Currently Using</th>
<th>Not Currently Using</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td>100.0</td>
<td>22.5 (1,994)</td>
<td>77.5 (6,870)</td>
</tr>
<tr>
<td>Rural</td>
<td>60.1</td>
<td>45.7</td>
<td>64.2</td>
</tr>
<tr>
<td>Non-Rural</td>
<td>39.9</td>
<td>54.3</td>
<td>35.8</td>
</tr>
</tbody>
</table>

In addition, it is important to note that the Democratic Republic of Congo continues to experience extremely high fertility levels. The range of this measure for the data is 0 to 16 children per woman. The distribution is illustrated in Chart 7. Similarly, the range of antenatal visits for these data experience high levels of variation throughout the DRC. The range of this measure is 0 to 20 visits per pregnancy, with a large proportion falling in the lower range. The distribution of antenatal visits is illustrated in Chart 8.

**Chart 7**: Number of Children per Female Respondent in DRC, 2007

![Number of Children per Female Respondent, in DRC, 2007](source: DHS Data, DRC, 2007)
An additional important factor regarding maternal health and maternal death is the wantedness of pregnancy. This distribution may suggest a relationship the level of need for modern family planning options throughout the region as women express a desire to limit the number of births. The distribution based on these data illustrates a relatively high level, with over a third of respondents’ most recent pregnancy indicated as unwanted during the time of that pregnancy.

Total: 100.0 percent
  Wanted Pregnancy: 65.1 percent
  Unwanted Pregnancy: 34.9 percent
Maternal Health Regression Results

The results from the regression analysis, with maternal heath as the dependent variable, are summarized in Table 4 and Table 5.

<table>
<thead>
<tr>
<th>Explanatory Variables</th>
<th>Model 1A</th>
<th>Model 1B</th>
<th>Model 1C</th>
<th>Model 1D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modern Family Planning (FP) Use</td>
<td>0.036</td>
<td>1.073***</td>
<td>1.042***</td>
<td>1.084***</td>
</tr>
<tr>
<td></td>
<td>(0.29)</td>
<td>(4.77)</td>
<td>(4.63)</td>
<td>(4.82)</td>
</tr>
<tr>
<td>Modern FP Knowledge</td>
<td>---</td>
<td>---</td>
<td>-0.418***</td>
<td>-0.360***</td>
</tr>
<tr>
<td></td>
<td>---</td>
<td>---</td>
<td>(-3.18)</td>
<td>(-2.70)</td>
</tr>
<tr>
<td>Ever Married</td>
<td>-0.811***</td>
<td>-0.558*</td>
<td>-0.697**</td>
<td>-0.575**</td>
</tr>
<tr>
<td></td>
<td>(-2.85)</td>
<td>(-1.95)</td>
<td>(-2.42)</td>
<td>(-2.00)</td>
</tr>
<tr>
<td>Age</td>
<td>0.047***</td>
<td>-0.176***</td>
<td>0.044***</td>
<td>-0.161***</td>
</tr>
<tr>
<td></td>
<td>(4.12)</td>
<td>(-3.35)</td>
<td>(3.84)</td>
<td>(-3.05)</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>1.038***</td>
<td>1.051***</td>
<td>1.053***</td>
<td>1.090***</td>
</tr>
<tr>
<td></td>
<td>(7.99)</td>
<td>(7.98)</td>
<td>(7.99)</td>
<td>(8.20)</td>
</tr>
<tr>
<td>Secondary</td>
<td>-0.071</td>
<td>0.014</td>
<td>-0.036</td>
<td>0.068</td>
</tr>
<tr>
<td></td>
<td>(-0.48)</td>
<td>(0.09)</td>
<td>(-0.24)</td>
<td>(0.44)</td>
</tr>
<tr>
<td>Higher</td>
<td>0.157</td>
<td>0.253</td>
<td>0.135</td>
<td>0.287</td>
</tr>
<tr>
<td></td>
<td>(0.33)</td>
<td>(0.52)</td>
<td>(0.28)</td>
<td>(0.59)</td>
</tr>
<tr>
<td>Working</td>
<td>-0.229***</td>
<td>-0.227**</td>
<td>-0.249**</td>
<td>-0.228**</td>
</tr>
<tr>
<td></td>
<td>(-2.05)</td>
<td>(-2.03)</td>
<td>(-2.22)</td>
<td>(-2.04)</td>
</tr>
<tr>
<td>Rural Residence</td>
<td>0.116</td>
<td>0.194</td>
<td>0.108</td>
<td>0.141</td>
</tr>
<tr>
<td></td>
<td>(0.94)</td>
<td>(1.56)</td>
<td>(0.86)</td>
<td>(1.11)</td>
</tr>
<tr>
<td>Number of Children</td>
<td>0.057*</td>
<td>0.096***</td>
<td>0.092***</td>
<td>0.093***</td>
</tr>
<tr>
<td></td>
<td>(1.80)</td>
<td>(2.86)</td>
<td>(2.77)</td>
<td>(2.75)</td>
</tr>
<tr>
<td>Antenatal Visits</td>
<td>-0.021</td>
<td>-0.031</td>
<td>-0.010</td>
<td>-0.023</td>
</tr>
<tr>
<td></td>
<td>(-1.01)</td>
<td>(-1.46)</td>
<td>(-0.46)</td>
<td>(-1.08)</td>
</tr>
<tr>
<td>Wantedness of Pregnancy</td>
<td>0.343***</td>
<td>0.316***</td>
<td>0.297***</td>
<td>0.299***</td>
</tr>
<tr>
<td></td>
<td>(3.22)</td>
<td>(2.95)</td>
<td>(2.77)</td>
<td>(2.79)</td>
</tr>
<tr>
<td>Locality of Health Facility</td>
<td>0.006</td>
<td>0.029</td>
<td>-0.007</td>
<td>0.011</td>
</tr>
<tr>
<td></td>
<td>(0.05)</td>
<td>(0.26)</td>
<td>(-0.06)</td>
<td>(0.10)</td>
</tr>
<tr>
<td>Body Mass Index (BMI)</td>
<td>0.011</td>
<td>0.022*</td>
<td>0.018</td>
<td>0.024*</td>
</tr>
<tr>
<td></td>
<td>(0.89)</td>
<td>(1.73)</td>
<td>(1.41)</td>
<td>(1.89)</td>
</tr>
<tr>
<td>Age, First Sexual Experience</td>
<td>0.033*</td>
<td>0.047**</td>
<td>0.043**</td>
<td>0.051**</td>
</tr>
<tr>
<td></td>
<td>(1.65)</td>
<td>(2.30)</td>
<td>(2.13)</td>
<td>(2.48)</td>
</tr>
<tr>
<td>Safe Drinking Water Source</td>
<td>0.635***</td>
<td>0.640***</td>
<td>0.643***</td>
<td>0.638***</td>
</tr>
<tr>
<td></td>
<td>(5.95)</td>
<td>(5.91)</td>
<td>(5.97)</td>
<td>(5.98)</td>
</tr>
<tr>
<td>Age Squared</td>
<td>---</td>
<td>-0.004***</td>
<td>---</td>
<td>0.003***</td>
</tr>
<tr>
<td></td>
<td>---</td>
<td>(4.31)</td>
<td>---</td>
<td>(3.97)</td>
</tr>
<tr>
<td>Number of Children*FPUse</td>
<td>---</td>
<td>-0.245***</td>
<td>-0.233***</td>
<td>-0.240***</td>
</tr>
<tr>
<td></td>
<td>---</td>
<td>(-5.30)</td>
<td>(-5.08)</td>
<td>(-5.20)</td>
</tr>
<tr>
<td>Constant</td>
<td>-2.748</td>
<td>-0.370</td>
<td>-2.900</td>
<td>-0.381</td>
</tr>
<tr>
<td></td>
<td>(-5.01)</td>
<td>(-0.44)</td>
<td>(-5.21)</td>
<td>(-0.45)</td>
</tr>
<tr>
<td>Observations</td>
<td>2377</td>
<td>2377</td>
<td>2377</td>
<td>2377</td>
</tr>
<tr>
<td>Chi Squared Statistic</td>
<td>470.23</td>
<td>516.27</td>
<td>507.60</td>
<td>523.55</td>
</tr>
<tr>
<td>Pseudo R²</td>
<td>0.144</td>
<td>0.158</td>
<td>0.156</td>
<td>0.161</td>
</tr>
</tbody>
</table>

* Statistic values are reported in parentheses
** * indicates significance at the 90%, 95%, and 99% level, respectively
Table 5 – Logistical Regression Analysis for Significant Variables in Model with Maternal Health as the Dependent Variable

<table>
<thead>
<tr>
<th>Variables</th>
<th>β</th>
<th>SE β</th>
<th>p</th>
<th>eβ (odds ratio)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modern Family Planning (FP) Use</td>
<td>1.084</td>
<td>0.225</td>
<td>0.00</td>
<td>2.957</td>
</tr>
<tr>
<td>Modern FP Knowledge</td>
<td>-0.360</td>
<td>0.134</td>
<td>0.007</td>
<td>0.697</td>
</tr>
<tr>
<td>Ever Married</td>
<td>-0.575</td>
<td>0.287</td>
<td>0.045</td>
<td>0.045</td>
</tr>
<tr>
<td>Age</td>
<td>-0.161</td>
<td>0.053</td>
<td>0.002</td>
<td>0.851</td>
</tr>
<tr>
<td>Primary Education</td>
<td>1.089</td>
<td>0.133</td>
<td>0.000</td>
<td>2.974</td>
</tr>
<tr>
<td>Number of Children</td>
<td>0.093</td>
<td>0.034</td>
<td>0.006</td>
<td>1.097</td>
</tr>
<tr>
<td>Body Mass Index (BMI)</td>
<td>0.024</td>
<td>0.013</td>
<td>0.059</td>
<td>1.025</td>
</tr>
<tr>
<td>Age, First Sexual Experience</td>
<td>0.051</td>
<td>0.020</td>
<td>0.013</td>
<td>1.052</td>
</tr>
<tr>
<td>Wantedness of Pregnancy</td>
<td>0.299</td>
<td>0.107</td>
<td>0.005</td>
<td>1.349</td>
</tr>
<tr>
<td>Safe Water Source</td>
<td>0.638</td>
<td>0.109</td>
<td>0.000</td>
<td>1.893</td>
</tr>
<tr>
<td>Age Squared</td>
<td>-0.161</td>
<td>0.053</td>
<td>0.000</td>
<td>1.003</td>
</tr>
<tr>
<td>Number of Children*FP Use</td>
<td>-0.240</td>
<td>0.461</td>
<td>0.000</td>
<td>0.786</td>
</tr>
</tbody>
</table>

**Significant Variables**

The results indicate that although both proposed hypotheses were significant and one hypothesis was supported while the other was the opposite of what was expected.¹ Focusing on Model 1D, it can be seen that a number of variables exhibit statistical significance regarding their effect on the level of maternal health of a woman of reproductive age. The use of modern family planning methods is significant, and positive, supporting the first hypothesis. The results suggest that women who utilize modern family planning methods are nearly 3 times more likely to experience appropriate hemoglobin levels or good maternal health, compared to women who do not employ modern family planning methods. As noted earlier, the majority of women surveyed suffer from extremely low hemoglobin levels, indicating poor maternal health, below the desired range of 110 to 130. However, the knowledge of modern family planning methods is also statistically significant, but the results indicate a negative relationship between knowledge of modern family planning practices and maternal health. Women with knowledge of modern family planning methods are approximately 0.70 times more likely to fall outside the range of appropriate maternal health levels, based on hemoglobin measures, compared to women with no knowledge of

---

¹ It is important to note that these models suffer from model specification error. Various attempts, including changing the function form and adding additional variables did not help.

Unfortunately, due to data constraints, including a lack of information on possible omitted variables, such as knowledge of prior pregnancy complications and quality of available health care, the omitted variable problem could not be removed.
modern family planning methods. It is difficult to explain this result other than that knowledge alone may be insufficient, individuals must still utilize the knowledge of specific practices and methods.

A number of other variables are significant and indicate a relationship to maternal health levels. The age variable suggests a negative relationship between aging and maternal health. The variable measuring the number of children per woman suggests a positive relationship between number of children and maternal health. The primary education, body mass index, age at first sexual experience, wantedness of pregnancy, and access to safe water sources variables are all positively related to maternal health while the ever married and working variables are negatively related. The results suggest that women with educational attainment of at least primary school are almost 3 times more likely to experience good maternal health compared to women without any educational attainment. The results also suggest that women with access to safe drinking water sources are twice as likely to experience good levels of maternal health compared to women without access to safe drinking water sources. The results suggest that with an increase in body mass index, as a proxy for nutritional status of women, of one unit women are 1.02 times more likely to be associated with good maternal health levels.
Maternal Death Regression Results

The results from the regression analysis, with the probability of maternal death as the dependent variable, are summarized in Table 6.

<table>
<thead>
<tr>
<th>Explanatory Variables</th>
<th>Model 2A</th>
<th>Model 2B</th>
<th>Model 2C</th>
<th>Model 2D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modern Family Planning (FP) Use</td>
<td>-0.142**</td>
<td>-0.131**</td>
<td>-0.116</td>
<td>-0.130**</td>
</tr>
<tr>
<td></td>
<td>(-2.28)</td>
<td>(-2.05)</td>
<td>(-0.86)</td>
<td>(-1.96)</td>
</tr>
<tr>
<td>Modern FP Knowledge</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>-0.009</td>
</tr>
<tr>
<td></td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>(0.11)</td>
</tr>
<tr>
<td>Ever Married</td>
<td>0.174</td>
<td>0.217</td>
<td>0.215</td>
<td>0.214</td>
</tr>
<tr>
<td></td>
<td>(1.25)</td>
<td>(1.31)</td>
<td>(1.25)</td>
<td>(1.25)</td>
</tr>
<tr>
<td>Age</td>
<td>-0.007</td>
<td>-0.014**</td>
<td>0.028</td>
<td>0.029</td>
</tr>
<tr>
<td></td>
<td>(-1.23)</td>
<td>(-2.27)</td>
<td>(0.80)</td>
<td>(0.81)</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>0.088</td>
<td>0.089</td>
<td>0.091</td>
<td>0.089</td>
</tr>
<tr>
<td></td>
<td>(1.35)</td>
<td>(1.18)</td>
<td>(1.20)</td>
<td>(1.21)</td>
</tr>
<tr>
<td>Secondary</td>
<td>0.191**</td>
<td>0.154*</td>
<td>0.143*</td>
<td>0.141*</td>
</tr>
<tr>
<td></td>
<td>(2.56)</td>
<td>(1.81)</td>
<td>(1.68)</td>
<td>(1.69)</td>
</tr>
<tr>
<td>Higher</td>
<td>0.369</td>
<td>0.339</td>
<td>0.341</td>
<td>0.340</td>
</tr>
<tr>
<td></td>
<td>(1.47)</td>
<td>(1.30)</td>
<td>(1.33)</td>
<td>(1.33)</td>
</tr>
<tr>
<td>Working</td>
<td>0.190***</td>
<td>0.203***</td>
<td>0.193***</td>
<td>0.193***</td>
</tr>
<tr>
<td></td>
<td>(3.38)</td>
<td>(3.42)</td>
<td>(3.17)</td>
<td>(3.17)</td>
</tr>
<tr>
<td>Rural Residence</td>
<td>-0.118*</td>
<td>-0.103</td>
<td>-0.086</td>
<td>-0.085</td>
</tr>
<tr>
<td></td>
<td>(-1.87)</td>
<td>(-1.51)</td>
<td>(-1.19)</td>
<td>(-1.15)</td>
</tr>
<tr>
<td>Number of Children</td>
<td>0.023</td>
<td>0.044**</td>
<td>0.043**</td>
<td>0.043***</td>
</tr>
<tr>
<td></td>
<td>(1.53)</td>
<td>(2.54)</td>
<td>(2.35)</td>
<td>(2.45)</td>
</tr>
<tr>
<td>Antenatal Visits (No.)</td>
<td>0.009</td>
<td>0.005</td>
<td>0.006</td>
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</tr>
<tr>
<td></td>
<td>(0.65)</td>
<td>(0.33)</td>
<td>(0.42)</td>
<td>(0.41)</td>
</tr>
<tr>
<td>Wantedness of Pregnancy</td>
<td>-0.219***</td>
<td>-0.204***</td>
<td>-0.212***</td>
<td>-0.211***</td>
</tr>
<tr>
<td></td>
<td>(-3.84)</td>
<td>(-3.27)</td>
<td>(-3.39)</td>
<td>(-3.40)</td>
</tr>
<tr>
<td>Locality of Health Facility</td>
<td>-0.159***</td>
<td>-0.164***</td>
<td>-0.160***</td>
<td>-0.161***</td>
</tr>
<tr>
<td></td>
<td>(-3.00)</td>
<td>(-2.84)</td>
<td>(-2.76)</td>
<td>(-2.76)</td>
</tr>
<tr>
<td>Safe Drinking Water Source</td>
<td>-0.319***</td>
<td>-0.279***</td>
<td>-0.269***</td>
<td>-0.270***</td>
</tr>
<tr>
<td></td>
<td>(-6.28)</td>
<td>(-4.79)</td>
<td>(-4.51)</td>
<td>(-4.69)</td>
</tr>
<tr>
<td>Maternal Health</td>
<td>0.000</td>
<td>0.000</td>
<td>-0.000</td>
<td>-0.000</td>
</tr>
<tr>
<td></td>
<td>(0.11)</td>
<td>(0.05)</td>
<td>(-0.12)</td>
<td>(-0.11)</td>
</tr>
<tr>
<td>Body Mass Index (BMI)</td>
<td>---</td>
<td>-0.004</td>
<td>-0.005</td>
<td>-0.005</td>
</tr>
<tr>
<td></td>
<td>---</td>
<td>(-0.51)</td>
<td>(-0.52)</td>
<td>(-0.50)</td>
</tr>
<tr>
<td>Age, First Sexual Experience</td>
<td>---</td>
<td>0.027**</td>
<td>0.261**</td>
<td>0.026**</td>
</tr>
<tr>
<td></td>
<td>---</td>
<td>(2.38)</td>
<td>(2.30)</td>
<td>(2.30)</td>
</tr>
<tr>
<td>Age Squared</td>
<td>---</td>
<td>---</td>
<td>-0.001</td>
<td>-0.000</td>
</tr>
<tr>
<td></td>
<td>---</td>
<td>---</td>
<td>(-1.25)</td>
<td>(-1.26)</td>
</tr>
<tr>
<td>Number of Children*FPUse</td>
<td>---</td>
<td>---</td>
<td>-0.003</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>---</td>
<td>---</td>
<td>(-0.11)</td>
<td>---</td>
</tr>
<tr>
<td>Constant</td>
<td>0.355</td>
<td>0.107</td>
<td>-0.526</td>
<td>-0.531</td>
</tr>
<tr>
<td></td>
<td>(1.60)</td>
<td>(0.33)</td>
<td>(-0.89)</td>
<td>(-0.89)</td>
</tr>
<tr>
<td>Observations</td>
<td>362</td>
<td>330</td>
<td>330</td>
<td>330</td>
</tr>
<tr>
<td>F Statistic</td>
<td>56.58</td>
<td>48.87</td>
<td>44.24</td>
<td>44.58</td>
</tr>
<tr>
<td>R²</td>
<td>0.483</td>
<td>0.516</td>
<td>0.520</td>
<td>0.520</td>
</tr>
</tbody>
</table>

T-Statistics are reported in parentheses
*., **, *** indicates significance at the 90%, 95%, and 99% level, respectively
1. Assessment of Data, Model 2

It is important to note that the $R^2$ of these models indicates that the models explain a good deal of the variation in the probability of maternal death for respondents, based on the sisterhood method regarding the probability of respondents’ sisters dying from maternal causes. Focusing on Model 2D, the $R^2$ indicates that 47.5 percent of the variation in probability of maternal death can be explained by this model. However, it is important to acknowledge that additional economic, social, and health factors also play a role in the level of maternal death experienced by women in developing regions, such as the Democratic Republic of Congo.

2. Significant Variables

The results indicate that one proposed hypothesis was significant while the other was not. The modern family planning usage variable is significant, suggesting a negative relationship as indicated by the first hypothesis. The results indicate women, who utilize modern family planning, including contraceptives and community health services, are 16.9 percent ($p=0.01$) less likely to die from maternal causes, holding all other variables constant. Since the usage of modern family planning practices includes multiple components, it cannot be determined which aspects of family planning are directly responsible for the decreased likelihood of death due to maternal causes. However, the modern family planning knowledge variable was not significant, indicating that individuals may not always utilize known practices or methods of family planning.

A number of variables were related to the probability of death due to maternal causes, including number of children, wantedness of pregnancy, health facility location, access to safe drinking water, and age of first sexual experience. The education variable was marginally positively

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2 It is important to note that these models suffer from model specification error. Various attempts, including changing the functional form and adding variables, did not improve the model. A variety of tests were utilized to determine errors in functional form of the existing models. In Model 1C both a higher order term and an interaction term were added. In addition, multiple variations were tested which are not listed above. None of these yielded significant improvements in the strength of the model (See Appendix C).

There is an indication of heteroskedasticity; therefore, robust standards errors were employed.
related, which is surprising since education and improved health are often related. The working variable was also positive, suggesting that women who are employed are 22.9 percent (p=0.00) more likely to experience death related to maternal causes, holding all else constant. Similarly, the number of children variable was positive. This suggests that women who have increasing numbers of children are 6.7 percent (p=0.00) more likely to experience death related to maternal causes, holding all other variables constant.

In contrast, a few variables indicate a decreased probability of death due to maternal causes. The proximity to a health facility variable was negative suggesting that distance to a health facility is associated with a 14.9 percent (p=0.01) decrease in likelihood of death related to maternal causes, holding all else constant. In addition, the variable measuring wantedness of pregnancy was also negative, suggesting a reduction in the likelihood of death due to maternal causes if pregnancies are wanted. This variable indicates that a wanted pregnancy is 21.5 percent (p=0.00) less likely to result in maternal death than an unwanted pregnancy, holding all else constant. The access to safe drinking water variable was negative, suggesting a relationship between access to safe drinking water and reduced incidence of maternal death. This variable indicates that access to safe drinking water is associated with a 26.8 percent (p=0.00) decrease in likelihood of death related to maternal causes.

3. Insignificant Variables
   While not statistically significant, it is important to note the effects of additional variables on maternal health in these models. It can be seen that the variables regarding BMI, as an indicator of nutritional levels, married or not married, and rural or urban residency did not influence the probability of death due to maternal causes.
CHAPTER IV.

POLICY IMPLICATIONS

*Results-Based Policy Implications for the DRC*

The results suggest a number of significant policy implications for family planning programs for the Congo. Results indicate use of modern family planning services may decrease the likelihood of death due to maternal causes. These results indicate that modern family planning programs have the potential to play a significant role in lowering the incidence of maternal mortality for reproductive health policy in the DRC. Policy focused on increased access to and availability of reproductive health services and commodities could target the reduction of maternal mortality in line with MDG #5.

Results indicate that control over fertility decisions, indicated by wantedness of pregnancy, can lead to reduced risk of maternal mortality. Therefore, policies targeting increased family planning resources may address the desire of women to limit their number of births as well as space them further apart. Policy mechanisms, which focus on reproductive health education and services as well as improved access to general health care services, have the potential to produce positive outcomes if meeting the “unmet need” to limit birth numbers in turn reducing the probability of maternal mortality. Policies, which empower women to determine individual fertility preferences, may have ramifications for reducing the incidence of maternal mortality in the DRC.

The results also suggest that access to safe drinking water sources may decrease the likelihood of maternal death. Thus, improvements in access to safe drinking water supplies may be more effective than other development policies in lowering the incidence of maternal mortality.

Finally, the results indicate an important relationship between improved health and educational attainment. Thus, policies targeting access to and improved educational programs within the DRC have the potential to positively affect maternal health and decrease the incidence of maternal mortality.
Current family planning programs in the DRC are directed by international bilateral and multilateral funding and executed by non-governmental and international organizations. International support is driven by increased attention and commitments to achieving progress on the 2015 targets of the Millennium Development Goals. The bulk of this assistance is contributed by foreign national governments and utilized through UNFPA programs (UNFPA, 2010).

As the results indicate, policy actions and initiatives have the potential to play an important role in reducing maternal mortality in the Congo. However, due to the unstable political conditions, the ability to implement family planning programs, and therefore the ability to reduce risks associated with maternal mortality, remains primarily driven by international support and funding. Specifically, UNFPA and USAID drive family planning programs in the DRC. UNFPA’s latest country program targets increasing the number of health care centers in the region and expanding access to family planning services at these centers (UNFPA, 2008). Simultaneously, USAID is implementing a range of projects in partnership with international NGOs. These projects address expanding the range of family planning services including, supply of reproductive health products and services, incorporation of family planning counseling and testing into existing health services provisions, and reducing barriers to family planning and reproductive health information and services (USAID, 2010).

The United States represents a significant contributor to family planning and reproductive rights. Chart 7 illustrates that the United States contributes the greatest share of financing for family planning expenditures to meet ICPD Programme of Action targets. In addition, reproductive health financing from the United States represents the largest single donor assistance contributed to meet ICPD targets (UNFPA, 2009).
Nevertheless, recent trends in international reproductive health funding illustrate a significant shift of population assistance away from family planning and reproductive health toward HIV/AIDS prevention and care, especially since the creation of the U.S. President’s Emergency Plan for AIDS Relief (PEPFAR) in 2003. Chart 10 illustrates the decrease in international population expenditures by category and the rise of HIV/AIDS funding over the last decade. In 2009, UNFPA estimated that 92 percent of expenditures on population activities in sub-Saharan Africa would be dedicated to targeting HIV/AIDS issues (UNFPA, 2009). This reallocation of financial resources represents a substantial obstacle for developing countries, such as the Congo, to meet domestic needs for family planning programs including access to contraceptive services and maternal health care.
In the Congo, family planning program access and educational information remains limited due to violence and internal displacement resulting from on-going regional conflict. As a result, shortcomings of international and domestic family planning policies exist (USAID, 2010). An unmet need for family planning in the form of contraceptive commodities remains high for Congolese women; according to USAID, approximately 24 percent of married women wish to space or limit births (USAID, 2010).
In addition, the DRC remains in the initial stages of a demographic transition with high total fertility rates, low life expectancy, and a high maternal mortality ratio. The underdevelopment of the Congolese population combined with a high unmet need for family planning services in this war-torn region suggests the possibility for significantly positive results from improved access to family planning programs (USAID, 2010). Although the lack of quantitative studies on family planning in the DRC presents a gap in analytical evidence, qualitative research and program feedback from international organizations support the conclusion that family planning can potentially mitigate the Congolese maternal mortality ratio by reducing fertility rates (USAID, 2010; UNFPA, 2010).

Current policies, including the Congo’s Strategic Plan for Reproductive Health and the National Program of Reproductive Health (PNSR), have not met stated goals of fully integrating family planning services into all health zones in order to increase access. Although the PNSR requires the national government to develop, standardize, and disseminate family planning policy; increase supplies of goods and services; and build or revitalize maternal health wards, these stated objectives are yet to be fulfilled (USAID – Health Policy Initiative, 2009).

The existing UNFPA country program for the DRC (2009-2013) seeks to accelerate the commitments of this national health development plan. In 2008, the UNFPA and United Nations Development Programme (UNDP) Executive Board committed 52 percent of assistance in the Congo to core programs for reproductive health and rights (UNFPA, 2008). Specifically, the current UNFPA program seeks to reduce maternal mortality by increasing the percentage of health centers with high-quality emergency obstetric care and increasing the availability of family planning services. These commitments include objectives to provide reproductive health services in the midst of humanitarian crisis settings – a necessary aspect of providing healthcare in the region due to violence and political upheaval (UNFPA, 2008).
Despite domestic and international specifications for improvement of reproductive health, broader obstacles remain. Political will and current policy advocates in the Congo are not receptive to expanding the scope of family planning programs. Existing laws conflict with certain aspects of the National Program of Reproductive Health and the ICPD Program of Action, and socio-economic policies persist which do not incorporate family planning as a development strategy on any level (United Nations, 1994). Furthermore, general development gaps, including poverty, lack of economic growth, lack of female empowerment, illiteracy and geographic inaccessibility of family planning products and services, continue to prevent progress (USAID–Health Policy Initiative, 2009).

In addition, educational attainment and opportunities are well established as development mechanisms to help lead families out of poverty. Research suggests that the incorporation of female education advancement can have a substantially significant impact of lowering maternal mortality by reducing high-risk pregnancies (Trussell & Pebley, 1984; Singh et al., 2009). However, education programs often are more costly than family planning programs, reducing the feasibility for universal access. The results show that educational attainment could improve this development process by contributing to a reduction in the incidence of maternal death (Trussell & Pebley, 1984; Singh et al., 2009).

If financial and political international support could fulfill the commitments required by the ICPD and Millennium Development targets, domestic political will may support changes and implementation of family planning policies. With international monetary support, direct support from international NGOs in the region could expand current reproductive health and family planning services to fill the lack of services provisions by the government. Chart 11 shows that international population assistance falls below the ICPD actual expected targets, with family planning assistance declining during the 2000s (UNFPA, 2008).
Most research concludes that in order to fully address the risks of maternal mortality, a dual program involving prevention and treatment aspects is necessary (Winikoff & Sullivan, 1987; Koenig et al. 1988; Maine 1991; McCarthy & Maine, 1992). Treatment incorporates improved health and medical services for pregnant women to reduce the risks of pregnancy. Prevention includes increased access to family planning resources to reduce the overall number of pregnancies (Maine, 1991; McCarthy & Maine, 1992). Winikoff & Sullivan assert that a quarter of maternal deaths can be avoided by reducing fertility with family planning, but in order to eliminate the remaining three-fourths of maternal deaths, pregnancy must be made safer for mothers and their children (Winikoff & Sullivan, 1987).

Therefore, a broad-based service strategy, including both family planning and maternal and child health improvement, is required to reduce maternal mortality ratios (Phillips et al., 1982; Koenig et al., 1988; Hale, 2006). Policies should target strengthening institutional support, expanding and modernizing access to health care services, and improving the distribution of reproductive health services and commodities throughout the region. Over time, as domestic organizations develop and strengthen, they can work with NGOs to fulfill the unmet need for family planning, through cooperative domestic and international programming.
CHAPTER V.

CONCLUSION

Although significant efforts to reduce maternal mortality worldwide exist, UNFPA maintains that maternal mortality rates in sub-Saharan Africa have barely changed in over two decades (UNIFEM, 2008). The target goals of Millennium Development Goal #5, reducing maternal mortality and providing universal access to reproductive health care including family planning services, continue to experience the least progress of the MDGs.

There is broad international consensus that access to family planning, including counseling, health services, and contraceptive commodities; access to quality care for pregnancy and childbirth; and access, when legal, to safe abortion services, are necessary to improving maternal health and reducing maternal mortality (Women Deliver, 2010). The National Program of Reproductive Health in the DRC must reflect these necessary aspects in order to reduce overall fertility, meet the unmet need for family planning, and ultimately reduce maternal mortality throughout the country. Political dissension at the national level should be targeted with international advocacy and financial backing to halt the continuation of unnecessary deaths in this developing region.

Family planning is one of the most cost effective ways to improve maternal and child health, and therefore reduce maternal mortality (Cincotta & Haddock, 2006; Prata 2007; Singh et al., 2009). Estimates, calculated by UNFPA and the Guttmacher Institute, indicate cost-benefit incentives for investment in family planning as opposed to the continuation of global inaction. Chart 12 illustrates these estimates, showing how expansion of family planning and maternal health services could significantly reduce maternal deaths. These estimates show that when a dual program of action (on both expanding family planning and improving maternal and child health care) is undertaken, maternal deaths could fall by over 50 percent, with unintended pregnancies falling by approximately 90 percent (Singh et al., 2009). Financial contributions to family planning services and maternal and newborn health care can therefore decrease long-term costs by reducing
maternal and newborn deaths, decrease maternal and child disabilities and reduce the number of mother-less children in developing regions. Chart 12 illustrates proposed family planning investments and benefits developed by UNFPA and the Guttmacher Institute, which would target these critical areas of development (Singh et al., 2009). Nevertheless, the recent 2010 Millennium Development Report cites inadequate funding for family planning as one of the major failures in fulfilling the 2015 commitments (United Nations, 2010).

Chart 12: Family Planning Investments and Benefits proposed for global improvements

Source: “Adding It Up: The Costs and Benefits of Investing in Family Planning and Maternal and Newborn Health” (Singh, et al., 2009).
USAID estimates, specific to the Congo, illustrate the economic benefits of achieving wider targets of multiple MDGs when family planning needs are met (USAID, 2009). Thus, programs targeting family planning policies and appropriate program funding are necessary to achieve Millennium Development Goal #5 targets, and also to achieve development goals represented by a broad spectrum of MDG concerns, including poverty, hunger, education, and health care.

Research concludes that family planning programs cannot be undertaken in isolation (Winikoff & Sullivan, 1987; Koenig et al. 1988; Maine 1991; McCarthy & Maine, 1992). Integrated development approaches, which incorporate the advancement of skilled medical services available to women and infants, access to safe water, and educational improvements, must be adopted in order to achieve the desired results in maternal mortality reductions (Fortney, 1987; Singh et al., 2009; Hogan et al., 2010). Policy implications must reflect this extremely important conclusion because many remote regions currently lack adequate health services and appropriate medical supplies (USAID, 2010).

Looking ahead, policy objectives in the Congo must incorporate these reproductive health aspects to optimize the reduction of maternal morality. However, due to political instability, the necessary policies to provide programs and health services will not develop without political will of international donor governments (Women Deliver, 2010). Financial contributions from the global community will be essential to support policy programs aimed at fulfilling the unmet need for family planning within the region, as well as ensuring expansion and strengthening of health and medical services available to women and families.
CHAPTER VI.

APPENDIX A: Construction of the Maternal Death Probability Variable

The maternal death probability variable was constructed using survey response information pertaining to respondents’ siblings, employing the “Sisterhood Method” of analysis for maternal mortality estimates. Due to data complication, a specific maternal mortality ratio could not be constructed. However, taking data on siblings of respondents, the average of sibling deaths due to maternal causes per survey respondent was constructed to formulate a probability of respondents’ likelihood of death related to maternal causes. The information on respondents’ siblings is collapsed into 1,372 individual respondent probabilities. The range of this probability variable is 0 to 1, with each individual respondent’s likelihood of death resulting from maternal causes falling along that scale. The distribution of the maternal death probability variable can be seen in Table 1.

Table 1: Distribution of Maternal Death Probability Variable Employed in Model 2

<table>
<thead>
<tr>
<th>Probability of Maternal Death (0 – 1)</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>879</td>
<td>64.07</td>
</tr>
<tr>
<td>0.333</td>
<td>8</td>
<td>0.58</td>
</tr>
<tr>
<td>0.5</td>
<td>138</td>
<td>10.06</td>
</tr>
<tr>
<td>0.667</td>
<td>1</td>
<td>0.07</td>
</tr>
<tr>
<td>1.0</td>
<td>346</td>
<td>25.22</td>
</tr>
<tr>
<td>Total</td>
<td>1,372</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Source: DHS Data, 2007, DRC
APPENDIX B: Variable Descriptions, Model 1 & Model 2

All variables are from the 2007 Demographic and Health Survey of the Democratic Republic of the Congo. The following are general definitions of the variables used in the models:

**Model 1 & 2:**

\( \beta_0 = Y \) Intercept

\( \beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7, \beta_0, \beta_9, \beta_{11}, \beta_{12}, \beta_{13}, \beta_{14}, \beta_{15} = \) Coefficients of respective independent variables

\( X_1 = \) FPKnowledge

Knowledge of Modern Family Planning (Modern Contraceptive Methods: Modern Contraceptive Methods: Pill, IUD, Injections, Diaphragm, Male Condoms, Female Condoms, Male Sterilization, Female Sterilization, Lactational Amenorrhea, Foam or Jelly) Indicator. Knowledge of Modern Contraceptive Methods versus no Knowledge of Modern Contraceptive Methods.

\( X_2 = \) FPUse

Usage of Modern Family Planning (Modern Contraceptive Methods) Indicator. At the time of the survey, current Use of at least one Modern Contraceptive Method versus no current Use of Modern Contraceptive Method.

\( X_3 = \) Evermarried

Marital Status Indicator. Ever Married (Currently, Formerly Married) versus Never Married.

\( X_4 = \) Age

Age Status. Age of the Respondent in Years.

\( X_5 = \) Education

Education Status. Highest level of Educational Attainment of Respondent, Divided into Three Categories: Primary, Secondary and Higher.

\( X_6 = \) Working


\( X_7 = \) Rural Residence

Geographic Location of Residence Indicator. Rural Dummy Variable. Rural residence versus Non-Rural Residence (Urban).

\( X_8 = \) Number of Children

Number of Children of Respondent.

\( X_9 = \) Antenatal Visits

Antenatal Visit Status. Number of Antenatal Visits per respondent during pregnancy over the past five years. Only applicable is respondent has children as indicated by \( X_9 \).

\( X_{10} = \) Wantedness of Pregnancy

Wantedness of Pregnancy Indicator. Dummy Variable, Wanted most recent pregnancy during period of Pregnancy versus Did not Want most recent pregnancy during period of Pregnancy.

\( X_{11} = \) Locality of Health Facility

Distance from Respondent’s Home to Health Facility Indicator. Distance to Health Facility Dummy Variable. Far Distance to Health Facility versus Close Proximity to Health Facility.

\( X_{12} = \) Health of Individual (BMI)

Respondent Health Indicator. Continuous Body Mass Index measure.

\( X_{13} = \) Age of First Sexual Experience

Age of Respondent at time of first sexual experience.

\( X_{14} = \) Access to Safe Drinking Water Source

Access to Safe Drinking Water Source (Piped water, Well water, Covered water, Tanker Truck, or Bottled Water) Indicator. Access to Safe Drinking Water Source versus No Access to Safe Drinking Water Source or Access to Unsafe Drinking Water Source

\( e = \) Unexplained Variance, Error
### APPENDIX C: Diagnostic Tests, Model 1 & Model 2

#### I. Multicollinearity

**Table 1.1: Multicollinearity Test, Model 1D**

<table>
<thead>
<tr>
<th>mhealth-good</th>
<th>mfpknowledge</th>
<th>fpuse</th>
<th>evermarried</th>
<th>age</th>
<th>primaryeduc</th>
<th>secondary-c</th>
<th>highered</th>
<th>working</th>
<th>rural</th>
<th>bparity</th>
<th>BMI</th>
<th>firstsexage</th>
<th>farhealth-facility</th>
<th>wantedpreg</th>
<th>antevis</th>
<th>safewaters-e</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>mhealth-good</strong></td>
<td>1.0000</td>
<td>-0.1413</td>
<td>1.0000</td>
<td>-0.0019</td>
<td>0.1300</td>
<td>1.0000</td>
<td>-0.0040</td>
<td>-0.0317</td>
<td>-0.0651</td>
<td>1.0000</td>
<td>0.3030</td>
<td>-0.1809</td>
<td>0.0170</td>
<td>0.1493</td>
<td>1.0000</td>
<td></td>
</tr>
<tr>
<td><strong>mfpknowledge</strong></td>
<td>0.2243</td>
<td>-0.1200</td>
<td>0.0218</td>
<td>0.0488</td>
<td>0.2715</td>
<td>1.0000</td>
<td>-0.2469</td>
<td>0.3003</td>
<td>0.1147</td>
<td>-0.0777</td>
<td>-0.1748</td>
<td>-0.6688</td>
<td>1.0000</td>
<td>0.0074</td>
<td>0.0462</td>
<td>0.0660</td>
</tr>
<tr>
<td><strong>fpuse</strong></td>
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<td>-0.1185</td>
<td>0.0098</td>
<td>0.0601</td>
<td>0.1417</td>
<td>0.0371</td>
<td>-0.0344</td>
<td>-0.0874</td>
<td>0.1394</td>
<td>-0.0150</td>
<td>0.0345</td>
<td>-0.0070</td>
<td>0.0646</td>
<td>0.0748</td>
<td>0.0912</td>
<td>0.1370</td>
</tr>
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**Table 1.2: Multicollinearity Test, Model 2D**

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**Model 2D**: 
- corr sideavgh fpuse evermarried age primaryeduc secondaryeduc highered working rural b parity BMI firstsexage farhealth-facility wantedpreg antevis mhealth safewatersource 

(obs=2377)
**Table 1.3: Multicollinearity Test, Model 1D**

collin mhealthgood mpfkknowledge fpuse evermarried age primarieduc secondarieduc highered working rural bparity BMI firstsexage farhealthfacility wantedpreg bparityfpuse antevisits safewatersource(obs=2377)

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<th>VIF Tolerance</th>
<th>Squared</th>
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Mean VIF 2.07

**Table 1.4: Multicollinearity Test, Model 2D**

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Mean VIF 1.88
II. Heteroskedasticity

Table 2.1: Informal Heteroskedasticity Test, Model 2D

![Graph showing residuals vs fitted values]

Table 2.2: Formal Heteroskedasticity Test, White's Test Results, Model 2D

Cameron & Trivedi's decomposition of IM-test

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III. Model Specification Error

Table 3.1: Linktest results, Model 1D

| Variable | Coeff. | Std. Error | Z      | P>|z| |
|----------|--------|------------|--------|------|
| _hat     | 0.999  | 0.0507     | 19.69  | 0.000 |
| _hatsq   | -0.003 | 0.040      | -0.06  | 0.949 |

Table 3.2: Linktest results, Model 2D

| Variable | Coeff. | Std. Error | t      | P>|t| |
|----------|--------|------------|--------|------|
| _hat     | -0.016 | 0.176      | -0.09  | 0.927 |
| _hatsq   | 1.060  | 0.176      | 6.01   | 0.000 |

Table 3.3: Ramsey's Reset Test Results Model 2D

Ramsey RESET test using powers of the fitted values of sdeathavg
Ho: model has no omitted variables
F(3, 308) = 20.28
Prob > F = 0.000
CHAPTER VII.

BIBLIOGRAPHY


