# THE IMPACT OF EDUCATION ON ADVERSE PREGNANCY OUTCOMES IN KENYA

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**A research project submitted to the School of Economics, University of Nairobi, in partial fulfillment of the requirement for the award of the Degree of Master of Science in Health Economics and Policy**

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## DECLARATION

This research paper is my original work and has not been presented for any award in any other University.

Signature……. Date…….

Patricia Chepng'etich Muttai

X53/64476/2013

This research paper has been submitted for examination with my approval as university supervisor.

Signature……. Date…….

Prof. Leopold Mureithi

## DEDICATION

Dedicated to my family and my grandmothers, Tabsabei and Christina.

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I thank Almighty God for granting me strength and good health and for enabling me to finish this course.

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**ABBREVIATIONS**

AIDS……Acquired Immune Deficiency Syndrome

ANC …… Antenatal Care

APHRC…….African Population and Health Research Center

BMI……Body Mass Index

CDC……..Center for Disease and Control

ICF……Independent Consulting Firm

IV……...Instrumental Variable

HIV……Human Immunodeficiency Virus

KDHS……Kenya Demographic and Health Survey

KNBS……Kenya National Bureau of Statistics

MDGs……...Millennium Development Goals

OLS……...Ordinary Least Squares

STI ……Sexually Transmitted Infections

WHO…….World Health Organization

UNFPA…..United Nations Population Fund

2SRI……..Two Stage Residual Inclusion

## GLOSSARY OF TERMS

**Abortion:** It is any forced interruption of a pregnancy.

**Adverse pregnancy outcomes:** This refers to pregnancy results of a non-viable baby.

**Gradient:** The relationship between education and adverse pregnancy outcomes.

**Intrapartum stillbirth**: Generally defined as stillbirth occurring after the onset of labour

**Miscarriage:** Pre-term birth of a fetus before it is viable at 24 or more weeks of gestation.

**Pre-mature birth:** This is any birth occurring between 24 and 37 gestation weeks. The resultant baby can be nursed to health and survival.

**Stillbirth:** This is any fetus born with no heartbeat or respiratory effort.

**Viable fetus:** This is a fetus at 24 or more weeks of gestation.

**ABSTRACT**

Pregnancy outcomes are often considered a litmus test for the health of a nation. Many Kenyan women endure a lifetime of poor health and poor nutritional status as a direct consequence of societal, cultural, political and economic factors. These factors aggravate their risks during pregnancy and childbirth hence making them vulnerable to adverse pregnancy outcomes. This paper aims to demonstrate the impact of education on adverse pregnancy outcomes in Kenya using the Kenya Demographic and Health Survey (KDHS) datasets for 2003 and 2008. The experience of adverse pregnancy outcomes is measured using an indicator of whether or not a woman has ever had a pregnancy that was aborted, miscarried of ended in a stillbirth. This paper adopts the 2SRI estimation strategy that controls for potential endogeneity of education and potential unobserved heterogeneity. Comparing the two datasets, our findings show mixed results. For 2008, achieving secondary and higher education reduces the probability of a mother experiencing a miscarriage, stillbirth, or an abortion however 2003 has a contrary finding that is insignificant. We recommend policies that support mothers to achieve secondary education and even higher education as one way of reducing the experience of adverse pregnancy outcomes.

# CHAPTER ONE
# INTRODUCTION

## 1.1 BACKGROUND

Maternal health is health of a woman during pregnancy, childbirth and postpartum period. Maternal health care aims at providing education, health promotion, screening and interventions for women of reproductive age to reduce risk factors that might affect future pregnancies. Complications that occur during pregnancy and childbirth as well as from STIs, HIV and AIDS are among the leading causes of death and disability among women of reproductive age in developing countries (Lule et al. 2005).

While pregnancy is a time of joy and excitement it can however be full of anxiety and concern (Lawn, 2005). Cheptum et al. (2012) observes that pregnancy and childbirth can have a massive impact on the physical, mental, emotional, and socioeconomic health of women and their families. The successful transition of the newborn baby from life in utero to life at birth is based on a complex balance between the health of the mother, the course of the pregnancy, and the process of delivery and immediate postnatal care (Lancet, 2005, Cheptum et al. 2012).

Pregnancy outcome is classified into three distinct categories: pregnancy wastage, preterm births and live full term births (Magadi, 2004). Pregnancy outcomes are among maternal health indicators and adverse pregnancy outcomes such as stillbirths, miscarriages, abortions and preterm births can be used to indicate the prevailing problems in maternal health (Awiti 2013). In medical terms, stillbirth is described as a viable fetus born with no heartbeat or respiratory effort. A fetus is viable when it reaches 24 weeks of gestation. Abortion is any forced interruption of a pregnancy while miscarriage is the birth of a fetus before it is viable at 24 or more weeks of gestation. Preterm birth is characterized as a birth of a viable fetus before the end of the gestation period (Potts et al. 1977, Adele 2010).In most developed countries, pregnancies are planned, complications are few and outcomes are generally favourable for both mother and infant. Adverse outcomes are reported more frequently in the developing world. The most severe adverse outcome of pregnancy is the death of the mother or her offspring. Wide disparities probably also exist in the rate of stillbirths, although fetal deaths in developing countries are grossly underreported (Kramer 2003).

According to Kupka et al. (2009), developing countries account for over 97% of the worldwide stillbirths, while sub-Saharan Africa, the geographic region with the highest incidence of stillbirth in the world, contributes more than one-fourth to the worldwide total. Everyday more than 7200 babies are stillbirth and the risk of intrapartum stillbirth for an African woman is 24 times higher than that of a woman in a high income country (Lawn et al., 2011).Preterm birth is associated with high risk of infant mortality and morbidity and has in most cases an unknown etiology. The risk of preterm birth has been shown to be prominent among the socioeconomic disadvantaged women in terms of maternal education (Morgen et al. 2008).

Adverse pregnancy outcomes have a number of risk factors that include long and short inter-pregnancy periods, maternal morbidity, maternal obesity and smoking (Awiti 2013). According to Arthukorala et al. (2010) mothers who are overweight or obese during pregnancy and childbirth are known to have high risk of intrapartum stillbirths and recurrent miscarriages. Cogswell et al. (2003) draws attention to the fact that smoking during pregnancy can result in the rise of spontaneous abortions during the first trimester. In addition the effect of smoking on adverse pregnancy outcomes is greater among older women.

In Kenya many women endure a lifetime of poor health and poor nutritional status as a direct consequence of societal, cultural, political and economic factors. These factors aggravate the risks that Kenyan women face during pregnancy and childbirth hence making them vulnerable to adverse pregnancy outcomes (Magadi et al. 2004). The estimated rate of induced abortion in Kenya is 48 induced abortions per 1000 women of reproductive age while induced abortion ratio is 30 per 100 live births (APHRC 2013) while WHO estimated that in 2009 stillbirth rate was at 22 per 1000 live births (WHO 2012). A Kenyan woman faces 1 in 35 lifetime risk of maternal death, the most critical time being during childbirth and in the first 24 hours postpartum (UNFPA, 2006).

Much of the policy discussion about reducing health disparities across socioeconomic groups has focused on improving health insurance coverage and access to health care (Conti et al. 2010). However, the WHO Commission on Social Determinants of Health has drawn attention to the need for consideration of the link between women's socio-economic characteristics and health.

The more socially and economically advantaged people are, the better their health (WHO 2008). Several scholars have noted that better health early in life is associated with higher educational attainment. More educated individuals, in turn, have better health later in life and better labour market prospects (Conti et al. 2010). Years of formal education are a well-recognized indicator of social position and studies have shown that people with progressively more advanced levels of education have better health and longer lives than those without (Morrison et al. 2005).

## 1.2 PROBLEM STATEMENT

Literature has linked the impact of education on health to increased consciousness and access to and use of maternal health services. Educated women are more likely to have higher self-determination that ensures they avoid risk factors that impact negatively on their pregnancies also they are more likely to improve their nutritional status which contributes positively to their pregnancy outcomes. Cutler et al. (2012) notably find that not only are the differences in health by education large, by most measures these differences have been growing in the recent years. This increasingly implores that the gradient in health by education should be systematically monitored across countries.

Previous studies have shown a fairly consistent relationship between some of the demographic factors, such as age and parity, and adverse pregnancy outcomes. However, the effect of some socioeconomic factors such as maternal education attainment has produced conflicting results (Magadi et al. 2001). Since most quantitative estimates of the relation between education, other socioeconomic variables and health are context specific depending on the country's socioeconomic and cultural environment, this suggests that policy decisions made should be based on empirical research that focuses on the appropriate contexts. Hence there is a need to establish the impact of education on adverse pregnancy outcomes in Kenya.

## 1.3 RESEARCH QUESTIONS

This study sought to answer the following questions:

1. What is the impact of education on adverse pregnancy outcomes in Kenya?
2. What effect do other factors have on adverse pregnancy outcomes in Kenya?
3. What are the appropriate policy recommendations?

## 1.4 OBJECTIVES

The general objective of this study was to analyze the impact of education on adverse pregnancy outcomes in Kenya.

The specific objectives were to:

1. Determine the impact of education on adverse pregnancy outcomes in Kenya.
2. Determine the effect of other factors on adverse pregnancy outcomes in Kenya.
3. Draw appropriate policy recommendations from the findings

## 1.5 SIGNIFICANCE OF THE STUDY

Pregnancy outcomes are often considered a litmus test for the health of a nation (Nagahawatte et al. 2008). A mother's own aspirations of a live born baby should have recognition among other world's health agenda. Due to cultural beliefs, many mothers face social stigma, blame and even marginalization when they experience a miscarriage or an abortion or when they have a stillbirth (Froen et al. 2011). Increasing mother's consciousness in taking care of their pregnancies and on the use of health care services will go a long way in the prevention of adverse pregnancy outcomes.

The WHO Commission on Social Determinants of Health recommends studies to be done on the link between women's socio-economic characteristics and maternal health since the more socially and economically advantaged people are, the better their health. Education being a key socio-economic characteristic and an important social determinant of health makes it paramount to study its effect on adverse pregnancy outcomes.

It is widely recognized that MDG 5 to improve maternal health has shown the least progress among all MDGs. Maternal mortality is strongly correlated with adverse pregnancy outcomes (Lawn et al. 2010). Increasing attention to the causation of adverse pregnancy outcomes will accelerate progress toward improvement of maternal, fetal, newborn and child health outcomes.

This study was therefore aimed at contributing to policy recommendation targeting the improvement of maternal health through a reduction in experiences of adverse pregnancy outcomes.

# CHAPTER TWO
# LITERATURE REVIEW

This chapter highlights the theoretical literatures to which this study is underpinned. Also a number of studies done on the impact of education on adverse pregnancy outcomes are presented.

## 2.1 THEORETICAL LITERATURE

### Theory of Human Development

Bronfenbrenner's theory attempts to explain the influence of environment on one's development. This theory contains five environmental systems ranging from the immediate association with social elements, to the broad spectrum of culture. The role that people play in Bronfenbrenner's system determines their behaviour and actions. Systems in the theory are the mesosytem, microsystem, chronosystem, macrosystem, and exosystem.The microsytem is the context within which the person lives. This context would contain the individual's family, neighborhood, schools, and peers. Within this system, many direct associations with social agents occur. The mesosystem is the direct relation of family events to school events, school events to church events, or family events to peer events. The exosystem refers to the way in which events occurring in one environment during life can have an effect on what one experiences in an immediate setting. The macrosystem describes the culture in which individuals live. Cultural contexts would include socioeconomic status, poverty, and ethnicity. The chronosytem refers to the patterning of environmental events and transitions through life course, and socio-historical situations. (Bronfenbrenner 1994, Feinstein et al,. 2006)

### Human Capital Model for the Demand for Health

The model posits that the stock of health capital enters the utility function as a consumption good because better health increases utility. The model puts forward that schooling causes health because schooling increases the efficiency of health production. Causality from schooling to health results when more educated persons are more efficient producers of health (Grossman, 2000, Altindag et al. 2010). The efficiency effect can take two forms: productive and allocative efficiency. In the productive efficiency approach, an increase in schooling raises the efficiency of

the production process in the nonmarket or household sector, just as an increase in technology raises the efficiency of the production process in the market. Hence the more educated will obtain a larger health output from given amounts of endogenous inputs (Grossman, 2000, Grossman, 2005). However, it has also been suggested that schooling influences health mainly through its impact on allocative efficiency. Allocative efficiency pertains to situations in which the more educated pick a different mix of inputs to produce health than the less educated; it is presumed that the more educated choose a combination of inputs that produces more output than does the input mix chosen by the less educated. Typically, approaches to allocative efficiency assume that the more educated have more information about the true nature of the production function. For example, the more educated may have more knowledge about the harmful effects of smoking or about what constitutes an appropriate diet. (Altindang et al. 2010, Grossman 2005, Feinstein et al. 2006)

**2.2EMPRICAL LITERATURE**

Grossman (2000) suggests that years of formal schooling completed is the most important correlate of good health. Also that schooling is a more important correlate of health than occupation or income, also components of socioeconomic status. Although schooling is a causal determinant of occupation and income, a significant portion of the gross schooling effect cannot be traced to the relationship between schooling and income or occupation. Cutler et al., (2006) puts forward that identification of the causal effect of education is a complex task, however the positive correlation between schooling and health can be explained by a causal relationship that runs from schooling to health, that it runs from health to schooling and that both are determined by a third factor such as time or risk preferences. Conti et al. (2010) observes that understanding the relative importance of each of these mechanisms in generating observed differences in health by education is helpful in designing policies to promote health. The disparities in health that are brought by education are captured by the education gradient (Cutler et al. 2006).

Andresen (2006) points out that educational attainment is the social variable that often displays the largest socioeconomic differential reason being that education affects income and occupation. However, education also represents the dimension of knowledge, which may be why education is associated with, for example, the ability to understand public health messages. Educational

attainment, which is acquired over many years, may be a more sensitive indicator of childhood and adolescent socioeconomic circumstances than income and occupation.

According to Aizer et al. (2010), there are multiple potential mechanisms behind the relationship between education and health. To start with, education may lead to better health because it leads to greater income and access to health care. However, the documented relationship between education and health often remains fairly diminished when controls for income are included, suggesting that income does not explain the entire relationship between education and health. Cutler et al. (2006) gives a theory on social support system that the more educated have larger social networks which provide financial, physical and emotional support, and may in turn have a causal effect on health. However evidence shows that social networks do not appear to explain the association between health and education. Another potential mechanism mentioned by Cutler et al. (2006) states that more highly educated individuals may have better jobs that, in addition to paying higher incomes and providing health insurance, offer safer work environments. But this too has not been sufficient to explain the education health gradient.

Investigating the socioeconomic position and the risk factors of preterm birth, Morgen et al. (2008) undertook a study within the Danish National Birth Cohort. Maternal education levels were found to be the strongest predictors of preterm birth among other socioeconomic measures. It was reported that mothers with less 10 years of education compared to those with greater than 12 years of education had an elevated risk of experiencing adverse pregnancy outcomes. In relation to income, the findings showed that lower household income did not count as a risk factor for preterm births. Smoking on the other hand, was found to be the only factor that explained the education gradient in adverse pregnancy outcomes for women who given birth one or more times.

Ugwuja (2011) studied the impact of socioeconomic status on pregnancy outcomes on Nigerian women. It was pointed out that several studies on socioeconomic status impact on pregnancy outcomes produced conflicting results. In this study, there was no definite observation on the trend of the impact of maternal education on pregnancy outcomes. However, for women without formal education most adverse outcomes were absent. More adverse pregnancy outcomes were

recorded among women who were housewives and farmers compared to women whose occupations were civil service and artisans.

Stillbirth represents a substantial proportion of perinatal mortality and maternal education is reported as a risk factor. However, little is known on how maternal education influences stillbirth at various gestation ages. Auger et al (2011) evaluated the association between education and stillbirth across gestation ages. Stillbirth rate were computed using stillbirth in a given gestational interval as the numerator. Multivariable logistic regression was used to compile odds ratio for the relationship between education rank and stillbirth. The results indicated that women with lowest education level had two times higher odds of overall stillbirth relative to those with the highest education.

Jansen et al. (2009) applied educational attainment level of pregnant women as an indicator of socioeconomic status. The study's objective was to examine the association between education and adverse pregnancy outcomes. Education was categorized as low :primary school, lower vocational training, intermediate general school and 3 years general secondary school, mid-low :>3 years general secondary school, intermediate vocational training and 1st year higher vocational training, mid- high :higher vocational training and Bachelor's degree, and high :higher academic education and PhD. Association between education level of pregnant women and adverse pregnancy outcomes was examined using logistic regression analysis with high education as the reference group. Study results showed that women with a low educational level had a nearly two times higher risk of experiencing adverse pregnancy outcome compared to women with a high educational level. One way the risk of adverse pregnancy outcome was explained was through lifestyle habits. Overweight: BMI>25 and thinness: BMI<18 are well established risk factors for adverse pregnancy outcomes. The study showed that the impact of overweight on adverse pregnancy outcomes among low educated women was larger than the impact of thinness since overweight was much more prevalent in this educational subgroup than thinness.

Lofwander (2012) investigated the association between education and stillbirth in a regional referral hospital in North Eastern Tanzania with particular interest on estimating stillbirth

differences in women with no education compared to those who had been to school. The measure of outcome was stillbirth and the reported stillbirth rate was 36 per 1000 births. An inverse gradient between the level of education and proportion of stillbirth was reported, where experience of stillbirth to women with no education was approximated at three times more compared to women with high education. The study also indicated that there was higher percentage of women <20 years with no education compared to other levels of education. A more discreet decline appeared between primary education and other levels of education. The study therefore concluded that there was a possible major reduction of stillbirth by elevating education levels from none to primary level. Furthermore this study showed significant adverse pregnancy outcomes influenced by culture. Cultural practices were reported to hinder mothers form seeking obstetric care. Most of these women were characterized as having very low education.

Magadi et al. (2001) addressed factors associated with unfavourable birth outcomes in Kenya. Examination of these factors was based on the 1993 KDHS data. The analysis was done using multilevel logistic regression models so as to take account of family and community effects. Results showed that attendance of antenatal care clinics had a negative association with incidence of preterm birth. The odds of unfavourable birth outcomes were found to vary significantly between women, whereas no significant association between maternal education and unfavourable birth outcomes was shown. Interestingly, the study illustrated a significant association between ethnicity and adverse pregnancy outcomes, this maybe an indication of the significant role played by cultural practices on pregnancy outcomes.

Magadi et al. (2004), sort to find the pathways of the determinants of unfavourable pregnancy outcomes in Kenya. This was a result of inconsistent pattern on the effects of socioeconomic factors such as maternal education attainment on unfavourable pregnancy outcomes. Graphical chain models were employed to explore the association structure of the factors that may have a contribution to unfavourable birth outcomes. Using the KDHS data the result showed that even though maternal education had no direct association with unfavourable pregnancy outcomes, it was demonstrated to have an indirect association through some of the intermediate factors particularly antenatal care.

Cheptum et al. (2012) studied poor pregnancy outcomes in public health facilities in Kenya. The objective of the study was to identify factors that contribute to adverse pregnancy outcomes among women seeking care in public health facilities. Women attending Maternal and Child Health/Family Planning (MCH/FP) of reproductive age 15-49 were sampled. The study noted that socioeconomic factors associated with poor pregnancy outcomes included low education level and lack of formal employment. The association between low level of education and poor pregnancy outcomes could be attributed to the women's lack of knowledge on health care for themselves. Even though the women were attending ANC, longer waiting time at the facility acted as contributing factor to poor pregnancy outcomes.

According to Kenny et al. (2013) older mothers are at increased risk of adverse pregnancy outcome compared to their younger peers. This risk is evident in women as young as 30–34 years of age and increases with age. Ayenigbrana (2012) however reports that teenage pregnancies have a significant association with stillbirth. To add on, Hollander (2006) puts forward that both teenagers and women aged 35 or older are at significantly higher risk of having a stillbirth than are women in their 20s and early 30s.

The rich-poor gap in pregnancy outcomes has been examined principally in terms of poorer women's reduced chances of receiving prenatal care. Izugbara et al. (2010) adds that poverty primarily generates adverse pregnancy outcomes by exposing women to exceedingly hard and heavy workloads during pregnancy; to intimate partner violence; as well as to inhospitable and unpleasant treatment by service providers. Poverty or lower socio economic status is also associated with an increase in behavioral risk factors such as smoking that is associated with adverse pregnancy outcomes (Nagahawatte et al. 2008). In the case of educated women who participate in the labour force, Magadi et al. (2001) points out that they have an increased chance of experiencing adverse pregnancy outcomes due to their use of motorized transport on bumpy roads, which cause intrauterine vibrations.

**RISK FACTORS**

Obesity, a lifestyle risk to health, has become a worldwide individual and public health issue with the rate dramatically increasing. Maternal overweight and obesity have been associated with adverse pregnancy outcomes such as stillbirth. Cedergren (2004) did an assessment of whether morbid obesity, defined by BMI 35.1-40 or BMI greater than 40, was associated with an increase in the risk of adverse pregnancy outcomes. The findings indicated that there was a 3 times increase of stillbirth in the group of obese women. Salihu (2011) provided evidence showing that the risk of stillbirth increased among obese mothers. It was noted that there was an incremental elevation of the risk of stillbirth with ascending BMI values, also there was improvement in fetal survival with a decrease in inter-pregnancy BMI among obese women. This provided sufficient evidence to show a causal relationship between maternal obesity and stillbirth.

Smoking during pregnancy has been associated with many adverse pregnancy outcomes. However there have been debates on whether smoking causes these outcomes. Walsh (1994) studied the effect of maternal smoking on adverse pregnancy outcomes. In the review of the criteria of causation, the study found that the relative risk of spontaneous abortions are increased by one-third in women who smoke during pregnancy compared to those who do not smoke. Also a strong gradient for smoking during pregnancy was reported in relation to spontaneous abortions. Ayenigbara (2012) found that the women with low education levels were more likely than others to smoke and this doubled their risk of delivering a stillbirth infant. However, contrary to these studies, Absar (2009) found no significant relation between smoking and adverse pregnancy outcomes in urban Ghana. To add on, exploring potential mechanisms for the relationship between poverty and adverse pregnancy outcomes in the United States, Najahawatic et al. (2008) reported that poorer women received less prenatal care compared to wealthier women. Whereas smoking increases risk of preterm and stillbirths, women of lower socioeconomic status with lower level of education were reported to be at a higher risk of smoking during pregnancy. Both underweight and obese status also accounted for the risk of adverse pregnancy outcomes.

## 2.3 OVERVIEW OF LITERATURE

The literature reviewed gives an analysis of the theoretical underpinning on how education influences production of health. The empirical literature has furthered insights on related studies

done with a view to show the gap left. Most of the literature points to the fact that maternal education has an association with adverse pregnancy outcomes where women of lower education level have higher chance of experiencing stillbirth, miscarriage, abortion or even preterm birth. However there are still studies that fail to confirm this. Education increases consciousness in risky behaviours that may increase the chances of adverse pregnancy outcomes. Obesity elevates the risk of stillbirth while smoking, mostly associated with women of low education level, can lead to spontaneous abortions and stillbirth. Whereas some studies indicate that women who are working have a higher risk of adverse pregnancy outcomes, others have concluded otherwise, that housewives have more experiences of adverse pregnancy outcomes.

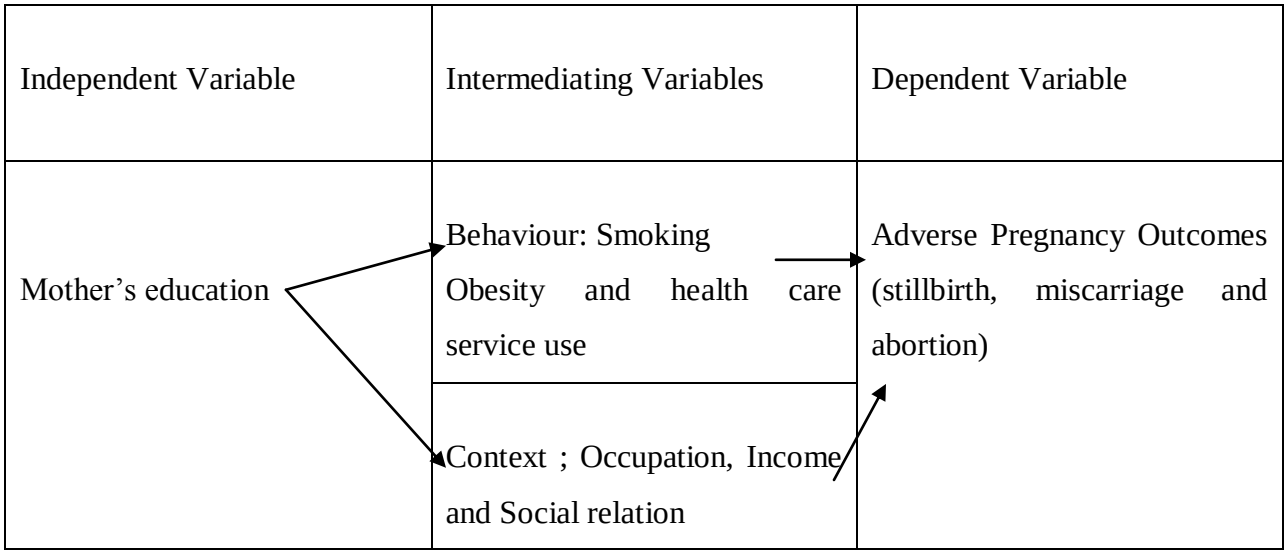
There is paucity of studies in Kenya about the influences of maternal education on adverse pregnancy outcomes. Specifically, it is not known how a mother's education level would impact on the experience of an adverse pregnancy outcome. Also the contribution of the health related behaviours on the education gradient is unknown. This study proposed to fill this information gap.

# CHAPTER THREE
# METHODOLOGY

## 3.1 CONCEPTUAL FRAMEWORK

A conceptual framework for analyzing the effect of education on adverse pregnancy outcomes based on the conceptual model on effects of education on health by Feinstein et al., (2006) adopted from Bronfenbrenner´s theory of human development is presented in figure 1 below.

**Figure 1: Diagrammatic representation of the Conceptual Framework**




**Source**: Feinstein et al. (2006)

It can be observed that the experience of adverse pregnancy outcomes can be influenced by education through occupation, income gained and the social relation participation of an individual. This goes on to influence the lifestyle behaviour such as smoking and obesity and also the use of health care services such as ANC visits.

## 3.2ANALYTICAL FRAMEWORK

The analytical framework of this study will be at the core of maternal health production. We assume that mothers derive utility from their own health, hence they will engage in their own health production using behavioural, market and non-market inputs (Mwabu 2008).

We specify the utility maximization problem as follows;

U= f (C, X, H)…….. (1)

Where U is the mother's utility function, C represents consumption of goods purchased that do not directly affect mother's health, X represents health inputs and behaviour which directly affects mother's health, such as access to health care services and behaviours that influence health such as smoking and obesity. H represents mother's own health status.

The health of the mother is influenced by her level of education E, health inputs and behaviour X, her background that affects health such as occupation and income B, socio-demographic characteristics Y, and μ which represents the unobserved characteristic some of which are known to the individual but unknown to the researcher such as inborn or intrinsic healthiness, environmental factors and measurement errors both random and systematic (Mugo 2012). Consequently the mother's health production function can be written as:

H= H (E, X, B, Y, μ)…….. (2)

The mother maximizes (1) and (2) subject to the following budget constraint:

I = PcC + PeE + PxX…… (3)

The maximization problem yields the following input demand equations:

C= C (Pc, Px, Pe, B, Y, I, μ)…… (4)

X= X (Px, Pc, Pe, B, Y, I, μ)…… (5)

E= E (Pe, Pc, Px, B, Y, I, μ)……..... (6)

Where I = Exogenous income

Pc= Consumption price

Pe = price of mother's education

Px = price of the health inputs

Combining equation (2) and (5) we can create a reduced form of maternal health production function which tends to causally link E to changes in maternal health status (Mwabu 2008, Awiti 2013). The reduced form of maternal health production can be written as:

$$H = H(Px, Pc, E, B, Y, I, \mu) \quad (7)$$

Where H is a measure of maternal health status which is a function of Pc, Px, E, B, Y, I as earlier defined and μ the unobserved factors. The estimation procedure to be adopted for Equation (7) should take into account the fact that E is potentially endogenous and the fact that μ is unobservable.

### 3.3ECONOMETRIC ISSUES AND MODEL ESTIMATION

The possibility of inconsistent parameters estimation due to endogenous regressors is a major complication. The instrument variable (IV) estimator provides a way of obtaining consistent parameter estimators. Both endogeneity and heterogeneity bias can compromise the validity of the OLS estimators. Endogeneity is said to arise from errors in variables, omitted variables and simultaneous causality (Bascel 2008).

Binary choice models assume that individuals are faced with a choice between two alternatives and the choice of any of the two depend on certain factors (Long 1997).

$$H_i = \begin{cases} 1 \text{ if the mother } i \text{ experienced an adverse pregnancy outcome given by miscarriage, stillbirth or abortion} \\ 0 \text{ otherwise} \end{cases} \quad (8)$$

Maternal health status takes a binary form where $H_i$ is the observed maternal health status of mother *i*. Therefore a binary regression model will be an appropriate model for maternal health status.

Assuming that the observed maternal health status is a continuous latent variable, $H_i^*$ is related to $H_i$ in the following way:

$$H_i = \begin{cases} 1 \text{ if } H_i^* > 0 \\ 0 \text{ otherwise} \end{cases} \quad (9)$$

The latent variable is then linked to the covariates by the following equation:

$$H_i^* = \beta_0 + \beta_1 E_i + \beta_2 W + \varepsilon_{1i} \quad (10)$$

Where W represents the control variables, E is the education level and ε is the stochastic error term.

Given E and W values, probability of $H_i$ can be shown as:

$$Pr(H_i = 1|E, W) = Pr(H_i^* > 0|E, W) \quad (11)$$

From equation (10) we can rewrite equation (11) as:

$$Pr(H_i = 1|E, W) = Pr(-\varepsilon_{1i} \leq \beta_0 + \beta_1 E + \beta_2 W|\ E, W) \quad (12)$$

Since equation (12) is the cumulative distribution frequency (cdf) of the error distribution evaluated at $\beta_0 + \beta_1 E + \beta_2 W$, we can write the following:

$$Pr(H_i = 1|E, W) = F(\beta_0 + \beta_1 E + \beta_2 W) \quad (13)$$

Where F is the cdf of $\varepsilon_{1i}$

Assuming a standard normal distribution of the error term gives us a probit model:

$$Pr(H_i = 1|E, W) = \phi(\beta_0 + \beta_1 E + \beta_2 W) \quad (14)$$

Where $\phi$ is the standard normal cdf

Mother's education can be shown as an ordinal variable and therefore an ordered regression model is used. We can construct the following education variable:

$$E_i = \begin{cases} 1 \text{ if mother } i \text{ has no education, 0otherwise} \\ 1 \text{ if mother } i \text{ highest level of education is primary education, 0 otherwise} \\ 1 \text{ if mother } i \text{ highest level of education is secondary education, 0 otherwise} \\ 1 \text{ if mother } i \text{ highest level of education is higher education, 0 otherwise} \end{cases} \quad (15)$$

We assume that the education level of mother *i*, $E_i$ is linked to a latent continuous variable $E_i^*$. Therefore $E_i^*$ is linked to the covariates by the following equation:

$$E_i^* = \alpha_1 + \alpha_2 W + \alpha_3 Z + \varepsilon_{2i} \quad (16)$$

Where W is a vector of controls, Z a vector of instruments and $\varepsilon_2$ is a stochastic disturbance term.

Due to unobservable characteristic contained in the error term of the maternal health production, the parameters in equation (2) are not identified (Mwabu 2008). The health input demand functions provide identifying instruments in the form of input prices and income. Other instruments may include ownership of assets and community or environmental characteristics such as access to public health services and other public infrastructure expressed as distances to these infrastructures (Mugo 2012).

To correct for potential endogeneity and non-linear interactions of unobservable variables with the observed regressor specified in equation (10), the equation is extended as shown below:

$$H_i^* = \beta_0 + \beta_1 W + \beta_1 E_i + \beta_2 ANC + \beta_3 OBE + \beta_4 SMO + \beta_5 OCC + \beta_6 WLTH + \beta_7 AGE + \beta_3 \varepsilon_{2i} + \beta_4 E_i \varepsilon_{2i} + \varepsilon_{1i} \quad (17)$$

Where $\varepsilon_{2i}$ is the residual of the endogenous input education, $E_i\varepsilon_{2i}$ is the interaction of the residual with an endogenous input. β's are parameters to be estimated. $\varepsilon_{2i}$ and $E_i\varepsilon_{2i}$ control for the effects of unobservable factors that would contaminate the OLS estimates of the structural parameters of maternal health measures. $\varepsilon_{2i}$ serves as a control for unobserved variables correlated with E, thus allowing E to be treated as though they were exogenous during estimation. $E_i\varepsilon_{2i}$ controls for effects of neglected non-linear interactions of the unobservable variables with the mothers' health measures (Mwabu 2008).

**Table 3.1: Variable definitions for Maternal Health Models**

| Variable | Measurement | Definition | Expected sign |
|---|---|---|---|
| Maternal Health Status (H) | Binary variable | 1 if mother experienced a stillbirth, a miscarriage or an abortion , 0 otherwise | |
| Education level (E) | Ordinal variable | No education = 1 if the mother has no education, 0 otherwise<br>Primary = 1 if mother's highest | Mixed results (Magadi 2004, Ugwuja 2011) |

| | | | |
|---|---|---|---|
| | | education level is primary, 0 otherwise<br>Secondary = 1 if mother's highest education level is secondary, 0 otherwise<br>Higher = 1 if mother's highest level of education is higher,0 otherwise | |
| Antenatal care (ANC) | Binary variable | ANC = 1 if the mother attends antenatal clinics, 0 otherwise | Attendance reduces the risk of adverse pregnancy outcomes (Magadi et al., 2004) |
| Obesity (OBE) | Binary variable | Obesity= 1 if BMI ≥25.0, 0 otherwise | Risk of adverse pregnancy outcome increases with obesity (Cadergren 2004) |
| Smoking (SMO) | Binary variable | Smoking = 1 if mother smokes, 0 otherwise | Cigarette smoking has been associated with many adverse pregnancy out comes(Walsh 1994) |
| Occupation (OCC) | Binary variable | Occupation = 1 if mother is working, 0 otherwise | Mixed results (Cheptum 2012, Magadi et al., 2001) |
| Wealth (WLTH) | Ordinal variable | Wealth quintiles =<br>1 if lowest, 2 if second, 3 if middle, 4 if fourth, 5 if highest | Those in the lowest wealth quintile have higher risk of adverse pregnancy outcomes (Nagahawatte et al., 2008) |
| Age (AG) | Discrete variable | Age of the mother | Teenagers and women aged 35 or older are at significantly higher risk of adverse pregnancy outcomes (Hollander 2006) |

### 3.4DATA SOURCE

This study used data from Kenya Demographic and health surveys (KDHS), nationally representative household surveys conducted in 2003 and 2008. Our study population comprised of women aged between 15 and 49 years who reported whether or not they had experienced an adverse pregnancy outcome that is, a miscarriage, stillbirth, or an abortion. The KDHS data captures the experience of a miscarriage, a stillbirth or an abortion as one variable. KDHS 2003 recorded that out of 5,948 women, 661 had experienced an adverse pregnancy outcome while KDHS 2008 recorded 662 women experienced an adverse pregnancy outcome out of 6,078. The study compared the findings for the two years.

# CHAPTER FOUR
# RESEARCH FINDINGS

This chapter contains the descriptive statistics and the empirical results from the data analyzed.

## 4.1 DESCRIPTIVE STATISTICS

Table 4.1 and table 4.2 present the descriptive statistics of the study variables. There were variations in the number of observations for the various variables since some of the variables were missing for some of the observations. The descriptive statistics shows the mean, standard deviation, minimum and maximum value of every variable considered.

**Table 4.1: Descriptive statistics for Maternal Health Models (2003)**

| VARIABLE | N | MEAN | SD | MIN | MAX |
|---|---|---|---|---|---|
| Maternal health status (H) | 5948 | 0.1111 | 0.314 | 0 | 1 |
| No education | 5949 | 0.2034 | 0.403 | 0 | 1 |
| Primary education | 5949 | 0.5809 | 0.493 | 0 | 1 |
| Secondary education | 5949 | 0.1735 | 0.379 | 0 | 1 |
| More than secondary education | 5949 | 0.0422 | 0.201 | 0 | 1 |
| Number of Antenatal care visits | 3870 | 4.0571 | 2.967 | 0 | 30 |
| Mother attends antenatal clinics (ANC) | 3870 | 0.8760 | 0.330 | 0 | 1 |
| BMI of respondent | 5656 | 22.257 | 4.082 | 12 | 61 |
| Respondent is thin for height (BMI<18.5 | 5656 | 0.1264 | 0.332 | 0 | 1 |
| Respondent is underweight (BMI<18) | 5656 | 0.0857 | 0.280 | 0 | 1 |
| Respondent is of healthy weight (BMI; 18.6 - 24.9) | 5656 | 0.6733 | 0.469 | 0 | 1 |
| Respondent is overweight (BMI; 25-29.9) | 5656 | 0.1353 | 0.342 | 0 | 1 |
| Respondent is obese (BMI>30) | 5656 | 0.0463 | 0.210 | 0 | 1 |
| Smokes cigarettes | 5948 | 0.0047 | 0.068 | 0 | 1 |
| Respondent reported to smoke something | 5948 | 0.0298 | 0.170 | 0 | 1 |
| Respondent is working (OCC) | 5942 | 0.6197 | 0.486 | 0 | 1 |
| Poorest wealth quintile | 5949 | 0.2520 | 0.434 | 0 | 1 |
| Poor wealth quintile | 5949 | 0.1775 | 0.391 | 0 | 1 |

| | | | | | |
|---|---|---|---|---|---|
| Middle wealth quintile | 5949 | 0.1878 | 0.385 | 0 | 1 |
| Rich wealth quintile | 5949 | 0.1575 | 0.364 | 0 | 1 |
| Richest wealth quintile | 5949 | 0.2217 | 0.415 | 0 | 1 |
| Respondent's age in years (AG) | 5949 | 28.162 | 6.654 | 15 | 49 |
| Respondent age is less than 20 | 5949 | 0.0684 | 0.252 | 0 | 1 |
| Respondent's age is more than 35 | 5949 | 0.1831 | 0.387 | 0 | 1 |
| Respondent sought prenatal care for nurse or midwife | 3955 | 0.7428 | 0.437 | 0 | 1 |
| Respondent sought prenatal care from a doctor | 3955 | 0.1934 | 0.395 | 0 | 1 |
| Respondent received some prenatal care | 3955 | 0.8786 | 0.327 | 0 | 1 |
| Urban residence | 5949 | 0.2579 | 0.437 | 0 | 1 |

**Table 4.2: Descriptive statistics for Maternal Health Models (2008)**

| VARIABLE | N | MEAN | SD | MIN | MAX |
|---|---|---|---|---|---|
| Maternal health status (H) | 6078 | 0.1089 | 0.312 | 0 | 1 |
| No education | 6079 | 0.2139 | 0.410 | 0 | 1 |
| Primary education | 6079 | 0.5642 | 0.495 | 0 | 1 |
| Secondary education | 6079 | 0.1684 | 0.374 | 0 | 1 |
| More than secondary education | 6079 | 0.0535 | 0.225 | 0 | 1 |
| Number of Antenatal care visits | 4016 | 3.5899 | 2.176 | 0 | 20 |
| Mother attends antenatal clinics (ANC) | 4016 | 0.9046 | 0.294 | 0 | 1 |
| BMI of respondent | 6010 | 22.425 | 4.416 | 11 | 75 |
| Respondent is thin for height (BMI<18.5 | 6010 | 0.1339 | 0.341 | 0 | 1 |
| Respondent is underweight (BMI<18) | 6010 | 0.0957 | 0.294 | 0 | 1 |
| Respondent is of healthy weight (BMI; 18.6 - 24.9) | 6010 | 0.6442 | 0.479 | 0 | 1 |
| Respondent is overweight (BMI; 25-29.9) | 6010 | 0.1496 | 0.357 | 0 | 1 |
| Respondent is obese (BMI>30) | 6010 | 0.0541 | 0.226 | 0 | 1 |
| Smokes cigarettes | 6072 | 0.0030 | 0.054 | 0 | 1 |
| Smokes pipe | 6071 | 0.0010 | 0.031 | 0 | 1 |
| Respondent reported to smoke something | 6072 | 0.0262 | 0.160 | 0 | 1 |

| | | | | | |
|---|---|---|---|---|---|
| Respondent is working (OCC) | 6064 | 0.5732 | 0.495 | 0 | 1 |
| Poorest wealth quintile | 6079 | 0.2923 | 0.455 | 0 | 1 |
| Poor wealth quintile | 6079 | 0.1775 | 0.382 | 0 | 1 |
| Middle wealth quintile | 6079 | 0.1620 | 0.369 | 0 | 1 |
| Rich wealth quintile | 6079 | 0.1620 | 0.369 | 0 | 1 |
| Richest wealth quintile | 6079 | 0.2061 | 0.405 | 0 | 1 |
| Respondent's age in years (AG) | 6079 | 28.236 | 6.665 | 15 | 49 |
| Respondent age is less than 20 | 6079 | 0.0581 | 0.234 | 0 | 1 |
| Respondent's age is more than 35 | 6079 | 0.1908 | 0.393 | 0 | 1 |
| Respondent sought prenatal care for nurse or midwife | 4076 | 0.6703 | 0.470 | 0 | 1 |
| Respondent sought prenatal care from a doctor | 4076 | 0.3013 | 0.459 | 0 | 1 |
| Respondent received some prenatal care | 4076 | 0.9060 | 0.292 | 0 | 1 |
| Urban residence | 6079 | 0.2413 | 0.428 | 0 | 1 |

There were 6078 and 5948 women in 2003 and 2008 respectively whose data on health status was available. The women were between 15 and 49 years. In 2003, 11.11% of the women experienced an adverse pregnancy outcome compared to 10.89% in 2008. Other demographics indicate that 18.10% of the women were overweight and obese in 2003, whereas in 2008 there were 20.37%. Women who smoke constituted 2.98% and 2.62% in 2003 and 2008 correspondingly.

Table 4.3 shows the distribution of maternal health status by level of education considering the whole population. The table shows that in 2003 and 2008 about 22.09% and 24.17% of the women who had no education experienced adverse pregnancy outcomes. The table also indicates that about 13.75% (2003) and 15.43% (2008) of the women who experienced adverse pregnancy outcomes had secondary education.

**Table 4.3: Distribution of Maternal Health Status by Level of Education, Percentages in Parentheses**

| Experienced a miscarriage, | Level of education | Total |
|---|---|---|

| stillbirth or abortion | No education | primary | secondary | higher | |
|---|---|---|---|---|---|
| 2003 | 146 | 373 | 102 | 40 | 661 |
| | (22.09%) | (56.43%) | (15.43%) | (6.05%) | (100%) |
| 2008 | 160 | 381 | 91 | 30 | 662 |
| | (24.17%) | (57.55%) | (13.75%) | (4.53%) | (100%) |

## 4.2 ASSESSING MULTICOLLINEARITY

The Variance Inflation Factors (VIF) is used for assessing multicollinearity. A rule of the thumb states that there is evidence of collinearity if the largest VIF is greater than 10. Therefore variables that have a VIF greater than 10 may not be considered in the final regression model. Table 4.4 presents VIF for covariates in 2003 and 2008 in that order.

**Table 4.4: Variance Inflation Factors for Covariates in 2003 and 2008**

| | 2003 | | 2008 | |
|---|---|---|---|---|
| VARIABLE | VIF | 1/VIF | VIF | 1/VIF |
| BMI of respondent | 80.15 | 0.012 | 73.28 | 0.014 |
| Respondent's age in years (AG) | 51.35 | 0.019 | 51.29 | 0.019 |
| Mother attends antenatal clinics (ANC) | 25.50 | 0.039 | 28.53 | 0.035 |
| Respondent is of healthy weight (BMI; 18.6 -24.9) | 29.79 | 0.034 | 27.47 | 0.036 |
| Primary education | 13.62 | 0.073 | 11.38 | 0.088 |
| Respondent sought prenatal care for nurse or midwife | 12.38 | 0.081 | 10.46 | 0.096 |
| Respondent is overweight (BMI; 25-29.9) | 9.92 | 0.101 | 10.02 | 0.100 |
| Respondent is thin for height (BMI<18.5 | 7.53 | 0.133 | 8.38 | 0.119 |
| No education | 5.74 | 0.174 | 6.61 | 0.151 |
| Respondent is obese (BMI>30) | 5.63 | 0.178 | 5.80 | 0.173 |
| Secondary education | 4.89 | 0.205 | 5.09 | 0.197 |
| Number of Antenatal care visits | 4.27 | 0.234 | 4.96 | 0.202 |
| Poorest wealth quintile | 4.13 | 0.242 | 4.15 | 0.241 |
| Respondent is underweight (BMI<18) | 3.09 | 0.323 | 3.91 | 0.256 |
| Respondent's age is more than 35 | 3.12 | 0.321 | 3.61 | 0.277 |

| | | | | |
|---|---|---|---|---|
| Poor wealth quintile | 3.28 | 0.305 | 3.21 | 0.312 |
| Middle wealth quintile | 3.05 | 0.328 | 3.20 | 0.312 |
| Urban residence | 2.93 | 0.341 | 2.99 | 0.334 |
| Respondent is working (OCC) | 3.10 | 0.323 | 2.98 | 0.336 |
| Rich wealth quintile | 2.49 | 0.401 | 2.74 | 0.365 |
| Respondent sought prenatal care from a doctor | 2.39 | 0.418 | 2.44 | 0.411 |
| Respondent age is less than 20 | 1.45 | 0.690 | 1.41 | 0.710 |
| Respondent reported to smoke something | 1.33 | 0.752 | 1.30 | 0.771 |
| Smokes cigarettes | 1.23 | 0.815 | 1.22 | 0.822 |
| **MEAN VIF** | **11.77** | | **11.52** | |

### 4.3 EMPIRICAL RESULTS

Here we present and compare results for maternal health production estimates using the 2SRI for adverse pregnancy outcomes. The use of 2SRI method produces estimates that are consistent for the model by introducing the endogenous variable residual and the interaction of the residual with the endogenous regressor.

Tables 4.5 and 4.6 present the findings of the impact of maternal education on adverse pregnancy outcomes. A comparison was made between the findings of year 2003 and 2008. Table 4.6 gives the model estimates that control for both potential endogeneity and the unobserved heterogeneity in the model. The $R^2$ of the two years brings a lot of contrast; year 2003 has an $R^2$ of 0.05 while 2008 has an $R^2$ of 0.60. This implies that for 2003 the regression explains only 5% of the variations in the model whereas for 2008 up to 60% of the variations in adverse pregnancy outcomes can be explained.

The education coefficients in table 4.5 are both negative though only the coefficient for year 2008 is statistically significant. Comparing with the model in table 4.6, year 2003 gives a positive coefficient while 2008 shows a negative coefficient that is statistically significant. The significant results imply that secondary and higher education has a negative impact on adverse pregnancy outcomes. This finding is consistent with the findings in the literature where there was found to be an inverse gradient between education and experience of stillbirth (Lofwader 2012)

and where women with higher levels of education were reported to have lower risks of experiencing adverse pregnancy outcomes compared to women with low education level (Jansen et al. 2009, Auger 2011 and Morgen et al. 2008).

In both models shown in table 4.6, mother's age and mother's marital status are positive and statistically significant. This implies that older age has a positive impact on the experience of stillbirth, abortion or miscarriage. The results also indicate that married mothers contribute positively to adverse pregnancy outcomes.

**Table 4.5: Estimates of Maternal Health Status Model**

| | 2003 coefficient (Z statistics) | 2008 coefficient (Z Statistics) |
|---|---|---|
| More than secondary education | -0.016 (-0.24) | -0.233** (-3.26) |
| Respondent sought prenatal care | 0.076 (0.82) | 0.187*(1.90) |
| Respondent is of healthy weight (BMI; 18.6 -24.9) | -0.058 (-0.93) | -0.158** ( -2.69) |
| Respondent is obese (BMI>30) | -0.104 (-0.79) | -0.014 (-0.12) |
| Smokes cigarettes | -0.035 (-0.22) | 0.223(1.38) |
| Respondent is working (OCC) | 0.052 (0.85) | -0.038 (0.66) |
| Respondent's wealth quintile is middle or higher | -0.100 (-1.53) | 0.025 (0.39) |
| Respondent's age | 0.036 (8.33) | 0.029** (7.03) |
| Respondent age is less than 20 | -0.085 (-0.59) | -0.39** (-2.28) |
| Respondent is married | 0.268 (3.64) | 0.287** (3.90) |
| Respondent is Roman Catholic | -0.049 (-0.70) | -0.186** (-2.43) |
| Urban resident | 0.047 (0.65) | -0.105 (-1.55) |
| Constant | -2.499 (-14.46) | -2.276 (-12.77) |

**p values <0.05; *p values<0.10

**Table 4.6: 2SRI Estimates of Maternal Health Status Model**

| | **2SRI** | |
|---|---|---|
| | 2003 coefficients (Z statistics) | 2008 coefficients (Z statistics) |

| | | |
|---|---|---|
| More than secondary education | 0.016 (0.09) | -1.347** (-4.27) |
| Respondent sought prenatal care | 0.072 (0.78) | 0.373** (2.24) |
| Respondent is of healthy weight (BMI; 18.6 -24.9) | -0.043 (-0.64) | -1.401** ( -13.37) |
| Respondent is obese (BMI>30) | -0.165 (-0.92) | 2.927** (8.81) |
| Smokes cigarettes | 0.056 (0.03) | -6.820** (-7.05) |
| Respondent is working (OCC) | 0.017 (0.19) | 2.239 **(11.60) |
| Respondent's wealth quintile is middle or higher | -0.209 (-0.98) | 12.296** (12.19) |
| Respondent's age | 0.036** (8.39) | 0.696 **(9.36) |
| Respondent age is less than 20 | -0.033 (-0.20) | -3.762** (-8.59) |
| Respondent is married | 0.268** (3.63) | 0.458** (4.02) |
| Respondent is Roman Catholic | -0.054 (-0.78) | 0.766** (4.93) |
| Urban resident | 0.047 (0.65) | -0.216*(-1.82) |
| Residuals | 0.460 (0.55) | -48.738** (-12.68) |
| Residuals/more than secondary education interaction | -0.114 (-0.23) | 5.170** (4.75) |
| Constant | -2.524 (-14.20) | -0.138 (-0.44) |

**p values <0.05; *p values<0.10

The 2SRI estimates for 2008 show that being obese, Catholic and belonging to a middle or higher wealth quintile has a positive impact on adverse pregnancy outcomes. Additionally working also has a positive impact on adverse pregnancy outcomes.

Despite not being statistically significant, the 2003 2SRI estimates indicate that smoking, working and being an urban resident have a positive impact on adverse pregnancy outcomes.

Tables 4.7 and 4.8 present the average marginal effects estimation results for the maternal health status model. Table 4.8 results include the residual and the interaction of the residual with the endogenous variable. The average marginal effect explains the likelihood of a mother experiencing an adverse pregnancy outcome increasing or decreasing based on the sign of a unit change in any of the maternal health status indicators in the tables 4.7 and 4.8 below.

**Table 4.7: Average Marginal Effects**

| | **Average marginal** | **Average marginal** |
|---|---|---|

| | effects (2003) | effects (2008) |
|---|---|---|
| More than secondary education | -0.003 | -0.041** |
| Respondent sought prenatal care | 0.014 | 0.033* |
| Respondent is of healthy weight (BMI; 18.6 -24.9) | -0.010 | -0.280** |
| Respondent is obese (BMI>30) | -0.019 | -0.002 |
| Smokes cigarettes | -0.006 | 0.039 |
| Respondent is working (OCC) | 0.009 | -0.007 |
| Respondent's wealth quintile is middle or higher | -0.018 | 0.004 |
| Respondent's age | 0.007** | 0.005** |
| Respondent age is less than 20 | -0.015 | -0.069** |
| Respondent is married | 0.048** | 0.051** |
| Respondent is Roman Catholic | -0.009 | -0.033** |
| Urban resident | 0.008 | 0.019 |
| Number of observations | 3742 | 4015 |

**p values <0.05; *p values<0.10

**Table 4.8: Average Marginal Effects with Residuals**

| | Average marginal effects (2003) | Average marginal effects (2008) |
|---|---|---|
| More than secondary education | 0.003 | -0.107** |
| Respondent sought prenatal care | 0.013 | 0.030** |
| Respondent is of healthy weight (BMI; 18.6 -24.9) | -0.008 | -0.111** |
| Respondent is obese (BMI>30) | -0.030 | 0.232** |
| Smokes cigarettes | 0.001 | -0.540** |
| Respondent is working (OCC) | 0.003 | 0.177** |
| Respondent's wealth quintile is middle or higher | -0.037 | 0.973** |
| Respondent's age | 0.006** | 0.006** |
| Respondent age is less than 20 | -0.006 | -0.230** |
| Respondent is married | 0.048** | 0.036** |
| Respondent is Roman Catholic | -0.010 | 0.061** |
| Urban resident | 0.008 | -0.017* |

| | | |
|---|---|---|
| Residuals | 0.083 | -3.856** |
| Residuals/more than secondary education interaction | -0.020 | 0.409** |
| Number of observations | 3742 | 4015 |

**p values <0.05; *p values<0.10

From table 4.8 we can observe that more than secondary school education is a significant determinant of maternal health status for 2008 unlike 2003.The results show that having secondary education or higher reduces the probability of experiencing a miscarriage, stillbirth or abortion by 0.107 holding other factors constant.

Among the risk factors for adverse pregnancy outcomes is obesity. The results of 2008 indicate that if a mother is obese, the probability of that mother experiencing a miscarriage, abortion or stillbirth increases by 0.194. The finding is in agreement with the findings of Sahilu (2011) and Cedergren (2004) that the risk of stillbirth was high in the group of obese women. On the other hand, the results show that women who are of healthy weight reduced their risk of experiencing adverse pregnancy outcomes by 0.0954 holding other factors constant. On the contrary, the results for 2003 show obese mothers are less likely to experience adverse pregnancy outcome. However this is not statistically significant.

Despite the fact that the smoking is a behavioural risk factor for adverse pregnancy outcomes, the 2008 results indicated an inconsistency compared to other findings in the literature. Walsh (1994) finding was that smoking increased the chances of spontaneous abortion; this however is reflected by the 2003 results.

According to the results, a one year increase in the age of the mother increase the probability of adverse pregnancy outcome by 0.006 holding other factors constant. This finding is in sync with Kenny et al. (2013) that increased mother's age increases the risk of adverse pregnancy outcomes. The results further indicate that for less than 20 years old mothers, the probability of experiencing adverse pregnancy outcome is reduced by 0.006 and 0.230 for 2003 and 2008 respectively holding other factors constant. This is however inconsistent with the findings of

Ayenigbara (2012) and Hollander (2006) that for teenage, pregnancies are at a significantly higher risk of ending up as stillbirths.

While most of the factors were not significant for the year 2003, majority of the factors were significant for year 2008. Focusing on 2008, the results reveal that if a mother is working her risk of experiencing stillbirth, abortion or miscarriage is higher compared to women who are not working. This may suggest that having an occupation can be detrimental to maternal health. This finding is consistent with Magadi et al. (2001) that mothers participating in the labour force are more likely to experience an adverse pregnancy outcome. According to the results mothers from wealthy households are more likely to experience adverse pregnancy outcomes, holding other factors constant. This is however not consistent with the finding in the literature that, poor women are more exposed to risk factors that increase their chances of adverse pregnancy outcomes (Izugbara et al. 2010).

Married mothers are more likely to experience adverse pregnancy outcomes compared to those who are not married as evident for both years. There are mixed results on the chances of a Catholic woman experiencing miscarriage, abortion or stillbirth holding other factors constant. If a mother lives in the urban areas, the 2008 results indicate that this reduces her risk of adverse pregnancy outcome by 0.017. Nevertheless in the results of 2003, urban residence increases the risk of adverse pregnancy outcome by 0.008 holding other factors constant.

# CHAPTER FIVE
# CONCLUSION AND POLICY RECOMMENDATION

## 5.1 CONCLUSION

This study estimated the impact of education on adverse pregnancy outcomes in Kenya. We measured the experience of adverse pregnancy outcomes using an indicator of whether or not a woman has ever had a pregnancy that was aborted, miscarried of ended in a stillbirth. We compared the impact in 2003 and 2008 using the KDHS 2003 and 2008 data. The estimation strategy adopted was the 2SRI that controls for potential endogeneity of education and potential unobserved heterogeneity.

For the year 2003, our findings indicate that despite controlling for any endogeneity and any unobserved heterogeneity, majority of the factors were not statistically significant. Nevertheless we find that mother's age and mother's marital status have a significant influence on whether a mother experiences an adverse pregnancy outcome or not.

Year 2008 main finding was that education has a negative impact on adverse pregnancy outcome. We find that achieving secondary and higher education reduces the probability of a mother experiencing a miscarriage, stillbirth, or an abortion, holding other factors constant. Furthermore, the experience of adverse pregnancy outcome is also shown to be significantly influenced by mother's age, household wealth, mother's place of residence (urban or rural), smoking and BMI.

We can draw a number of conclusions from the findings in this paper. First, from the 2008 results, we demonstrate that education lowers the risk of adverse pregnancy outcomes. This is consistent with findings in the literature. Secondly, from the 2003 results, we show that there is no significant impact of education on adverse pregnancy outcomes. This is also backed by some of the literature findings. For the two years, we find that the mother's age and mother's marital status significantly influence maternal health status.

## 5.2 POLICY RECOMMENDATIONS

From our significant findings we recommended:

- Policies that encourage and support mothers to achieve secondary and higher education levels to be enforced. This can be done by ensuring that secondary and higher education is affordable and can be accessed by all women. Thereby women who drop out of school after primary level can be able to continue with education and enjoy the benefits that come with it.
- Adoption of interventions that encourage women to maintain healthy weight and avoid obesity. Obesity is linked to other non communicable diseases and these negatively affect health. Maintaining healthy body weight will go a long way in ensuring good maternal health.
- Promotion of early childbearing to boost favourable pregnancy outcomes this is because as women get older, they tend to experience more adverse pregnancy outcomes.

### 5.3 AREA FOR FURTHER RESEARCH

It would be informative for researchers to establish the effects of socio-cultural practices such as female genital mutilation on adverse pregnancy outcomes.

Also a study using pooled data sets that will test for time dynamics for the two periods can be done.

Furthermore it would be enlightening for researchers to study the regional effects on adverse pregnancy outcomes since the KDHS gives data by provinces.

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# APPENDICES

## Appendix 1: Probit regression and Average marginal effect (2003)

```
Iteration 0:   log pseudolikelihood = -1301.6286
Iteration 1:   log pseudolikelihood = -1238.5784
Iteration 2:   log pseudolikelihood = -1237.3392
Iteration 3:   log pseudolikelihood =  -1237.335
Iteration 4:   log pseudolikelihood =  -1237.335

Probit regression                               Number of obs   =       3742
                                                Wald chi2(12)   =     132.26
                                                Prob > chi2     =     0.0000
Log pseudolikelihood =  -1237.335               Pseudo R2       =     0.0494
```

| H | Coef. | Robust Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| secondary_plus | -.0164683 | .0698053 | -0.24 | 0.813 | -.1532841 | .1203475 |
| some_prenatalcare | .0755193 | .092192 | 0.82 | 0.413 | -.1051738 | .2562124 |
| healthy_weight | -.0576315 | .0619045 | -0.93 | 0.352 | -.1789621 | .0636991 |
| OBE | -.1039288 | .1312249 | -0.79 | 0.428 | -.361125 | .1532674 |
| SMO | -.0345695 | .1563181 | -0.22 | 0.825 | -.3409474 | .2718084 |
| OCC | .0521498 | .0611001 | 0.85 | 0.393 | -.0676041 | .1719037 |
| middle_plus | -.1000684 | .0656095 | -1.53 | 0.127 | -.2286608 | .0285239 |
| age | .0364158 | .0042681 | 8.53 | 0.000 | .0280505 | .0447811 |
| teenagers | -.0847254 | .1445238 | -0.59 | 0.558 | -.3679868 | .198536 |
| married | .2676431 | .0736272 | 3.64 | 0.000 | .1233365 | .4119498 |
| catholic | -.0488992 | .0695317 | -0.70 | 0.482 | -.1851788 | .0873805 |
| urban | .046645 | .0716978 | 0.65 | 0.515 | -.0938801 | .1871702 |
| _cons | -2.499406 | .1728212 | -14.46 | 0.000 | -2.838129 | -2.160683 |

```
Average marginal effects                        Number of obs   =       3742
Model VCE    : Robust

Expression   : Pr(H), predict()
dy/dx w.r.t. : secondary_plus some_prenatalcare healthy_weight OBE SMO OCC middle_plus age teenagers married catholic urban
```

| | dy/dx | Delta-method Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| secondary_plus | -.0029594 | .0125481 | -0.24 | 0.814 | -.0275532 | .0216345 |
| some_prenatalcare | .0135709 | .0165693 | 0.82 | 0.413 | -.0189043 | .0460461 |
| healthy_weight | -.0103565 | .0111269 | -0.93 | 0.352 | -.0321648 | .0114519 |
| OBE | -.0186761 | .023588 | -0.79 | 0.428 | -.0649078 | .0275555 |
| SMO | -.0062122 | .0280916 | -0.22 | 0.825 | -.0612708 | .0488464 |
| OCC | .0093714 | .0109806 | 0.85 | 0.393 | -.0121502 | .0308929 |
| middle_plus | -.0179824 | .0117835 | -1.53 | 0.127 | -.0410777 | .0051129 |
| age | .006544 | .0007699 | 8.50 | 0.000 | .005035 | .0080529 |
| teenagers | -.0152253 | .0259793 | -0.59 | 0.558 | -.0661437 | .0356932 |
| married | .0480958 | .0132728 | 3.62 | 0.000 | .0220816 | .07411 |
| catholic | -.0087872 | .0124917 | -0.70 | 0.482 | -.0332705 | .015696 |
| urban | .0083822 | .0128876 | 0.65 | 0.515 | -.0168771 | .0336415 |

```
Iteration 0:   log pseudolikelihood = -1301.6286
Iteration 1:   log pseudolikelihood = -1238.4523
Iteration 2:   log pseudolikelihood = -1237.1867
Iteration 3:   log pseudolikelihood = -1237.1824
Iteration 4:   log pseudolikelihood = -1237.1824

Probit regression                               Number of obs   =       3742
                                                Wald chi2(14)   =     132.47
                                                Prob > chi2     =     0.0000
Log pseudolikelihood = -1237.1824               Pseudo R2       =     0.0495
```

| H | Coef. | Robust Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| secondary_plus | .0161019 | .1726134 | 0.09 | 0.926 | -.3222142 | .3544181 |
| some_prenatalcare | .072261 | .0926515 | 0.78 | 0.435 | -.1093325 | .2538546 |
| healthy_weight | -.0431165 | .0676916 | -0.64 | 0.524 | -.1757896 | .0895566 |
| OBE | -.1645632 | .1786427 | -0.92 | 0.357 | -.5146965 | .1855701 |
| SMO | .0055985 | .1772004 | 0.03 | 0.975 | -.3417078 | .3529048 |
| OCC | .0172705 | .0886946 | 0.19 | 0.846 | -.1565677 | .1911087 |
| middle_plus | -.2094359 | .2127669 | -0.98 | 0.325 | -.6264513 | .2075796 |
| age | .0361637 | .0043125 | 8.39 | 0.000 | .0277113 | .0446161 |
| teenagers | -.0334901 | .1643221 | -0.20 | 0.839 | -.3555555 | .2885752 |
| married | .267719 | .073706 | 3.63 | 0.000 | .1232578 | .4121801 |
| catholic | -.0540276 | .0696424 | -0.78 | 0.438 | -.1905242 | .0824691 |
| urban | .0468498 | .0717261 | 0.65 | 0.514 | -.0937307 | .1874304 |
| resid_educ | -.1140412 | .4973661 | -0.23 | 0.819 | -1.088861 | .8607784 |
| deviance | .4599106 | .8418348 | 0.55 | 0.585 | -1.190055 | 2.109876 |
| _cons | -2.524275 | .1778102 | -14.20 | 0.000 | -2.872776 | -2.175773 |

```
Average marginal effects                        Number of obs   =       3742
Model VCE    : Robust

Expression   : Pr(H), predict()
dy/dx w.r.t. : secondary_plus some_prenatalcare healthy_weight OBE SMO OCC middle_plus age teenagers married catholic urban resid_educ
               deviance
```

| | dy/dx | Delta-method Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| secondary_plus | .0028932 | .0310131 | 0.09 | 0.926 | -.0578913 | .0636777 |
| some_prenatalcare | .0129839 | .01665 | 0.78 | 0.435 | -.0196495 | .0456174 |
| healthy_weight | -.0077472 | .0121634 | -0.64 | 0.524 | -.0315871 | .0160927 |
| OBE | -.0295689 | .0321156 | -0.92 | 0.357 | -.0925143 | .0333765 |
| SMO | .0010059 | .0318395 | 0.03 | 0.975 | -.0613984 | .0634102 |
| OCC | .0031032 | .015936 | 0.19 | 0.846 | -.0281309 | .0343373 |
| middle_plus | -.0376317 | .0382381 | -0.98 | 0.325 | -.1125771 | .0373137 |
| age | .0064979 | .0007775 | 8.36 | 0.000 | .004974 | .0080219 |
| teenagers | -.0060175 | .0295269 | -0.20 | 0.839 | -.0638892 | .0518541 |
| married | .0481041 | .013286 | 3.62 | 0.000 | .0220639 | .0741442 |
| catholic | -.0097077 | .0125107 | -0.78 | 0.438 | -.0342282 | .0148128 |
| urban | .008418 | .0128911 | 0.65 | 0.514 | -.016848 | .0336841 |
| resid_educ | -.0204911 | .0893624 | -0.23 | 0.819 | -.1956382 | .1546561 |
| deviance | .0826373 | .1512884 | 0.55 | 0.585 | -.2138826 | .3791571 |

## Appendix 2: Probit regression and average marginal effects (2008)

```
Iteration 0:   log pseudolikelihood = -1375.1901
Iteration 1:   log pseudolikelihood =  -1305.838
Iteration 2:   log pseudolikelihood = -1303.4832
Iteration 3:   log pseudolikelihood = -1303.4738
Iteration 4:   log pseudolikelihood = -1303.4738

Probit regression                                 Number of obs   =       4015
                                                  Wald chi2(12)   =     140.70
                                                  Prob > chi2     =     0.0000
Log pseudolikelihood = -1303.4738                 Pseudo R2       =     0.0522
```

| H | Coef. | Robust Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| secondary_plus | -.2331277 | .0714332 | -3.26 | 0.001 | -.3731342 | -.0931213 |
| some_prenatalcare | .1869903 | .0985708 | 1.90 | 0.058 | -.0062048 | .3801854 |
| healthy_weight | -.1582602 | .0588142 | -2.69 | 0.007 | -.2735339 | -.0429865 |
| OBE | -.0137445 | .1164842 | -0.12 | 0.906 | -.2420494 | .2145604 |
| SMO | .2233372 | .1613881 | 1.38 | 0.166 | -.0929777 | .539652 |
| OCC | -.037568 | .0568604 | -0.66 | 0.509 | -.1490123 | .0738764 |
| middle_plus | .0251281 | .0650794 | 0.39 | 0.699 | -.102425 | .1526813 |
| age | .0293056 | .0041694 | 7.03 | 0.000 | .0211337 | .0374776 |
| teenagers | -.3903109 | .1714123 | -2.28 | 0.023 | -.7262729 | -.054349 |
| married | .2867008 | .0735567 | 3.90 | 0.000 | .1425323 | .4308693 |
| catholic | -.1859868 | .076519 | -2.43 | 0.015 | -.3359613 | -.0360124 |
| urban | -.1050297 | .0737779 | -1.42 | 0.155 | -.2496317 | .0395724 |
| _cons | -2.276005 | .1782636 | -12.77 | 0.000 | -2.625395 | -1.926614 |

```
Average marginal effects                          Number of obs   =       4015
Model VCE    : Robust

Expression   : Pr(H), predict()
dy/dx w.r.t. : secondary_plus some_prenatalcare healthy_weight OBE SMO OCC middle_plus age teenagers married catholic urban
```

| | dy/dx | Delta-method Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| secondary_plus | -.041104 | .0126121 | -3.26 | 0.001 | -.0658234 | -.0163847 |
| some_prenatalcare | .0329693 | .0174002 | 1.89 | 0.058 | -.0011345 | .067073 |
| healthy_weight | -.0279037 | .0103739 | -2.69 | 0.007 | -.0482361 | -.0075713 |
| OBE | -.0024234 | .0205367 | -0.12 | 0.906 | -.0426745 | .0378278 |
| SMO | .0393778 | .0284485 | 1.38 | 0.166 | -.0163803 | .0951359 |
| OCC | -.0066238 | .0100252 | -0.66 | 0.509 | -.0262728 | .0130252 |
| middle_plus | .0044305 | .0114736 | 0.39 | 0.699 | -.0180574 | .0269184 |
| age | .005167 | .0007369 | 7.01 | 0.000 | .0037228 | .0066113 |
| teenagers | -.0688178 | .0302791 | -2.27 | 0.023 | -.1281638 | -.0094719 |
| married | .0505498 | .0130119 | 3.88 | 0.000 | .0250469 | .0760527 |
| catholic | -.0327924 | .0134789 | -2.43 | 0.015 | -.0592106 | -.0063741 |
| urban | -.0185183 | .0130163 | -1.42 | 0.155 | -.0440298 | .0069931 |

```
Iteration 0:   log pseudolikelihood = -1375.1901
Iteration 1:   log pseudolikelihood = -678.83598
Iteration 2:   log pseudolikelihood = -560.20006
Iteration 3:   log pseudolikelihood = -554.68723
Iteration 4:   log pseudolikelihood = -554.66839
Iteration 5:   log pseudolikelihood = -554.66839

Probit regression                                 Number of obs   =       4015
                                                  Wald chi2(14)   =     417.39
                                                  Prob > chi2     =     0.0000
Log pseudolikelihood = -554.66839                 Pseudo R2       =     0.5967
```

| H | Coef. | Robust Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| secondary_plus | -1.347113 | .3152145 | -4.27 | 0.000 | -1.964922 | -.7293037 |
| some_prenatalcare | .3730751 | .1663718 | 2.24 | 0.025 | .0469925 | .6991578 |
| healthy_weight | -1.401018 | .104799 | -13.37 | 0.000 | -1.60642 | -1.195616 |
| OBE | 2.927412 | .3323441 | 8.81 | 0.000 | 2.276029 | 3.578794 |
| SMO | -6.820354 | .9676744 | -7.05 | 0.000 | -8.716961 | -4.923747 |
| OCC | 2.239485 | .1930204 | 11.60 | 0.000 | 1.861172 | 2.617798 |
| middle_plus | 12.29609 | 1.008333 | 12.19 | 0.000 | 10.31979 | 14.27238 |
| age | .0696203 | .0074385 | 9.36 | 0.000 | .0550411 | .0841994 |
| teenagers | -3.762361 | .4381214 | -8.59 | 0.000 | -4.621064 | -2.903659 |
| married | .4577959 | .1137744 | 4.02 | 0.000 | .2348022 | .6807896 |
| catholic | .7659952 | .1554045 | 4.93 | 0.000 | .461408 | 1.070582 |
| urban | -.2161162 | .1188731 | -1.82 | 0.069 | -.4491033 | .0168709 |
| resid_education | 5.169803 | 1.088169 | 4.75 | 0.000 | 3.03703 | 7.302575 |
| deviance | -48.73748 | 3.844728 | -12.68 | 0.000 | -56.27301 | -41.20195 |
| _cons | -.1378217 | .3137343 | -0.44 | 0.660 | -.7527297 | .4770863 |

```
Note: 108 failures and 0 successes completely determined.

Average marginal effects                          Number of obs   =       4015
Model VCE    : Robust

Expression   : Pr(H), predict()
dy/dx w.r.t. : secondary_plus some_prenatalcare healthy_weight OBE SMO OCC middle_plus age teenagers married catholic urban resid_education
               deviance
```

| | dy/dx | Delta-method Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| secondary_plus | -.1065857 | .0243561 | -4.38 | 0.000 | -.1543229 | -.0588486 |
| some_prenatalcare | .0295183 | .0127909 | 2.31 | 0.021 | .0044485 | .0545881 |
| healthy_weight | -.1108508 | .0070344 | -15.76 | 0.000 | -.1246381 | -.0970636 |
| OBE | .2316216 | .0211838 | 10.93 | 0.000 | .1901021 | .273141 |
| SMO | -.5396374 | .0564506 | -9.56 | 0.000 | -.6502786 | -.4289963 |
| OCC | .1771917 | .0087993 | 20.14 | 0.000 | .1599454 | .194438 |
| middle_plus | .9728863 | .039304 | 24.75 | 0.000 | .8958519 | 1.049921 |
| age | .0055085 | .000478 | 11.52 | 0.000 | .0045716 | .0064453 |
| teenagers | -.2976841 | .0238121 | -12.50 | 0.000 | -.3443549 | -.2510133 |
| married | .0362216 | .0092432 | 3.92 | 0.000 | .0181053 | .0543378 |
| catholic | .0606068 | .0111684 | 5.43 | 0.000 | .038717 | .0824965 |
| urban | -.0170995 | .0094557 | -1.81 | 0.071 | -.0356322 | .0014333 |
| resid_education | .4090431 | .0832437 | 4.91 | 0.000 | .2458884 | .5721978 |
| deviance | -3.856188 | .1547587 | -24.92 | 0.000 | -4.159509 | -3.552866 |

| | H | no_educ | primary | second~y | higher | A | ANC | BMI |
|---|---|---|---|---|---|---|---|---|
| H | 1.0000 | | | | | | | |
| no_educ | 0.0338 | 1.0000 | | | | | | |
| primary | 0.0177 | -0.5365 | 1.0000 | | | | | |
| secondary | -0.0508 | -0.2293 | -0.5556 | 1.0000 | | | | |
| higher | -0.0074 | -0.1206 | -0.2922 | -0.1248 | 1.0000 | | | |
| A | 0.0044 | -0.2290 | -0.0317 | 0.1222 | 0.2322 | 1.0000 | | |
| ANC | 0.0118 | -0.3381 | 0.1461 | 0.1006 | 0.0757 | 0.5342 | 1.0000 | |
| BMI | 0.0197 | -0.2177 | 0.0000 | 0.0980 | 0.1883 | 0.1715 | 0.1356 | 1.0000 |
| thin | 0.0305 | 0.2252 | -0.0901 | -0.0623 | -0.0731 | -0.0877 | -0.1416 | -0.4573 |
| underweight | 0.0415 | 0.2097 | -0.0895 | -0.0536 | -0.0636 | -0.0903 | -0.1291 | -0.4080 |
| healthy_we~t | -0.0517 | -0.0368 | 0.0983 | -0.0246 | -0.1036 | -0.0870 | 0.0109 | -0.3156 |
| overweight | 0.0236 | -0.1066 | -0.0264 | 0.0626 | 0.1228 | 0.1270 | 0.0727 | 0.4168 |
| OBE | 0.0222 | -0.0859 | -0.0311 | 0.0441 | 0.1296 | 0.1112 | 0.0527 | 0.6631 |
| cigarettes | 0.0185 | 0.0030 | -0.0123 | 0.0117 | 0.0013 | 0.0191 | 0.0199 | 0.0093 |
| pipe | -0.0095 | 0.0347 | -0.0129 | -0.0134 | -0.0071 | -0.0117 | -0.0224 | -0.0016 |
| SMO | 0.0317 | 0.1893 | -0.0874 | -0.0549 | -0.0330 | -0.0433 | -0.0686 | -0.0821 |
| OCC | 0.0127 | -0.2343 | 0.0944 | 0.0539 | 0.0924 | 0.1063 | 0.1067 | 0.0978 |
| poorest | 0.0263 | 0.4662 | -0.1189 | -0.2210 | -0.1398 | -0.2248 | -0.2531 | -0.2454 |
| poor | 0.0063 | -0.0713 | 0.1508 | -0.0580 | -0.1018 | -0.0606 | 0.0428 | -0.0812 |
| middle | 0.0145 | -0.1039 | 0.1126 | 0.0123 | -0.0859 | -0.0058 | 0.0559 | 0.0036 |
| rich | -0.0237 | -0.1470 | 0.0577 | 0.0872 | -0.0263 | 0.0408 | 0.0439 | 0.0645 |
| richest | -0.0241 | -0.1925 | -0.1614 | 0.1889 | 0.3318 | 0.2525 | 0.1333 | 0.2624 |
| age | 0.1479 | 0.0889 | -0.0939 | -0.0145 | 0.0749 | 0.0327 | -0.0378 | 0.1310 |
| teenagers | -0.0768 | -0.0315 | 0.0807 | -0.0336 | -0.0608 | -0.0851 | -0.0262 | -0.0699 |
| older_women | 0.1151 | 0.1115 | -0.0612 | -0.0343 | 0.0037 | -0.0437 | -0.0784 | 0.0642 |
| nurse | -0.0162 | -0.1255 | 0.0910 | 0.0407 | -0.0532 | 0.2048 | 0.4621 | 0.0109 |
| doc | 0.0300 | -0.1342 | 0.0158 | 0.0345 | 0.1261 | 0.1887 | 0.2113 | 0.1038 |
| some_prena~e | 0.0118 | -0.3381 | 0.1461 | 0.1006 | 0.0757 | 0.5342 | 1.0000 | 0.1356 |
| urban | -0.0432 | -0.1431 | -0.1215 | 0.1467 | 0.2395 | 0.2053 | 0.1269 | 0.2291 |

| | thin | underw~t | health~t | overwe~t | OBE | cigare~s | pipe | SMO |
|---|---|---|---|---|---|---|---|---|
| thin | 1.0000 | | | | | | | |
| underweight | 0.8319 | 1.0000 | | | | | | |
| healthy_we~t | -0.5001 | -0.4160 | 1.0000 | | | | | |
| overweight | -0.1693 | -0.1409 | -0.5756 | 1.0000 | | | | |
| OBE | -0.0970 | -0.0807 | -0.3297 | -0.1116 | 1.0000 | | | |
| cigarettes | -0.0236 | -0.0197 | 0.0132 | -0.0050 | 0.0190 | 1.0000 | | |
| pipe | -0.0106 | -0.0088 | 0.0021 | 0.0127 | -0.0070 | -0.0017 | 1.0000 | |
| SMO | 0.0791 | 0.0820 | -0.0109 | -0.0464 | -0.0185 | 0.3954 | 0.1766 | 1.0000 |
| OCC | -0.0617 | -0.0577 | -0.0350 | 0.0729 | 0.0493 | -0.0070 | 0.0043 | 0.0055 |
| poorest | 0.1786 | 0.1543 | 0.0295 | -0.1367 | -0.1109 | -0.0076 | 0.0050 | 0.1262 |
| poor | 0.0137 | 0.0184 | 0.0737 | -0.0685 | -0.0633 | -0.0169 | -0.0124 | -0.0351 |
| middle | -0.0206 | -0.0108 | 0.0182 | 0.0000 | -0.0069 | -0.0054 | -0.0123 | -0.0204 |
| rich | -0.0587 | -0.0592 | -0.0020 | 0.0387 | 0.0183 | -0.0066 | 0.0116 | -0.0410 |
| richest | -0.1247 | -0.1120 | -0.1095 | 0.1659 | 0.1592 | 0.0334 | 0.0063 | -0.0439 |
| age | 0.0076 | 0.0084 | -0.1381 | 0.0949 | 0.1205 | 0.0000 | -0.0183 | 0.0561 |
| teenagers | 0.0087 | 0.0121 | 0.0609 | -0.0501 | -0.0597 | 0.0137 | -0.0078 | -0.0254 |
| older_women | 0.0129 | 0.0220 | -0.0796 | 0.0399 | 0.0734 | 0.0104 | -0.0137 | 0.0219 |
| nurse | -0.0257 | -0.0180 | 0.0153 | 0.0121 | -0.0108 | -0.0094 | -0.0003 | -0.0569 |
| doc | -0.0775 | -0.0714 | -0.0275 | 0.0533 | 0.0738 | 0.0046 | 0.0021 | 0.0032 |
| some_prena~e | -0.1416 | -0.1291 | 0.0109 | 0.0727 | 0.0527 | 0.0199 | -0.0224 | -0.0686 |
| urban | -0.0931 | -0.0802 | -0.1058 | 0.1400 | 0.1381 | 0.0464 | 0.0249 | -0.0341 |

| | OCC | poorest | poor | middle | rich | richest | age | teenag~s |
|---|---|---|---|---|---|---|---|---|
| OCC | 1.0000 | | | | | | | |
| poorest | -0.1362 | 1.0000 | | | | | | |
| poor | 0.0426 | -0.2637 | 1.0000 | | | | | |
| middle | 0.0561 | -0.2599 | -0.2014 | 1.0000 | | | | |
| rich | 0.0252 | -0.2680 | -0.2076 | -0.2046 | 1.0000 | | | |
| richest | 0.0303 | -0.3248 | -0.2516 | -0.2480 | -0.2557 | 1.0000 | | |
| age | 0.1664 | 0.0305 | 0.0525 | 0.0256 | -0.0322 | -0.0713 | 1.0000 | |
| teenagers | -0.1529 | 0.0150 | 0.0046 | -0.0130 | 0.0087 | -0.0159 | -0.4259 | 1.0000 |
| older_women | 0.0595 | 0.0517 | 0.0609 | 0.0210 | -0.0357 | -0.0932 | 0.7737 | -0.1417 |
| nurse | 0.0381 | -0.0584 | 0.0371 | 0.0385 | 0.0111 | -0.0164 | -0.0461 | -0.0035 |
| doc | 0.0706 | -0.1456 | -0.0309 | 0.0159 | 0.0474 | 0.1202 | 0.0218 | -0.0284 |
| some_prena~e | 0.1067 | -0.2531 | 0.0428 | 0.0559 | 0.0439 | 0.1333 | -0.0378 | -0.0262 |
| urban | -0.0204 | -0.3337 | -0.2271 | -0.2043 | 0.0118 | 0.7104 | -0.1021 | 0.0174 |

| | older_~n | nurse | doc | some_p~e | urban |
|---|---|---|---|---|---|
| older_women | 1.0000 | | | | |
| nurse | -0.0560 | 1.0000 | | | |
| doc | -0.0001 | -0.5792 | 1.0000 | | |
| some_prena~e | -0.0784 | 0.4621 | 0.2113 | 1.0000 | |
| urban | -0.1051 | 0.0018 | 0.1082 | 0.1269 | 1.0000 |

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