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Maternal Mortality in Sub-Saharan Africa: Steps Towards Millennium Developmental Goals

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MATERNAL MORTALITY IN SUB SAHARAN AFRICA:
STEPS TOWARDS MILLENNIUM DEVELOPMENTAL GOAL 5

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MATERNAL MORTALITY IN SUB SAHARAN AFRICA:
STEPS TOWARDS MILLENNIUM DEVELOPMENTAL GOAL 5

THESIS

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By

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Background: With one year to the millennium developmental goals (MDGs) target deadline of 2015, goal 5 "Improve maternal health" is still falling short compared to many of the other goals. Its first target: "the reduction of maternal mortality by 75%" will not be realized by the deadline as only 50% deduction had been achieved according to 2013 data. The aim of this paper was review several indicators of Sub-Saharan Africa as they relate to maternal mortality such as GDP per capita, education, access to antenatal care, and skilled birth attendance.

Methods: This paper conducted a linear regression with year fixed effects analysis on the effect of various factors, such as skilled birth attendance, antenatal care, and GDP per Capita, on maternal mortality. The method of statistical analysis used for this study was a regression analysis. The unit of analysis is by country.

Results: The analysis found that maternal mortality ratio had reduced of the periods of the study. Skilled birth attendance, Antenatal care, Education, GDP per capita and Economic Freedom were significant and were highly correlated with the reduction in maternal mortality.

Conclusion: Maternal mortality is an issue that, sadly, still adversely affects the developing regions of the world, which led to its addition in the Millennium Development Goals (MDGs) in 2000 (United Nations Children's Fund, 2012). Since the inclusion of maternal mortality in the MDGs there has been a reduction in worldwide maternal mortality rate. The reduction of maternal mortality is an ongoing that requires dedication resources and implementation of various strategies.

CHAPTER 1

Introduction

With one year to the millennium developmental goals (MDGs) target deadline of 2015, goal 5 "Improve maternal health" is still falling short compared to many of the other goals. Its first target: "the reduction of maternal mortality by 75%" will not be realized by the deadline as only 50% deduction had been achieved according to 2013 data. According to the latest MDG report, maternal mortality rate has seen a reduction from its pre-1990 benchmark rate of 400 deaths per 100,000 live births worldwide to 210 deaths per 100,000 live births worldwide in 2010. This was a great reduction, but it is not sufficient to achieve the targeted 75% reduction goal. Of the several regions reviewed by MDGs, the sub-Saharan region has made the least reduction with a 41% reduction, compared to regions like eastern Asia with a 69% reduction (the highest of all regions), and Southern Asia which had a 64% reduction (United Nations Millennium Development Goals Indicators, 2013).

The Millennium Development Goals were developed in an attempt to close the inequalities between developing and developed countries at the Millennium summit in 2000. There are 8 goals that make up the MDGs, and they attempt in some form to increase development, peace, and security or improve human rights. Goals like "Eradicate Extreme Poverty and Hunger", "Ensure Environmental Sustainability", and "Develop A Global Partnership For Development" are direct methods to reduce the inequality between all the regions of the world. While goals such as "Achieve Universal

Primary Education", "Promote Gender Equality And Empower Women", "Reduce Child Mortality", "Improve Maternal Health", and "Combat HIV/AIDS, Malaria And Other Diseases", are indirect measures, but necessary to combat poverty and create advancement (United Nations Millennium Development Goals Indicators, 2000). These goals were established under the United Nations Millennium Declaration's Development and Poverty Eradication as part of the global development agenda, which was signed by the 189 United Nations member countries (United Nations Children's Fund, 2012).

Many developed and developing regions of the world are, sadly, still affected by the issue of maternal mortality, although it is more prominent in developing regions. Maternal mortality is the death of a woman as a result of pregnancy, delivery, or within 42 days of termination of her pregnancy. This definition also includes deaths from aggravated causes due to pregnancy, and HIV related deaths (World Health Organization , 2014). Most deaths are preventable and occur in settings in which resources are scarce (World Health Organization , 2012). Some major causes of these deaths include severe bleeding (hemorrhage); obstructed labor; infection; and a seizure disorder called Eclampsia. Also included in the causes are unsafe abortions, which account for 13% of pregnancy related deaths in developing countries (Give Well, 2009). About 88% of maternal deaths occur during the postpartum period and childbirth. This information has led to more maternal mortality prevention intervention interest being focused on the period surrounding childbirth (Alvarez, 2009).

At the introduction of the millennium development goals in 2000, about 500,000 women died annually worldwide from pregnancy and childbirth related causes. Since then there has been a major but slow reduction in maternal mortality with the current

estimated number at 800 women, according to the World Health Organization (WHO). Women, who gave birth in developing countries in the year 2000, had an average risk of 450 deaths per 100,000 live births, a very poor outcome at the time (United Nations Millennium Development Goals Indicators, 2005). The lifetime risk of dying due to a pregnancy related cause was 1 in 74 worldwide. For the developing regions the lifetime risk rates were 1 in 16 in sub-Saharan Africa, 1 in 210 for Northern Africa, 1 in 840 in Eastern Asia, 1 in 46 in South-Central Asia, 1 in 140 for South-Eastern Asia 140, 1 in 120 in Western Asia, and 1 in 60 for Latin America and the Caribbean Oceania. The rates for these developing regions are all high when compared to 1 in 2,800 in developed countries (Maternal Mortality in 2000). Of the 20 countries that have the highest maternal mortality rate, only one Afghanistan, is located in Southeast Asia, while the rest are located in Sub-Saharan Africa.

The maternal mortality ratio (MMR) in developing countries is 240 per 100,000 live births, which is high when compared to developed countries with a ratio of 16 per 100,000. 50 percent of all maternal deaths occur in Sub-Saharan Africa, and the close second is South Asia with 33% of deaths. The maternal mortality ratio in Sub-Saharan Africa is an estimated 7 women per 1,000 live births (United Nations Population Fund , 2013). *The aim of this paper was review several indicators of Sub-Saharan Africa as they relate to maternal mortality such as GDP; education; income distribution, gender roles/norms, gender employment distribution; access to prenatal service; and skilled birth attendance.*

Background

A recent MDG target achievement is the proportion of deliveries that now occur in health facilities (Souza, 2013). When the project first began in 2000, the percentage of skilled attendant at birth was 41% in developing regions. By 2005 this proportion had increase to 57% for developing regions, and an even greater increase to 65% in 2010 (United Nations Millennium Development Goals Indicators, 2007). For comparison, the skilled birth attendant rate for developed countries in 2008 was 99%, showing that developing regions still have some catching up to do. There was also a noted increase in the number of women who were attended by at least one skilled attendant increasing from 64% to 80%. This increase was not noted in Sub-Saharan Africa, with only 50% of deliveries occurring at medical facilities or in the presence of a skilled attendant. There were different skilled attendant rates amongst the sub-regions of Sub-Saharan Africa, with the lowest noted in East Africa at 33.7% coverage, and the highest in West Africa at 41.2% skilled birth attendance.

At the country level, 6 countries in sub Saharan Africa, with the highest maternal mortality ratio (MMR) amongst the developing regions have experienced a decline in MMR from 1990 to 2010. The largest decline occurred in Nigeria with a 41% decline, the country that formally accounted for 14% of all global maternal deaths. The other countries that have shown improvement are Liberia with a 38% decrease in MMR, Sierra Leone with a 30% decline, Guineas-Bissau with a 29% decrease, Burundi with a 26% decline and the least occurred in Central African Republic, which experienced a 4% decline (United Nations Population Fund, 2012).

Sub-Saharan Africa Demographics

Sub-Saharan Africa consists of the 48 countries below the Sahara desert that includes West African countries such as Cote d'Ivoire, Ghana, Nigeria, and Sierra Leone; Central African countries such as Angola, Cameroon, Equatorial Guinea, and Sao Tome and Principe. East African countries such as Tanzania, Kenya, Madagascar, and Uganda; Southern African countries such as Botswana, Lesotho, Malawi, Namibia, South Africa, and Swaziland are also part of the Sub-Saharan region. This is a growing region with a population of about 840 million inhabitants (United Nations Population Fund , 2013).

Determinants of Maternal Mortality

The number of people living on less than a \$1 in Sub-Saharan Africa constitutes close to 46% of its total population. Second to Latin America, Africa is one of the most inequitable regions as well as being one of the poorest. In terms of GDP, this region is dreadfully behind all other developing regions. Prior to 2002, the Gross Domestic Product (GDP) growth rate was negative; but by 2002 the GDP for the region collectively amounted to \$319 billion. With a population of about 688 million people at the time, this summed to a per capita average of under \$2 per day (Sai, 2004). The annual average GDP growth rate for the region by 2009 was 5% with a gross national income (GNI) of \$879.6 billion (World Bank, 2009).

This inequality is evident in the distribution of income, where the wealthy citizens capture a larger percentage of income. There is also a notable division in the geographic setting in sub-Saharan African countries, with a majority of its poorer citizen dwelling in the rural areas when compared to the urban areas. Countries like Angola,

Botswana, Comoros, Lesotho, Namibia, and Swaziland exhibit the most inequality and are currently on the top ten list of most inequitable countries in the world. South Africa tops the list for this region but has experienced a GINI Coefficient increase from 58 to 67 in the period between the years 2000 and 2006 (African Development Bank Group, 2012).

Fertility and Family Planning

The current childbearing age range is usually between 16 and 49 years of age; this however can be lower in some developing countries. The median age of first sexual activity in most sub-Saharan African countries is 18.5 years. Countries like Chad, Mali, and Mozambique have a median as low as 16 years, with highest median age in this region at 19.6 years in countries like Ghana, and Senegal. This is according to surveys conducted by the Demographic and Health Surveys and the AIDS Indicator Surveys.

The average median age is comparable to some other developing regions such as Latin America, where the average median ages of first sexual activity ranges between 18 to 19 years (Hindin & Fatusi, 2009). Another maternal characteristic common to most African countries is the ages of first birth, over 25% of its women deliver their first baby before their 18th birthday (Bruce & Jain, 1994). This corresponds to the previous statement on the median age of first sexual activity. The exception to this is Niger, with its first delivery rate before 18 at 50% (Bruce & Jain, 1994).

Another target for the improvement of maternal health is to “achieve universal access to reproductive health” this includes increase in the use of contraceptives. The contraceptive usage rate among married women in East Asia in 2004 was 76% the highest amongst the developing regions, followed by Latin America and the Caribbean

at 68%, then North Africa at 50%, and South Asia at 39% usage rate. The lowest contraceptive using at the time was Sub-Sahara Africa at 17% (Sai, 2004). Among women of reproductive age in 2013, only 1 in 4 admitted to currently using some form of contraceptive or family planning method (Van Lith, Yahner, & Bakamijan, 2013).

The most common form of family planning in this region is birth spacing. There has been an increasing demand for contraception, which arises more from the need to end childbearing than to postpone childbearing. This increase is more common in Eastern and Southern Africa compared to the other sub-regions (Van Lith, Yahner, & Bakamijan, 2013). Countries like Botswana, Kenya, South Africa and Zimbabwe have been successful at significantly increasing contraceptive use through their family planning programs (Sai, 2004). Family planning interventions have been proven to have a direct positive effect on the reduction of maternal deaths as well as the prevention of transmission of disease from mother to child. The average Sub-Saharan African woman will have 5.4 children in her lifetime (Gribble & Haffey, 2008).

Education and Gender Norms

The third Millennium Development Goal “Promote Gender Equality and Empower Women’ is related to maternal mortality. This also directly related to Education because, the more educated a woman is, the more empowered she becomes. She is also more engaged in the society by being gainfully employed and assisting her families with more income. In early 1990s for every 100 boys enrolled in primary schooling in developing regions, there were an average of 87 girls. This is a poor number when compared to Europe who in the same time frame that had equal number of enrollments for both boys and girls. But this was not to say that all developing regions had low female primary

school enrollment. Regions such as Eastern Asia, and Latin America and the Caribbean had higher enrollments with rates of 93 girls per 100 boys and 98 girls respectively. While regions such as Southern Asia had rates of 76 girls per 100 boys enrolled; Sub-Saharan Africa and Western Asia had equal rates of 83 girls per 100 boys (United Nations Millennium Development Goals Indicators, 2005).

In sub-Saharan Africa there is variation between countries, with some countries making progress towards equal enrollment. Low enrollments are more evident in rural areas due to the location of the schools, family incomes, and norms (The Economist, 2013). Another cause of low female school enrollment is religious prejudices; this is further discussed in a section below. There is a strong positive association between increased education and improved good health, lower fertility rates and improved general well-being. Without addressing education efforts to alleviate poverty, disease and increase economic development will be to naught (Browne & Barrett, 1991).

The female child in Africa faces some difficulties when it comes to education. As a child her primary duties consist of household chores and education for the female child is not a priority for the majority of the people indigenous to the sub-Saharan region. Therefore she is less likely to gain an education compared to her male siblings, early marriage is also a factor for her (Sai, 2004). Gaining an education can help a woman to determine she plans her family that is marriage and children. She can determine what age to get married at and how many children she will have. She will also be better equipped to face the challenges of inequality, and to have a say in the issues that affect her and her family (Rose, 2013).

The region has made some progress in its school enrollment at the primary, secondary and tertiary levels since 1990s. In 1990s its primary enrollment was 83 girls per 100 boys, in 2011 this rate was 93 girls per 100 boys; still short of the 2015 target but showed some improvement. Its secondary enrollment was at 76 girls per 100 boys in 1990, and was at 83 girls per 100 boys in 2011, and its tertiary enrollment also showed some improvement between 1990 and 2011 also with rates at 48 girls per 100 boys to 61 girls per 100 boys (United Nations Millennium Development Goals Indicators, 2013).

Healthcare Delivery

A big factor in the reduction maternal mortality is access to skilled birth attendants. A skilled birth attendant is a person who has been trained with skills necessary to manage "normal" pregnancies, childbirth, and the immediate postnatal period. A normal pregnancy is a pregnancy in which there are no complications involved. A skilled birth attendant is also trained to identify, manage and refer complications in pregnancies and newborns. Examples of skilled birth attendants are doctors; midwives; and nurses (Harvey, Blandon, & Binns, 2007).

Encompassing the issue of skilled birth attendants is a broader issue - the health care delivery system. The healthcare delivery systems in sub-Saharan Africa constantly struggle to meet up to with basic delivery standards, most deaths from diseases or combination of diseases occur from preventable or manageable diseases (Bryan, Conway, Keesmaat, & Richardson, 2009). The life expectancy in 2005 for this region was 47.1 years while that of developed nations is over 80 years (Sekheji, 2006).

Primary care delivery in sub-Saharan Africa is very poor. A majority of its residents reside in rural areas and with the inadequate transportation systems access to

healthcare is limited. Bundled with inequity which plagues the region most people cannot afford to obtain healthcare when it is available (Ahmed, Vellani, & Awiti, 2011). The primary care health system in sub-Saharan Africa relies mostly on a reactive approach, curing illness when they occur versus proactive methods such as engaging in health education. This region lacks skilled healthcare workers and experiences a shortage in essential medications due to bad procurement and distribution systems (The Economist Intelligence Unit, 2011). There are on average 76 medical doctors for every 100,000 persons, even less are dedicated to maternal and child health (Cook, 2002).

Causes of Maternal Deaths

As previously stated the healthcare delivery system in the sub-Saharan region is severely lacking, and many mothers die due to lack of access to basic healthcare. This is especially true in sub-Saharan Africa due to the proximity challenges to necessary care, based on the remote location of these women's homes (World Health Organization , 2012). The causes of maternal mortality are generally classified into two groups, direct causes and indirect causes. Some examples of direct causes are hemorrhage (severe bleeding), infection, hypertensive disorders, and obstructed labor. Indirect causes are conditions exacerbated by pregnancy, this are usually pre-existing conditions (Alvarez, 2009).

Hemorrhage (severe bleeding) is the leading cause of maternal death in the sub-Saharan region, causing 33.9% of all maternal deaths. It can kill a healthy woman within 2 hours after birth if not properly managed (World Health Organization , 2014). The most common cause is uterine rupture, this occurs when the wall of the uterus tears

during pregnancy and more frequently during delivery or post-partum. In 1%-13% of ruptured uterine cases, the mother dies, even in cases without a previously scarred uterus. (Hofmeyr, Say, & Gulmezoglu, 2005). Hemorrhaging can be treated with blood transfusions, oxytocics, or by the removal of the placenta manually (Columbia University , 2014)

Second to hemorrhages, hypertensive disorders are the next leading cause of maternal deaths; 16.1% of all maternal deaths in sub-Saharan Africa can be credited to hypertensive disorders. The most common types of hypertensive disorders in mothers are eclampsia and pre-Eclampsia (World Health Organization , 2014). Eclampsia is an incident during pregnancy, labor, or within seven days after delivery were a woman experiences clonic convulsions. This type of seizure generally occurs in the second trimester up until 10 days postpartum.

Preceding the seizure, a woman will likely experience headaches, nervousness, increase in blood pressure, visual impairment or anxiety (Onuh & Aisien, 2004). Pre-eclampsia usually occurs before eclampsia and can be detected and managed before the onset of eclampsia, it is more likely to occur during the pregnancy. The characteristics of pre-eclampsia are hypertension, sudden weight gain, and a condition called proteinuria, which is protein in the urine. The administration of medication at the detection to pre-eclampsia can prevent the onset of eclampsia and save the life of the mother (Columbia University , 2014).

Another cause of maternal deaths is infection, the most common being maternal sepsis, which accounts for 9.7% of maternal deaths (World Health Organization , 2014).

Maternal sepsis is general term that refers to obstetric and genito-urinary tract infections introduced to a woman during delivery, which can lead to septicaemic shock and eventually death if left untreated. Poor hygiene and the lack of infection control methods from slack standards can lead to maternal sepsis. Most of these infections can be treated with antibiotics, but as most deliveries do not take place at a healthcare facility or in the presence of skilled birth personnel, the condition is left untreated (Columbia University , 2014).

Obstructed labor occurs during delivery when the fetus is unable to pass through the birth canal. This is more likely to take place when the fetus is larger than the mother's pelvic brim. Obstructed labor can lead to death when the delivery does not take place in a healthcare facility as it can be prevented by operative delivery. The presence of a skilled birth worker can also prevent demise, as they are able to detect an obstruction and sometimes reposition the fetus or refer to a healthcare facility prior to the incident. Obstructed labor can also lead to trauma in uterus or vagina leading to hemorrhaging (Dolea & Abouzahr, 2003). Obstructed labor constitutes 4.1% of all maternal deaths in sub-Saharan Africa (World Health Organization , 2014).

CHAPTER 2

Methods

This paper conducted a descriptive analysis and a univariate analysis on the effect of various factors, such as skilled birth attendance, antenatal care, and GDP per Capita, on maternal mortality. The data was collected from organizations with monitor the trends of the various variables in the countries of interest. The sources of data for the analysis in this paper are the World Health Organization (WHO) Millennium Development Indicators databank, the United Nations Millennium Development Goals Indicator databank, and the World Bank databank. These sources only collect data on an interval basis but this is the best data available for the variables of interest in the countries under review. The collection periods determine the classification of the data. The data is classified into three periods; the first period is from 1990 through 1999, the year 2000 through 2004 is classified as the second period, and 2005 through to 2010 is the third period.

Maternal mortality is the primary dependent variable under review; it is quantified as Maternal Mortality Ratio by Country. The importance of maternal mortality has been explained in the previous sections and is one of the key goals under the Millennium Development Goals. The predictor variables are Skilled Birth Attendance, Antenatal Care (at least one visit), Primary/Secondary Education Enrollment, and Rural Population. It will also include Per Capita GDP, Deficit, and Economic Freedom.

Maternal mortality ratio (MMR) is the number of deaths related to pregnancy and childbirth that occur in a country annually. It is calculated by dividing documented/estimated maternal deaths by total documented/estimated live births in the same period to calculate the maternal mortality ratio per 100,000 live births. The purpose of the MMR is to determine the capacity of a country's healthcare system for providing care that prevents maternal death.

The skilled birth attendance rate measures the number of births that took place in the presence of skilled birth personnel. It is calculated by dividing the total number of births attended by skilled health personnel by the total number of live births, per 100. The presence of skilled birth attendant/personnel is important, because they can ensure a safe delivery in the case of an emergency such as a hemorrhage (United Nations Population Funds, 2014). The skilled birth attendance rate does not only measure the number of births that took place in the presence of skilled birth personnel, such as midwives but it also indirectly measures the awareness on the importance of health facilities in the birthing process (Stanton, 2008).

Antenatal care (at least one visit) is an estimate of the percentage of woman between the ages of 15 and 49 who received antenatal care by a skilled health personal at least once during pregnancy over a period of time. It is calculated as a ratio between the number of women who received care at least once during their pregnancy by a skilled birth personnel and the total number of pregnant women in the same time period and is given as a percentage. Antenatal care is a package of interventions consisting of the identification and management of obstetric complications and infections and the

promotion of healthy behaviors during and after pregnancy (Linceto, Mothebesoane-Anoh, & Gomez, 2006).

The inclusion of skilled birth attendance and antenatal care measures are important to the analysis of maternal mortality because they cover the methods taken to directly improve maternal health during pregnancy, delivery, and the immediate post-natal period.

Education measures the number of girls enrolled in schools when compared to the number of boys enrolled. There are two measures; one is for primary education enrollment and the other is for secondary education enrollment. It is calculated as the ratio of girls to boys enrolled in primary and secondary education and is expressed as a percentage. This measure helps to explain the gender norms and the importance placed on women. There has been a noted association between a woman's socio-economic status (SES) and health: the higher her SES, the better her health. This relationship can also be noted between education and maternal mortality, because education is an indicator of SES, and maternal mortality is an indicator of health (Karlsen, Say, & Souza, 2011).

Rural population evaluates how much of the population lives in rural areas as compared urban areas. The rural population is estimated from using the ratio of a country's population living in designated rural areas to that country's total population at midyear, and is given as a percentage. This important to note in maternal mortality as most healthcare facilities in the sub-Saharan region are located in urban areas, and this can be used to determine a woman's access to healthcare services.

The per capita GDP is the gross domestic product for a country divided by its midyear population; its unit is in US dollars. There has been an established relationship between the adequate expenditure on health care and health status. As the effectively targeted expenditures on healthcare increase health status improves. Investment in a country's healthcare systems invariably improves health statuses and conditions of its citizens. In the past Sub-Saharan Africa has allocated very little of its Government budget to its health sector due to scarce resources (Novigon, Olakojo, & Nonvignon, 2012).

Economic Freedom measures whether a country government and structure allows for economic growth and development. The measures for the Economic Freedom Index include 10 quantitative and qualitative factors based on Rule of Law, Limited Government, Regulatory Efficiency, and Open Markets, and rated on scale of 0 to 100. Economic Freedom index measures the association between economic freedom and a number of social goals. Societies with higher economic freedom have been associated with higher levels of health, wealth human development, and reductions in poverty (Heritage Foundation, 2014). This index was included in the study to determine the effects of corruption, ineffective governments, and economic stagnation on maternal mortality.

A statistical analysis was conducted to determine the relationship between the dependent variable and the predictor variables. The method of statistical analysis used for this study was a regression analysis. A Linear regression with year fixed effects analysis were conducted to determine what type relationship exists between the variables. The unit of analysis is by country. A Univariate analysis was conducted to

determine the means, standard deviations, and ranges of the dependent and predictor variables and reported in Tables 1 and 2. The study also determined the trend of maternal mortality, and to note if there has been a reduction.

The analysis also excludes country where data on the dependent variable, maternal mortality ratio, may be missing/incomplete or not available. Four countries were excluded for that reason. The countries that have been excluded from review are Djibouti, Seychelles, Somalia, and Sudan. This brings the total number of countries under review to 44 out of the 48 in the Sub-Saharan African region.

CHAPTER 3

Results

Dependent Variable

The mean maternal mortality ratio (MMR) for the 44 countries under review in the first time period, 1990 to 1999, was 722.68, with a standard deviation of 349.26. By the third time period, 2005 to 2010 there was an observed decrease in the mean down to 445.33, and a standard deviation of 230.66. The range of values also changed from the first time period to the third. The maximum value decreased from 1300 in the first period to 1100 in the third period. This is consistent with the assumption of a decrease in the MMR of these countries and is shown in Table 1.

Key Independent Variables

There has been an increasing trend in the means of the key variables, skilled birth attendance and antenatal care. These variables are assumed to have a positive effect on the dependent variable over the course of time, and as they increase there is a reduction maternal mortality. Mean skilled birth attendance increased from 49.02 percent in the first time period to 60.07 percent in the third time period; these values are depicted in Table 2. This increase was also observed in the minimum and maximum values.

A large change was noted in the minimum value of skilled birth attendance, which changed from 5 percent in the period 1990 -1999, to 10 percent in the period 2005 -2010, but a smaller change was observed in the maximum values, which moved

from 99 percent to 100 percent. Increases were also observed in the means of antenatal care 1 visit, from 79.39 percent in the first period to 84.85 percent in the third period. There was no change in the maximum values, but the minimum values increased from 23 percent in the first period to 43 percent, as depicted in Table 2.

Other Contributing Factors

According to the Millennium development goals reports, female education has increased since the inception of the MDGs. This increase is corroborated by the data, the mean total enrollment increased from 79.39 percent in 1990 -1999 to 88.83 percent in 2005 -2010. The minimum value also increased between the first and third period, from 40.9 percent to 53 percent. The maximum total enrollment value decreased from 124 in the first period to 106 in the third period.

The percentage of persons living in rural areas has declined from the first period, which was at 68.58 percent, to 60.20 percent in the third period. This is also evident in the range of values. The minimum value fell to 14 percent between 2005 and 2010, from 24.35 between 1990 and 1999. The maximum value of the rural population percentage also decreased to 89.36 percent, from 95 in the first period. These values are shown in Table 2

GDP per capita showed some improvement, with an increase in its mean from 814.19 in the first period to 1208.13 in the third period, as shown in Table 2. Economic Freedom showed a decrease in its mean and overall values. The mean for Economic Freedom dropped from 53.85 in the first period to 50.91 in the final period. These values are given in Table 2, and their implications on maternal mortality are explained in the discussion section.

Regression

A linear regression analysis with year fixed effects was conducted and shown in Table 3; a confidence level of 95% was used in the model. The results show that the model was significant, with an adjusted R square value of 0.669. The F-test also further justifies the significance of the model with a P-value of .0001 and an error rate of 0.5. Skilled birth attendance, antenatal care, and total education enrollment were significant, with P-values below 0.05.

Skilled birth attendance had a P-value of 0.0001, and coefficient of -4.435, which means that, holding all other variables constant, for every 1 percentage increase in skilled birth attendants there is a corresponding decrease in maternal mortality, by 4.435 per 100,000 live births. Antenatal care also had a P-value of 0.0001; its coefficient was -5.225. This indicates that when antenatal visits increase by 1 percentage point, the maternal mortality ratio decreases by 5.225 per 100,000 live births. These values are shown in Table 3.

Education enrollment ratio of girls to boys was significant, with a P-value of 0.003 and a coefficient value of -3.025, as shown in Table 3. This means that, with all other variables held constant, for every 1 percentage increase in female enrollment in school (primary and secondary levels) there is a decrease in maternal mortality by 3.025 per 100,000 live births. Rural population, on the other hand was not significant, with a p-value of 0.969. Its coefficient was -0.039, which indicated that an increase in the rural population by 1 person corresponds with a decrease in the maternal mortality ratio by 0.039 per 100,000 live births; these values are presented in Table 3. Though rural

population was not significant, it was correlated with GDP per capita, which was significant, depicted in Table 4).

As noted in the last statement, GDP per capita was significant. Its P-value was 0.001, with a coefficient of -3.395, indicating that an increase in GDP per capita by \$1 will affect a decrease in the maternal mortality ratio by 3.395 per 100,000 live births. Economic Freedom was significant with a P-value of 0.002 and a coefficient value of -3.145. Period 3 was significant, with a p-value of 0.003; period 2 was not significant with a p-value of 0.910. The results of the regression analysis are reported in Tables 3 and 4.

CHAPTER 4

Discussion

As expected, regression results for skilled birth attendance showed that it was highly predictive with the reduction in the maternal mortality ratio. It was noted earlier in the paper that the presence of skilled birth personnel was important to the reduction of maternal mortality, as these personnel have been trained to detect a complication in the delivery and either control it or refer it to a specialist more adept in dealing with the situation. According to the United Nations Population Funds, in an emergency the presence of skilled birth personnel can ensure safe delivery especially for cases in which there is a hemorrhage (United Nations Population Funds, 2014).

Antenatal care was also highly correlated with reduction in the maternal mortality ratio, as expected. Antenatal care covers a range of services and interventions offered to a mother during her pregnancy to ensure a healthy pregnancy and safe delivery. The aim of antenatal services is to prevent health problems during pregnancy, while preparing the mother for birth. Identification and treatment of pre-existing and pregnancy related illnesses are part of standard antenatal care services (Linceto, Mothebesoane-Anoh, & Gomez, 2006).

There has been a noted positive association between female education and both improved good health and lower fertility rates (Browne & Barrett, 1991). The regression results also verify the positive relationship between female education and reductions in the maternal mortality ratio. Although there have been some difficulties in increasing

female education, there has been progress in increasing the number of girls enrolled in primary and secondary school (United Nations Millennium Development Goals Indicators, 2013). Gender empowerment is one of the major preconditions for overcoming poverty, disease and hunger, and access to education is key to gender empowerment (United Nations Millennium Development Goals Indicators, 2010).

Although the effect of rural population on the maternal mortality ratio was not significant, this could be due to its co-linearity with GDP per capita, its importance however, has been noted in earlier in the introduction section of this paper. The majority of the population in sub-Saharan Africa is rural; therefore, access to health care, this includes access to prenatal services and delivery services, is limited (Ahmed, Vellani, & Awiti, 2011). GDP per capita was significant in the regression analysis, and this was expected, because the more income of a country increases the more services the country is able to provide to its citizens. This provision includes services that it can render to its citizens living in rural areas (United Nations Millennium Development Goals Indicators, 2010).

The Economic Freedom index was another highly predictive variable of maternal mortality ratio. This index measures a country's ability to provide a financially & economically stable environment free of corruption, where individuals can work freely and have personal liberty (The Heritage Foundation, 2014). Many sub-Saharan African countries have recently experienced some form of war in the past 20 years, about the same time frame in which was analyzed in this study. Without stability, the interventions towards the reduction of maternal mortality would be ineffective.

Period 2 cover the years between 2000 and 2004. Although the Millennium Development goals were signed in 2000, the commitment of funds to the cause did not come until 2005, during the Gleneagle, Scotland G8 meeting (Lykens, Singh, Ndukwe, & Bae, 2009). During the convention the OECD member countries made a commitment to provide a percentage of their national incomes towards the furthering of the goals (United Nations Millennium Development Goals Indicators, 2009). Due to this commitment the actual interventions did not begin until after 2005. This commitment also explains why period 3 (the years between 2005 and 2010) was significant in the analysis, because this when an actual reduction could be measured in the maternal mortality ratio.

CHAPTER 5

Policy Implications

It has been stated numerous times in this paper that the Sub-Saharan region has experienced the smallest amount of improvement in reduction of maternal mortality (United Nations Millennium Development Goals Indicators, 2010). That withstanding, the region has made some progress, although there are some more ways it can move towards the Millennium Development Goals target. One way is through increasing the number of maternal health personnel available to mothers.

On average there are 76 medical professionals available per 100,000 populations, and not all of these professionals are trained in maternal services, so that there are even fewer maternal health personnel available the same population (Cook, 2002). Increasing the number of personnel trained in providing maternal services will increase these mothers' access to the necessary health services thereby facilitating the reduction of maternal mortality (Ahmed, Vellani, & Awiti, 2011).

A major obstacle to antenatal and delivery care access is transportation, because if the mother cannot go to the hospital for her check-ups the care has to be brought to her. This is especially true for mothers living in rural areas, where transportation systems when available are inefficient. One way to rectify this obstacle is to increase the number of community health workers trained to handle pregnancies. These community health workers can go into the community and provide basic antenatal services and educate the mothers. They will also be able to determine cases with

complications and refer the mothers to a specialist. The community health workers will act as a liaison between the mothers and the other maternal health professionals (Gilmore & McAuliffe, 2013).

To deal with the issue of the rural placement of these mothers, staffing the community health centers with midwives can help reduce maternal mortality. An example of this in practice is South Africa's Prince Mshiyeni Memorial Hospital. To deal with their health specialist shortage the hospital trained midwives to help fill the gap. These midwives attend to the mothers during delivery at the hospital and refer to the specialist if necessary (IRIN News, 2011).

As stated earlier in this paper there has been an established relationship between the adequate expenditure on health care and health status (Novignon, Olakojo, & Nonvignon, 2012). Investment in a country's healthcare systems invariably improves health statuses and conditions of its citizens. Based on that assumption, increasing the amount of a country's GDP appropriated to maternal healthcare will lead to improved infrastructure and better targeted services. These improved infrastructure and services will help ensure the lives of these mothers, thereby, aiding in the reduction of maternal mortality. Prolonging the lives of these women will benefit the society as well as, they can be only be productive members of the society when they are alive.

Economic Freedom index measures the association between economic freedom and a number of social goals. One of such social goals is improvement of overall health, maternal health included. According to the Heritage Foundation, societies with higher economic freedom have been associated with higher levels of health (Heritage

Foundation, 2014). Thus it can be concluded that improvements in a country's economic freedom can lead to improved health statuses for its citizens. One of the issues measured by the Economic Freedom Index is corruption.

Sub-Saharan Africa is commonly considered to be one of the most corrupt regions, six of the world's 10 most corrupt countries are located in this region (Hanson, 2009). Corruption can affect health because it can impair a healthcare system's ability to provide effective care as monies dedicated to that system might be filched for private gain. Enactment and implementation of anti-corruption laws is one way to combat this problem, especially laws that regulate the disbursement of public funds. This can help ensure funds allocated to the healthcare sector are spent appropriately and that the people who need the care receive it.

A focus on female education is also necessary to reduce maternal deaths. Increasing female education enrollment is an investment to reduce child and maternal deaths, prevent illness and their transmission, and to elevate poverty. This is because educated women are more likely to protect themselves from preventable illnesses (Rose, 2013). In order to achieve higher female enrollment, more resources from the national governments and the private sector have to be allocated to their education systems (United Nations Educational, Scientific and Cultural Organization, 2004).

CHAPTER 6

Conclusion

Maternal mortality is an issue that, sadly, still adversely affects the developing regions of the world, which led to its addition in the Millennium Development Goals (MDGs) in 2000 (United Nations Children's Fund, 2012). Since the inclusion of maternal mortality in the MDGs there has been a reduction in worldwide maternal mortality rate from 400 deaths per 100,00 live births pre-1990 to 210 deaths per 100,000 live births in 2010. Sub-Saharan Africa has experienced the least reductions in maternal deaths (United Nations Millennium Development Goals Indicators, 2013).

Some determinants of maternal mortality are access to maternal health services such as antenatal care and skilled birth personnel, female education, gender norms, and access to other resources such as employment. Major causes of maternal deaths are hemorrhage (severe bleeding), infections such as maternal sepsis, hypertensive disorders, and obstructed labor. Other causes are pre-existing conditions that can be aggravated by pregnancy (Alvarez, 2009).

The reduction of maternal mortality is an ongoing that requires dedication resources and implementation of various strategies. Some ways to decrease maternal deaths include increase of medical maternal personnel through funding and training, increase of access to maternal health services, and boost the number of female enrollment in primary and secondary level. Improvement of the transportation system

will also reduce maternal mortality because it will increase the ability of mothers to access health care services and allow the health workers to reach the mothers.

Limitations

The limitations of this study are changes made analysis for countries where data may be missing/incomplete or not available. Changes were made to the skilled birth attendance data for one country, Zimbabwe, the value for period two (2000 to 2005) was missing and was replaced with values for the year 2006, as it was the next year following the maximum year for that time period. Some changes were also made to the data for antenatal care, where the values for the first period (1990 to 1999) were missing and were replaced with values from 2001 as that was the closest year with values available. The Republic of Congo, Gabon, Mauritius, were removed because they did not have up to two data points. Zimbabwe was missing a data point for year value 2 so it was replaced with data for 2006.

Appendix

Table 1 – Dependent Variable Descriptives

Variable	Year	Mean	Standard Deviation	Minimum	Maximum
Maternal Mortality Ratio (MMR)	1990 - 1999	722.68	349.255	68	1300
	2000 - 2004	629.09	293.408	28	1300
	2005 - 2010	445.66	230.658	60	1100

Table 2 – Independent Variables Descriptives

Variable	Year	Mean	Standard deviation	Minimum	Maximum
Skilled Birth Attendance	1990 - 1999	49.02	21.8	5	99
	2000 - 2004	53.62	20.13	6	100
	2004 - 2010	60.07	14.54	10	100
Antenatal Care	1990 - 1999	72.67	20.79	23	99
	2000 - 2004	76.65	15.84	27	97
	2004 - 2010	84.85	14.54	43	99
Education Girls to Boys	1990 - 1999	79.39	19.36	40.9	124
	2000 - 2004	82.65	14.34	50.86	107
	2004 - 2010	88.83	12.03	53	106
Rural Population	1990 - 1999	68.58	14.82	24.35	95
	2000 - 2004	64.52	15.56	20	91.75
	2004 - 2010	60.2	16.58	14	89.36
GDP Per Capita	1990 - 1999	814.19	1198.09	129	5645
	2000 - 2004	888.04	1397.77	87	7579
	2004 - 2010	1208.13	1986.15	104	8661
Economic Freedom	1990 - 1999	52.85	8.899	21	76
	2000 - 2004	51.8	9.14	24	67
	2004 - 2010	50.91	8.36	27	63

Table 3 – Coefficients

Model	Unstandardized Coefficients		t	Sig.
	B	Std. Error		
(Constant)	1798.959	128.835	14.183	0.000
Skilled Birth Attendance	-2.881	0.649	-4.435	0.000
Antenatal Care 1 Visit	-5.274	1.009	-5.225	0.000
Education Girls to Boys	-3.482	1.151	-3.025	0.003
Rural Population	-0.047	1.200	-0.039	0.969
GDP Per Capita	-0.063	0.19	-3.395	0.001
Economic Freedom	-4.693	1.492	-3.145	0.002
Period 2	4.104	36.245	0.113	0.910
Period3	-124.174	41.257	-3.010	0.003

a. Dependent Variable: MM Data b. Adjusted R Square: 0.669 c. F-test: 35.895; P-value: 0.0001

Table 4 – Coefficient Correlations

Model	Economic Freedom	Skilled Birth Attendance	Rural Population	Education Girls to Boys	Antenatal Care 1 Visit	GDPP	
Correlations	Economic Freedom	1	0.107	-0.017	-0.073	-0.12	-0.172
	Skilled Birth Attendance	0.107	1	0.005	0.09	-0.042	-0.004
	Rural Population	-0.017	0.005	1	-0.291	0.083	0.607
	Education Girls to Boys	-0.073	0.09	-0.291	1	-0.491	-0.345
	Antenatal Care 1 Visit	-0.12	-0.042	0.083	-0.491	1	-0.048
	GDP Per Capita	-0.268	0.008	0.643*	-0.373	-0.02	1

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