The Regression Model of Risk Factors Associated with Maternal Mortality in Tanzania

Fulgence Juliana[1]   NdumeVitalis[2]   MtafyaAmbele[3]   Expeditho Mtisi[4]

1.VETA- Vocation Education and Training Authority

2.Dar es salaam Institute of Technology, Computer studies department

3.Dar es salaam Institute of Technology, General study Department

Abstract

Maternal mortality is one of the statistics showing the largest degree of disparity between the developed and developing countries. According to literature up to 2016 Tanzania was among the countries with unacceptably maternal mortality ratio and claimed to be still very far from reaching the Millennium developing goals. This study aimed at modeling of risk factors for maternal mortality using pre collected data Based on Tanzania Demographic Health Survey (TDH 2015 -16. Therefore secondary data were used to build the model. Data were reanalyzed by descriptive statistics using statistical software package STATA version 13. Based on data the result indicates that mortality was about 345 per 100,000 live births. The contributing factor was identified as education [OR= 0.81), Age group between 20 to 24 (OR = 2.84), distance to the health center (OR = 0.89), Marital status (OR = 1.39). It is concluded that, the risk factor of maternal death is age groups 20 – 24 and 25 – 29 years especially in the mainland rural.

Keywords : Martenal Motility, Regression model, Prevalence on maternal

1.0 INTRODUCTION

Maternal mortality is defined as the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated or its management but not from accidental or incidental causes (Shah & Say, 2007). Maternal death is clustered around labour, delivery and the immediate postpartum period, with obstetric haemorrhage being the main medical cause of death (Ronsmans, C., Graham, W.,2006).

1.1 The state or art of maternal mortality in developing countries

Maternal mortality is a major public health issue in developing countries due to its shocking magnitude and lower declining pattern (Girum & Wasie, 2017). In addition, maternal mortality is one of most sensitive indicators of the health disparity between richer and poorer nations (Ronsmans, Graham, & group, 2006). It shows that, the life time of dying due to maternal causes is about one in six in the poorest countries compared to about one in 30,000 in Northern Europe (Ronsmans, Graham, & group, 2006)

Over 99% of the annual global estimate of 585,000 maternal deaths occur in developing countries; a woman in sub-Saharan Africa who becomes pregnant is 75 times more likely to die as a result of this than a woman in Europe (excluding Eastern Europe) or North America (WHO & UNICEF, 1996).According to the 2004/05 DHS data, the MMR in Tanzania is 578 deaths per 100,000 live births and the 2010 DHS data shows that MMR was 454 deaths per 100,000 live births.

It argue by (Girum & Wasie, 2017), Policy and programs targeted to improve maternal health and reduce maternal deaths should consider population dynamics, socio-economic influence and health system factors that impose a major risk on mothers. Most maternal deaths occur to women who were young, married, with low levels of education and those having at least two births.

Tanzania is among the countries with unacceptably high maternal mortality ratio and still very far from reaching the Millennium developing goals (Shija, Msovela, & Mboera, 2011). Although maternal care is provided free of charge and there are lot of maternal health awareness campaign activities. Despite all these initiatives in place, maternal mortality continues to be a serious problem in Tanzania fromTDHS report of 2010 indicates that MMR was 454 and Population and Housing Census in Tanzania2012 present maternal mortality ratio estimated rate of 432 maternal deaths per 100,000 live births which is about six times higher; as compared to 2016 -2030 MDG target of reducing the global maternal mortality ratio to less than 70 per 100,000 live births Alkema, L., Chou, D., Hogan, D., Zhang, S., Moller, A.-B., Gemmill, A., et al. (2016).

1.2 RELATED WORKS ON MATERNAL MORTALITY

Maternal mortality is among the public health care problems which have received numerous global and local attentions ranging from preventive, curative and rehabilitative.

A study conducted by (Chukwu & Oladeji) in 2015 in Nigeria, consider seven factors in the model. They

using Logistic regression (LR) and artificial Neutral Network (Kassebaum et al.) andtheir results show that, the parity and woman ages are at a higher risk of having complication that may lead to dearth. However (Mulama, 2015) in Namibia conducted study and observed to be high among the teenage mothers between the age group of 15-19 years. However Lihongeni & Indongo in 2014 observed that, a range of socio demographic, clinical and health system factors were found to be the possible contributors to maternal deaths in Namibia.

In year 2014 it was noted in Kenya that maternal mortality ratio was 510 per 100,000 live births and average annual rate of MMR reduction was 1% (UNICEF, 2015). A study conducted by (Yego, D'Este, Byles, Williams, & Nyongesa, 2014) in Kenya uses Logistic regression and they found that Antenatal care and maternal education are important risk factors for preventing maternal mortality. Similarly, (Kitui, Lewis, & Davey, 2013) in Kenya ,They used multiple logistic regressions and founded that access to health facilities through distance and/or lack of transport and economic consideration are important barriers for women to delivering in a health facility in Kenya.

In Uganda after improving community awareness to increase women seeking maternal services from a health facilities, the number of pregnant women delivering at home in Uganda decreased from 56% to 42% by 2011 (UBOS, 2012). In 2015 maternal mortality ratio in Uganda was 343 per 100,000 live births and average annual rate of MMR reduction was 3% (UNICEF, 2015).A study conducted by (Mbonye, 2001)uses Log liner analysis and results shows that those who had a history of two or more abortions and stillbirths; parity of five and above and living within a distance of more than 10km to the nearest health center has a high risk of maternal death.

1.3 Maternal Mortality Situation in Tanzania

Tanzania's population is estimated at 50 million people and expected to clock 56 million by 2020; 43.9% are below the age of 15 years. The 12 million women of reproductive age and 2 million expected pregnancies is highlighted by a population growth of 3.1% (Ministry of health and social welfare, 2016) also there is a strong policy focus on reducing maternal and newborn mortality rates, yet these are declining slowly and off-track to meet the MDGs (Tatem et al., 2014). Several studies about Maternal mortality have been done in Tanzania, all intended to reduce the maternal mortality. According to (WHO, 2014) Tanzania has the fourth highest number of maternal deaths in Sub-Saharan Africa and the sixth highest in the world. The aim of MDG 5 was to reduce maternal mortality by 75% between 1990 and 2015 (Assembly, 2000). Although Tanzania shows progress towards improving maternal health, maternal mortality remains high (WHO & UNICEF,2012).

A study conducted by (Hanson, 2013) in five rural districts of Southern Tanzania, they used Multilevel logistic regression, to analyze the effects of distance to health facilities providing delivery care on pregnancy – related mortality. The finding shows that overall pregnancy-related mortality was high at 712 deaths per 100,000 live births. Nevertheless (Mapunda et al., 2016) conducted a study in Shinyanga regional referral hospital. The result indicated that maternal mortality ratio declined from 635/100,000 live births in 2010 to 449/100,000 live births in 2014 however observed maternal mortality ratio was higher compared to the national average.

The study conducted by Maro and Mosha et al.,(2016) in Northern Tanzania indicated that MMR is 492.1/100,000 live deliveries and the major causes was hemorrhage and hypertensive diseases which is preventable causes of deaths. Also(Illah, Mbaruku, Masanja, & Kahn, 2013)conducted study in rural Tanzania, They used Cox proportional hazards regression the results indicated that maternal age and marital status were the factors associated with increased risk of maternal death.

Research results from Southern Tanzania on the implication for achievement of MDG-5 targets concluded, among other things that, although almost all pregnant women seek antenatal care, less than half of deliveries are attended by skilled personnel(Mpembeni et al., 2007).

In an effort to reduce maternal mortality, like several other governments in developing countries, Tanzania's government has declared maternal and child health services, including facility delivery, to be exempt from user fees in government facilities (Wilkin-son et al. 2001; United Republic of Tanzania Ministry of Health 2003; (Witter, Arhinful, Kusi, & Zakariah-Akoto, 2007), (Mtei, Makawia, & Masanja, 2014),(Kruk, Mbaruku, Rockers, & Galea, 2008).The government is the major provider of health services with private (mainly faith-based) organizations providing one-third of all health services (National Bureau of Statistics of Tanzania 2007). Despite of all these initiatives, the Tanzania Demographic Health Survey (TDHS) report of 2010 indicates that the maternal mortality rate (MMR) was 454, comparing to the global MMR target for all countries to lower MMR to less than 70 by 2030 (Kassebaum, et al., 2016).The discrepancy shows that MMR in Tanzania is still a big problem which needs a multi-sectorial approach to understand.

The Ministry of Health and Social Welfare has been advocating for safe motherhood through attendance at Reproductive and Child Health (RCH) clinics before, during and after deliveries, as well as delivery with skilled health care providers, the ultimate goal being to achieve the MDG 5 targets. In order to develop, implement and evaluate policy, understanding of why women are dying from pregnancy complications is more important than waiting to establish the level of maternal mortality. The aim of this study is to determine the factors associated to maternal mortality in Tanzania in order to understand better the causes of maternal mortality in the country. We

approach the problem by   applying mathematical and statistical modeling point of view.

2.0 Methods and Materials

A cross sectional study from 2015/16 DHS survey data from Tanzania was used. Data were collected from 30 regions from both rural and an urban areas which was multistage sampling designed to give a nationally representative sample of 13,266 siblings' women age 15-49 in all selected households. A total of 345 maternal death identified from the 13,266 siblings who interviewed in each household at least 20 siblings to get the information about their woman siblings whose died related to pregnancy. In this study variables considered as risk factor in maternal health includes education level, place of residence that is rural or urban or sub urban, marital status, women age at death, place of delivery and distance to the health facility. The information of maternal mortality in 2015-16 TDHS asked women about deaths of their sisters to determine maternal mortality/ deaths associated with pregnancy and childbearing by using sisterhood method.

In order to   accomplish this objective TDHS data were reanalyzed by descriptive statistics using STATA 13 version statistical software package. The maternal mortality parameter was the taken as depended variable (Maternal death) which categorized as, if at least one reported female sibling in the household died while pregnancy, during delivery, or 5 – 6 weeks = 1 and if at least one reported female sibling in the household died from causes not related to pregnancy or was never pregnancy = 0 and independent variable also categorized as follows; Women age group presented as (<15 &> 49) = 0, (15 -19) = 1 , (20 – 24) = 2, (25 - 29) = 3, (30 – 34) = 4, (35 - 39) = 5,(40 – 44) = 6 and (45 -49) = 7. However educational level presented as No education, primary level, secondary level and higher level .Likewise blood pressure presented as women taken blood during pregnancy = 1 and women not taken blood during pregnancy = 0. Place of delivery presented as women who deliver at health centers = 1 and women who deliver at home = 0 also place of residence indicated as the women who died in a urban area = 1 and rural area = 0. Marital status categorized as never in union, marriage, living with partners widowed, divorced and no longer living together and distance to the health facility categorized by asking the siblings if distance to the health facility is big problem = 1 but if not a big problem = 0.

In order to identify most risk factors associated with maternal mortality, all significance tests was to be two sides and differences were considered significant when P-value equal or less than 0.05. Due this criterion the model was run twice, the first model run were contained all the proposed independent variables while the second run without variables eliminated due to higher P – values but categorical variable that has at least one category with P –Value less than 0.05 were retained.

By using the data, the risk of maternal mortality was estimated by fitting the fixed effect logistic regression model and unadjusted odds ratio (OR) and confidence intervals (CL) were estimated. Significant variables in the regression model were identified using stepwise selection criterion at a 0.05 level of significant.

3.0 FINDINGS AND DISCUSSION

The maternal mortality in this study is 345 death per 100,000 live birth. This finding shows that Maternal Mortality Ratio (MMR) in Tanzania was high in the study period. Most of the maternal mortality occurred at the age group of 20–29 years similar to the study conducted in Ethiopia by Gizachew Assefa Tessema (2016).

3.1 Maternal mortality in Mainland (urban & rural) compared to Islands

Women who had been in mainland urban area were found to be 69% less likely to experience a maternal death compared to those women in mainland rural area (OR = 0.31, 95% CL = 0.1 – 0.81; P = 0.017). This reveal that there is also statistical significant relationship between those maternal death and place of residence in Mainland as evidenced by the small value of calculated p-value which is less than the level of significance (5%). However, Women who had been in Unguja area were found to be 33% more likely to experience a maternal death compared to those women in mainland urban (OR = 1.33, 95% CL = 0.7 – 2.58; P = 0.405). Mainland rural area has a risk of women death related to pregnancy. This is also statically significant at 5% level of significance.

(i)   **Education**

Generally it is observed that educating women not only decrease maternal mortality but also children death. This argument is put forward by Smirita Sharma 2016 who argues that even when controlling for alternative explanations, the level of female education in a country has considerable effects on rates of maternal death. Our finding also supports this argument. The study findings reveal that the women who had a primary education level were found to be 18% less likely to experience a maternal death compared to those women who had no education [OR= 0.81; 95%; CL=0.60 – 1.12; P=0.21] . However the women who had a secondary education level were found to be 32% less likely to experience a maternal death compared to those women who had no education[OR=0.68; 95% CI=0.44 – 1.1; P=0.09] . The woman who had a higher education level found to be 78% less likely to experience a maternal death compared to those women who had [OR=0.22; 95% CI=0.03-1.68; P=0.14]. It could be that woman who went up to secondary school level delay their time to fall pregnant, these reduce risk of dying due to maternal related causes compared to their counterparts with low level of education.

Likewise, other studies have supported similar findings as evidenced by Ghana,(Alida,2011) who also found out that primary and middle school education is high risk factor compared to higher education and Tanzania (McLeod & Rhode,1998) found that low formal education of the husbands were associated with increased risk of maternal death in a rural district in Tanzania. Additionally, Mpembeni et al (2007) found that low level of spouse's education was a risk factor for maternal mortality]. Formal education in this study is categorical, but is not significant, P-values > 0.05.

(ii) **Age at death**

The finding concerning age group at death show that women aged 15 – 19 years were 80% less likely to experience a maternal death compared to women aged less than 15 and greater than 49 years (OR = 0.8, 95% CI = 0.7 – 4.02; P < 0.0001) . The highest risk age group was mothers aged 20 to 24 years who were 184 % more likely to experience a maternal death compared to those women less than 15 and greater than 49 years (OR = 2.84, 95% CI = 1.2 – 5.21; P < 0.0001). However the highest risk age group was mother aged 25 – 29 years who were 166% more likely to experience a maternal death compared to those women less than 15 and greater than 49 years (OR = 2.66, 95% CI = 1.6 – 5.32; P < 0.0001). Women aged 30 – 34 years were 45% less likely to experience a maternal death compared to women aged less than 15 and greater than 49 years (OR = 0.65, 95% CI = 0.2 – 3.74; P < 0.0001) . Women aged 35 – 39 years were 2% more likely to experience a maternal death compared to women aged less than 15 and greater than 49 years (OR = 1.02, 95% CI = 0.6 – 4.54; P < 0.0001) . Women aged 40 – 44 years were 81% less likely to experience a maternal death compared to women aged less than 15 and greater than 49 years (OR = 0.19, 95% CI = 0.1 – 4.6; P < 0.0001) . Women aged 45 – 49 years were 88% less likely to experience a maternal death compared to women aged less than 15 and greater than 49 years (OR = 0.12, 95% CI = 0.1 – 3.10; P < 0.0001) .This study found that a highest maternal death was age groups 20 - 24 and 25 -29 years similar studies conducted by Mulama (2015) found a high maternal mortality in age groups 20 -24, 25 -29 and 30 – 34. Also the study found by Blanc, Winfrey and Rose (2013) found an increase in the risk of maternal mortality with age , they found that the maternal mortality ratio starts low and rises steeply and non linearly age 30.

(iii) **Marital status**

Concerning Marital status,women who had married were found to be 39% more likely to experience a maternal death compared to those women who had never in union (OR = 1.39, 95% CL = 0.88 – 2.19; P = 0.16). Women who had living with partner were found to be 24% more likely to experience a maternal death compared to those women who had never in union (OR = 1.24, 95% CL = 0.73 – 2.09; P = 0.4). Women who had widowed were found to be 5% less likely to experience a maternal death compared to those women who had never in union (OR = 0.95, 95% CL = 0.46 – 1.96; P = 0.89). Women who had been divorced were found to be 53% more likely to experience a maternal death compared to those women who had never in union (OR = 1.53, 95% CL = 0.84 – 2.76; P = 0.16). Women who had no longer living together were found to be 57% more likely to experience a maternal death compared to those women who had never in union (OR = 1.57, 95% CL = 0.85 – 2.89; P = 0.15).The marital status statistical is not significantly because the P –value>0.05. Similar study done in Namibia (Mulama, 2015) show that maternal death are less likely to occur to women living together with their partners than those who are not living together (OR; 0.57). This study differ to the study done by Mulama, maternal death can be in married women.

(iv) **Distance to the health center**

The distance from health center is among the big factor that contributed to maternal mortality. In this study the finding indicated thatwomen who had been leave near for a distance to the health center were found to be 11% less likely to experience a maternal death compared to those women who had leave far for a distance to the health center (OR = 0.89, 95% CL = 0.7 – 1.4; P = 0.39). The distance to the health center is not significant because the P – value is > 0.05.

(v) **Types of place of residence**

Many circumstances,maternal dearth occur in rural compare to the urban. This study find that women who had been in urban area were found to be 65% less likely to experience a maternal death compared to those women in rural (OR = 0.35, 95% CL = 0.14 – 0.87; P = 0.025). This shows Statistical significant relationship between those two variables as evidenced by the small value of calculated p-value which is less than the level of significance (5%). Studies done in Namibia (Mulama, 2015) have evidence that woman in urban areas are less likely to experience a maternal death than those in rural areas (OR; 0.52) in Namibia

(vi) **Blood pressure**

According to Freg and Graham (2007) it was estimated in 2000 that 26.4% of adult population had hypertension (systolic pressure >=140 mmHg and the total number of adult with hypertension was approximate to. 1 billion worldwide. It is well documented that blood pressure gradually and progressively raised with increase of age so that the percentage of people with high blood pressure in any country vary with age group, approximately 20% of 20-years olds, 40% of 40 –years old , 60% of 60 years old and 80% of 80 –years old. In this study similar situation is observed. In this study women who had not blood pressure were found to be 11% less likely to experience a maternal death compared to those women who had blood pressure (OR = 0.89, 95% CL = 0.7 – 1.4;

P = 0.39), but blood pressure was not significant. The study conducted in South Africa show that Hypertensive disorders in pregnancy is the commonest direct causes of maternal deaths in South Africa.

3.2 Regression modeling equation of the maternal mortality in second model

The second modal run without variables eliminated due to higher P – values but categorical variable that has at least one category with P –Value < 0.05 were retained. This model expressed in term of coefficients rather than odds ratio.

Logistic regression is preferred to be used when the dependent variable is binary (0/ 1, True/ False, Yes/ No) in nature as it is in our chosen variables of interest to be used in the study. Here the value of Y ranges from 0 to 1 and it can represented by following equation

$$Odds = \frac{Pi}{1-Pi} = Odds\ 0f\ the\ event \qquad (4\text{-}1)$$

$$In\ (odds) = In\ (\frac{Pi}{1-Pi}) \qquad (4\text{-}2)$$

$$Logit\ (Pi) = In\left(\frac{Pi}{1-Pi}\right) = b0 + b1x1 + b2x2 + b3x3 + \cdots + bkxk \qquad (4\text{-}3)$$

Where, Pi is the chance of the ith women dying due to maternal cause, $1 - Pi$ is the chance of the ith women not dying due to maternal cause. The quantity $\left(\frac{Pi}{1-Pi}\right)$ is the odds of the ith woman dying due to maternal cause, and $x1, x2, x3 \dots xk$ represent predictor variables. The $b0, b1, b2, b3, \dots, bk$ are unknown regression parameters associated with the predictor variables, and rate are to be estimated using the data.

When probability are small $\left(\frac{P}{1-P}\right)$ approximately equal to P because 1 – P is approximately 1.

The log odds of maternal death are as presented in equation (4-3) was appear as the following;

$$Matdeath = -b0 - 1.113921 * placeresi1 + b2agegroup - 0.18430678bloodpressureb$$

Where b2 is the coefficient of age group

$$Logit\ (P) = -6.180892 - 1.113921 * Placeresi1 + \begin{cases} 5.230749 * age\_15 - 19 \\ 5.924416 * age\_20 - 24 \\ 5.876032 * age\_25 - 29 \\ 5.5.18183 * age\_30 - 34 \\ 5.384674 * age\_35 - 39 \\ 5.339134 * age\_40 - 44 \\ 4.92111 * age\_45 - 49 \end{cases}$$

$$- 0.18430678bloodpressure$$

From the modal above it is observed that   there is positive correlation of maternal mortality with age group. However the variation is noted from mature young women (lower level age group) to older women (higher level age) group near to menopause. The study observed that prevalence of age group was higher in 20-24 and 25-29. This can be explained that these are the majority who conceive first time   and therefore have no experience in pregnancy careering, moreover, since it is their first time some don't or are ashamed of attending clinic and therefore lack health facilities education on management of pregnancy. Either this age group may be suspected of other communicable diseases which are not analyzed in this thesis.

Blood pressure has been mentioned in many literature as the source of miscarriage, and death of women at delivery time. From this analysis we observed that there is a negative correlation between maternal mortality with blood pressure. The more women having high or lower blood pressure the more she is exposing to the risk of death.

There is negative coefficient of maternal mortality with place of residence. However the variation is noted women died from rural is higher compared to urban. The study observed that prevalence of place of residence was higher in rural area.   This can be explained that these are the majority who died due to maternal death and maybe there are scarcity of transport, education of antenal care and drugs during delivery.

4.0 CONCLUSION AND RECOMMENDATIONS
4.1 Conclusion

This study concludes that, the risk factor of maternal death is age groups 20 – 24 and 25 – 29 years especially in the mainland rural area. The study also found that there is positive correlation of maternal mortality with age group. This is due to the reason the majority were the first time to conceive. And therefore have no experience in pregnancy careering, moreover, since it is their first time some don't or are ashamed of   attending clinic and therefore lack health facilities education on management of pregnancy. Either this age group may be suspected of other communicable diseases which are not analyzed in this thesis.

4.2 RECOMMENDATIONS

In order to ensure that there is a significant decrease of maternal deaths in Tanzania, the study recommends to government and other stakeholder as follows:

i.   Regarding the risk factors that contribute to maternal death, the study recommends that, the government policy and strategies harmonization and coordination strengthen policy and political support for maternal health, increase women's entitlement and access, increase state accountability for maternal health and integrate a rights perspective into aid instrument such as marked disparities by social group in women's access to skilled birth attendance and to essential obstetric care.

ii.   Extension of maternal health care especially in rural areas without undermining urban areas as well due rapid growth of population

iii.   To improve economic welfare of the marginalized women through capacity building and provision of necessary resources for self-employment

iv.   The government and stakeholder should add more fund for PSSN programme particularly in cash transfer projects to reach wider women community mainly pregnant women

v.   Strengthening community participation and women empowerment to take role of their own health and the family at large;

vi.   Supporting research development to answer the immediate issues in the health sector; and strengthening the health system to provide skilled attendance during child birth

vii.   To achieve substantial reductions in maternal mortality levels, works must be done on the specific risk factors especially to target the most vulnerable rural populations and poor people, which is essential if substantial progress is to be achieved by year 2030. Further research is needed in order to understand other possible contributors, such as those found in the community and factors associated with quality of care.

5.0 REFFERENCE

Assembly, U. G. (2000). United Nations millennium declaration. *United Nations General Assembly*.

Chukwu, A., & Oladeji, R. Modelling the Determinants of Maternal Mortality: A Comparative Study of Logistic Regression and Artificial Neural Network Model.

Girum, T., & Wasie, A. (2017). Correlates of maternal mortality in developing countries: an ecological study in 82 countries. *Maternal Health, Neonatology and Perinatology, 3*(1), 19.

Hanson, C. (2013). *The epidemiology of maternal mortality in southern Tanzania.* London School of Hygene and Tropical Medicine.

Illah, E., Mbaruku, G., Masanja, H., & Kahn, K. (2013). Causes and risk factors for maternal mortality in rural Tanzania-Case of Rufiji health and demographic surveillance site (HDSS). *African journal of reproductive health, 17*(3), 119-130.

Kassebaum, N. J., Barber, R. M., Bhutta, Z. A., Dandona, L., Gething, P. W., Hay, S. I., et al. (2016). Global, regional, and national levels of maternal mortality, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015. *The lancet, 388*(10053), 1775-1812.

Kitui, J., Lewis, S., & Davey, G. (2013). Factors influencing place of delivery for women in Kenya: an analysis of the Kenya demographic and health survey, 2008/2009. *BMC pregnancy and childbirth, 13*(1), 40.

Kruk, M. E., Mbaruku, G., Rockers, P. C., & Galea, S. (2008). User fee exemptions are not enough: out-of-pocket household financing of "free" delivery services in rural Tanzania.

Mapunda, O. E., Msuya, S. E., Kapologwe, A., John, B., Damian, D. J., & Mahande, M. J. (2016). Assessment of Maternal Mortality and its Associated Causes at Shinyanga Regional Hospital in Tanzania. *Women's Health, 4*, e38976.

Mbonye, A. K. (2001). Risk factors associated with maternal deaths in health units in Uganda. *African journal of reproductive health*, 47-53.

Mpembeni, R. N., Killewo, J. Z., Leshabari, M. T., Massawe, S. N., Jahn, A., Mushi, D., et al. (2007). Use pattern of maternal health services and determinants of skilled care during delivery in Southern Tanzania: implications for achievement of MDG-5 targets. *BMC pregnancy and childbirth, 7*(1), 29.

Mtei, G., Makawia, S., & Masanja, H. (2014). Monitoring and evaluating progress towards universal health coverage in Tanzania. *PLoS medicine, 11*(9), e1001698.

Mulama, L. N. (2015). *Analysis of causes and risk factors associated with maternal deaths in Namibia.*

Ronsmans, C., Graham, W. J., & group, L. M. S. S. s. (2006). Maternal mortality: who, when, where, and why. *The lancet, 368*(9542), 1189-1200.

Shah, I. H., & Say, L. (2007). Maternal mortality and maternity care from 1990 to 2005: uneven but important gains. *Reproductive Health Matters, 15*(30), 17-27.

Shija, A. E., Msovela, J., & Mboera, L. E. (2011). Maternal health in fifty years of Tanzania independence: challenges and opportunities of reducing maternal mortality. *Tanzania Journal of Health Research, 13*(5).

Tatem, A. J., Campbell, J., Guerra-Arias, M., De Bernis, L., Moran, A., & Matthews, Z. (2014). Mapping for maternal and newborn health: the distributions of women of childbearing age, pregnancies and births. *International journal of health geographics, 13*(1), 2.

UBOS, I. (2012). Uganda demographic and health survey 2011. *Kampala and Claverton: Uganda Bureau of Statistics and ICF International Inc*.

Witter, S., Arhinful, D. K., Kusi, A., & Zakariah-Akoto, S. (2007). The experience of Ghana in implementing a user fee exemption policy to provide free delivery care. *Reproductive Health Matters, 15*(30), 61-71.

Yego, F., D'Este, C., Byles, J., Williams, J. S., & Nyongesa, P. (2014). Risk factors for maternal mortality in a Tertiary Hospital in Kenya: a case control study. *BMC pregnancy and childbirth, 14*(1), 38.