




# **Trend and determinants of maternal mortality in Jimma University specialized hospital**

By:

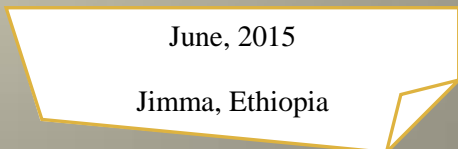
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A thesis submitted to Jimma University, Collage of health Sciences, Department of population and family health, in Partial Fulfillment for the Requirement for the Degree of Masters of Public Health in Reproductive Health (MPH/RH).



June, 2015

Jimma, Ethiopia



**Jimma University**  
**College of Health Sciences**  
**Department of Population and Family Health**

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University specialized hospital**

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## Abstract

**Background:** Loss of a woman from family because of death during pregnancy, delivery and within 6 weeks of postpartum can threaten the survival of the entire family. Child less than 9 year is more likely to be chronically malnourished and die when their mother dies than child who lost his father. Per capita gross domestic product is reduced by US\$ 0.36 per year per women in World Health Organization African region. The number of death that occurs in Ethiopia is high as World Health Organization maternal death classification. However, some hospital based studies in the country show-inconsistency in death trend and there is also limited evidence on causes of maternal mortality and associated factors

**Objective:** To assess trends, causes of maternal mortality and its associated factors in Jimma University specialized hospital, Southwest Ethiopia from January 2010 to December 2014.

**Methods:** A matched case control study was conducted on 600 charts, 120 cases and 480controls. Data was collected using checklist adapted from maternal death surveillance review of Ethiopia guide line. Six data collectors were recruited. Data entered into epi data 3 and exported to STATA 13 for analysis. Maternal mortality ratio was calculated for each year to observe trend of maternal death. Conditional logistic regression was done to identify the independent predictors of maternal death. The AMOR with 95%CI was reported and significance was declared at  $p \leq 0.05$ . For causal inference propensity score matching analysis was used. To ensure confidentiality only code was written on the check list.

**Result:** Maternal mortality ratio was  $857/10^5$  and has decreasing trend from highest in 2010 of  $1873/10^5$  to lowest of  $350/10^5$  in 2014. More than two third (68%) of death occurred during post-partum period. The leading cause of maternal death was hemorrhage (54%) ( $\beta=0.477$ , 95%CI (0.307, 0.647) followed by pregnancy induced hypertension (20%) ( $\beta=0.232$ , 95%CI(0.046, 0.419) and anemia (12%)( $\beta=0.110$ , 95%CI(0.017, 0.204)). Predictors of maternal death include: age group of 20 – 34 (AMOR= 0.299, 95% CI (0.113, 0.792)), being from rural area (AMOR = 2.594, 95%CI(1.001,6.726)), prolonged labour (AMOR=37.141,95%CI(13.296, 103.750)), comorbidities (AMOR=9.631,95%CI(3.135, 29.588)), referred cases from health center (AMOR=4.011, 95% CI (1.113, 14.464) and other health institution (AMOR=6.029, 95%CI(1.565, 24.626)).

**Conclusion and recommendation:** there is decreasing trend of maternal death. Most of them died in post-partum period. Hemorrhage was major cause of death identified in each year of study. Duration of labour, age, comorbidities, residence and referral were the major factors that affect maternal death. Increasing awareness of the community in rural part - on utilization of maternal health services and avoidance of delays in intervention should be sought

Key words: maternal death, maternal mortality, determinants of maternal death, trend of maternal death

## Table of Contents

Abstract .....	III
List of tables.....	VI
List of figures.....	VI
Acknowledgment .....	VII
Acronyms and abbreviations.....	VIII
CHAPTER ONE: INTRODUCTION.....	1
1.1 Background.....	1
1.2 Statement of problem.....	3
CHAPTER TWO: LITERATURE REVIEW .....	5
2.1.Trend of maternal mortality.....	5
2.2 Timing of death.....	6
2.4 Factors associated with maternal death.....	7
2.5 Conceptual framework.....	10
CHAPTER THREE: OBJECTIVES.....	12
CHAPTER FOUR: METHODS .....	13
4.1 Study area and period.....	13
4.2 Study design.....	13
4.3 Population .....	13
4.4 Inclusion and exclusion criteria .....	14
4.5 Sample size determination and sampling procedures .....	14
4.6 Variables .....	15
4.7 Data collection instrument .....	16
4.8 Data collectors .....	16
4.9 Data processing and analysis .....	16
4.10 Data quality assurance .....	18

4.11 Operational and definitions of terms.....	18
4.12 Ethical consideration.....	19
4.13 Dissemination plan.....	19
<b>CHAPTER FIVE: RESULT .....</b>	<b>20</b>
5.1. Socio - demographic characteristics .....	20
5.2. Trend of maternal mortality .....	27
5.3. Timing of death.....	28
5.4. Cause of maternal death.....	29
5.5. Predictors of maternal death .....	31
<b>CHAPTER SIX: DISCUSSION .....</b>	<b>34</b>
6.1. Trend of maternal death .....	34
6.2. Timing of maternal death.....	35
6.3. Causes of maternal death .....	36
6.4. Factors affecting maternal death.....	37
Problem faced, strength and Limitation of study.....	40
<b>CHAPTER SEVEN: CONCLUSION AND RECCOMENDATIONS .....</b>	<b>41</b>
<b>CONCLUSION .....</b>	<b>41</b>
<b>RECOMMENDATION .....</b>	<b>42</b>
<b>References.....</b>	<b>43</b>

## List of tables

Table 1: Socio-demographic characteristics of women in JUSH, May, 2015.....	20
Table 2: Past obstetric history of women in JUSH, May, 2015. ....	22
Table 3; shows delivery history of women in JUSH, May 2015.....	24
Table 4; Obstetric complications of women in JUSH, May, 2015.....	26
Table 5: total death and live births in JUSH, May, 2015 .....	27
Table 6; Causes of maternal death in sample population in JUSH, May 8, 2015 .....	31
Table 7; Predictors of maternal death in JUSH, May, 2015 .....	32

## List of figures

Figure 1: Conceptual framework for maternal death developed after literature review, JUSH, MAY, 2015.....	10
Figure 2: Schematic presentation of the sampling procedure, JUSH, May, 2015.....	15
Figure 3; Referral and maternal status of women in JUSH, May, 2015 .....	21
Figure 4; ANC follow up by maternal status of women in JUSH, May, 2015 .....	23
Figure 5; Mode of delivery by maternal status of women in JUSH, May, 2015.....	24
Figure 6: Trend of maternal death from 2010 to 2014 in JUSH, May, 2015 .....	27
Figure 7: Timing of death of women in JUSH, May, 2015.....	28
Figure 8: Cause of death of women in JUSH, May, 2015.....	29
Figure 9; Trends of causes of maternal death in JUSH, May, 2015.....	30

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## Acronyms and abbreviations

ANC = Antenatal Care

APH = antepartum hemorrhage

CEO = chair executive officer

CLR = conditional logistic regression

CS = cesarean section

CSA = Central Statistical Agency

EDHS = Ethiopian Demographic Health Survey

FGC = Female Genital Cutting

GDP = gross domestic product

HEW = health extension workers

HI = health institution

HTP = Harmful Traditional Practice

ICU = intensive care unit

JUSH = Jimma university specialized hospital

MDG = Millennium Development Goals

MDSR = maternal death surveillance review

MMR = Maternal Mortality Ratio

MTRH = Moi teaching and referral hospital

MPH = Master of Public Health

OL = obstructed labour

PIH = pregnancy induced hypertension

PNC = Post Natal Care

PPH = post-partum hemorrhage

PROM = prolonged rupture of membrane

RH = Reproductive health

SPSS = Statistical Package for Social Sciences

SSA = Sub-Saharan Africa

TBA = Traditional Birth Attendant

WHO = World Health Organization

UNPD = United Nation Population Division



# CHAPTER ONE: INTRODUCTION

## 1.1 Background

Loss of a woman from family because of death during pregnancy, delivery and within 6 weeks of postpartum can threaten the survival of the entire family. Particularly new born baby and young children in the family are endangered by the death of the mother. Women who die due to pregnancy-related causes are in the prime of new born baby and young children lives and are responsible for the health and well-being of their families. Many women shoulder a double burden of helping to support the family by working outside the home and taking full responsibility for household duties and child care. Yet, despite this vital role played by women in society, the health needs of a women is neglected which is evidenced by high level of maternal mortality in many poor countries(1,2).

Women's and children's health is directly affected by the social factors, institutional factors cultural factors and economic status. Issues such as their low socio economic status, harmful traditional practices (HTP), especially female genital cutting (FGC), early marriage, and low female literacy, all have a direct negative impact on women's health (3,4).

Poverty or low socio economic status results in poor child and maternal health care services, lower skilled care and poor access to health care services are some of the consequences that have direct impact on health of mother. These things results in high maternal mortality rates. An estimated 74% of maternal deaths could be averted if all women had access to the interventions for preventing or treating pregnancy and birth complications, in particular emergency obstetric care. As a result, the use of ante natal care (ANC), skilled delivery attendants and post natal care (PNC) are recognized as key maternal health services to improve health outcomes for women and children (3,4).

Worldwide different strategies have been implemented since 1950 as potentially effective ways to tackle the high rates of maternal mortality, and substantial changes have occurred in recent decades. Initial efforts since the 1950s have focused on antenatal clinics and maternal education, followed by an emphasis on family planning. In the 1970s, training and promotion of traditional birth attendants (TBAs) were introduced, while the 1990s were dominated by an emphasis on

increased access to and quality of obstetric care. More recently, a ‘‘new magic bullet’’ has been introduced, namely, the nutritional supplementation of pregnant or reproductive age women (5).

Maternal mortality ratio (MMR) globally has fallen by 45% from 523,000 (380/100,000) in 1990 to 289 000 (210/100,000) in 2013 yielding an average annual decline of 2.6%. It is one of the statistics showing the largest degree of disparity between developed and developing countries. It clearly highlights the huge gap between developed and developing countries. In 2013, developing countries account for 99% (286 000) of the global maternal deaths with sub-Saharan Africa region alone accounting for 62% (179 000) followed by Southern Asia (69 000). Oceania is the region with the fewest maternal deaths at 510. The MMR in developing regions was 14 times higher than in developed regions. All regions experienced a decline of 37% or more in MMR between 1990 and 2013. The highest reduction in the 23-year period was in Eastern Asia (65%). In Africa there is 47% reduction in MMR between 1990 and 2013 from 870 to 460 per 100,000. The highest reduction in Africa is experienced in North Africa which is (57%) (6,7).

In general in sub Saharan Africa (SSA) there is 49% reduction from 990 to 510 per 100,000 but eastern Africa reduces MMR by 57% from 1000 to 440 per 100,000 which are highest in SSA. Ethiopia decreased maternal death from 1400 to 420 per 100,000 MMR between 1990 and 2013 which is making progress to achieve MDG 5a by 2015 (2,3,7).

The majority of maternal deaths in developing countries are due to five major direct obstetric complications: hemorrhage, infection, unsafe abortion, hypertensive disorders of pregnancy, and obstructed labor. From causes of maternal death, 70–80% is due to direct obstetric causes (i.e., complications of pregnancy, labor, delivery or the postpartum period). Indirect causes of maternal death account for women who die from any other disease during the maternal period (pregnancy and up to 42 days postpartum or post abortion). Indirect causes represent a varying spectrum of the burden of maternal deaths, from an average of approximately 4% in Latin America up to 13% in Asia and 17% in Africa (7).

Societies that have achieved the lowest level of maternal mortality have done by preventing pregnancies, by reducing incidence of certain pregnancy complications, and by having adequate facilities and well trained staff to treat the complications (8).

## 1.2 Statement of problem

Maternal death has devastating effects on the family she leaves behind and country level. Women in developing countries lose more disability-adjusted life years (28 million) to maternal causes than to any other. Different literatures show that children less than 9 year are more likely to be chronically malnourished and to die than children who lost their father. Studies in developing countries indicate that the risk of death for children less than five years doubles or triples if their mother dies. Other studies estimate that children whose mothers have died are 3-10 times more likely to die within two years than those whose parents are both alive. The other consequence is economic burden on family, total lost economic productivity and out of pocket expenditure of households with maternal death is 10 times higher than that in without maternal death (9–12). Maternal mortality of a single person was found to reduce per capita GDP by US\$ 0.36 per year in WHO African region. The study has demonstrated that maternal mortality has a statistically significant negative effect on GDP (13).

The MMR in developing regions in 2013, which is 210/100,000, was 14 times higher than in developed regions, which is 16/100,000. This figure indicates that death of woman is most commonly burden of developing countries. Africa has the highest MMR in the world which is 460/ 100,000. SSA covers the highest range maternal death including Ethiopia. Sera Leone and 15 countries (all in SSA) in the world have extremely high MMR and very high MMR respectively. Ethiopia is grouped under high MMR with 420/100,000 in 2013 (7).

Ethiopia is making progress to achieve MDG 5a by reducing MMR by 69% from 1990 MMR, even though there are inconsistencies in between figures at international, national level and different regional data's. Between 1<sup>st</sup> July 2010 to 30<sup>th</sup> June 2012 there were an increase of MMR in public hospitals of Tigray regional state. The 2011 EDHS (676/100,000) shows that there is bit increment of MMR with 2005 EDHS (673/100,000), even though the 95 % CI is coinciding. 2005 EDHS report (673/100,000) and joint estimation by WHO, UNICEF, UNFPD and world bank in same year (740/100,000) have wide variation (7,14–17).

Review done in jimma hospital before 15 years back shows fluctuation of MMR in the range of (1635, 2331/10<sup>5</sup>) with total MMR of 1965/10<sup>5</sup>. Review done from 2002 – 2006 in JUSH shows a fluctuation with total MMR of 888/105 in the range of (417, 1828/10<sup>5</sup>) (30–33).

Each maternal death has a story to tell and can provide indications on practical ways to address problems. Understanding the underlying factors that led to the deaths is important for successful reduction of MMR. 70–80% of maternal death is due to direct obstetric causes, and these maternal deaths could be prevented through actions that are proven to be effective and affordable, even in the poorer countries of the world (23). In Ethiopia Abortion was the major cause in 1980s; however in 2000 sepsis become the major causes. Currently pregnancy induced hypertension is an increasing cause of maternal death as observed in Tigray region (14,15).

Even though Ethiopia reduces the maternal death from previous times as the report of international organizations, still the number of death that occurs currently is high as WHO maternal death classification. In contrary, some hospital based study in our country shows inconsistency in death trend. So the need of further study is unquestionable to identify trend, causes, timing and factors affecting maternal death.

Besides this inconsistency of findings in already there literatures, there is scarcity of literatures in Ethiopia and particularly in the study set up, regarding cause, timing and factors associated with maternal death. To the best knowledge of the investigator, only one case control study that was done in Tigray region is available which is done for two year period only. There are also other studies done in different areas like in Addis Abeba and in JUSH but they are death audit which is poor in identifying factors affecting maternal death. This study will identify trend in maternal mortality, trend of specific causes of maternal death, independent predictors of maternal death and timing of maternal death. So the importance of this study is to add additional data about maternal death for our country and as input for JUSH particularly on trend of maternal death whether it is increasing or decreasing in the last five year period. In addition this study will help planners to design contextualized plan for intervention and as in put for policy makers, researchers and academicians.

## CHAPTER TWO: LITERATURE REVIEW

### 2.1. Trend of maternal mortality

Worldwide, the MMR has fallen by 45% from 380/100,000 in 1990 G.C. (523 000 annual death) to 210/100,000 in 2013 G.C. (289,000 annual death) giving 2.6% annual decline (7).

Africa has the highest MMR in the world which is 460/ 100,000. SSA covers the highest range maternal death including Ethiopia. Sera Leone and 15 countries (all in SSA) in the world have extremely high MMR and very high MMR respectively. Ethiopia is grouped under high MMR with 420/100,000 in 2013 (7).

Ethiopia decreased maternal death consistently from 1400 to 420 per 100,000 MMR between 1990 and 2013. As The report of CSA of Ethiopia report there is an increase of maternal death in 2011 G.C. (676/100,000) from 2005 G.C. (673/100,000), even though the 95 % CI is coinciding. There is clash of report on MMR of Ethiopia between CSA of Ethiopia and joint report by WHO, UNICEF, UNPD, UNFPA and World bank in 2005G.C. CSA of Ethiopia report said 673/100,000 and joint report said 740/100,000 of maternal death (7,16,17). A case control study carried out between 1<sup>st</sup> July 2010 and 30<sup>th</sup> June 2012 G.C. in public hospitals of Tigray regional state shows increment of maternal death from 28 to 34, which is an increment of 9.7% (15).

On the other hand a retrospective cohort study conducted in Ambo Hospital from Jan 1, 2001 to Dec 31, 2005; revealed that there were 73 maternal deaths and 3,941 live births making the overall MMR of 1,852 per 100,000 live births. The trend of MMR in the five year period was not increasing or decreasing order, in the year 2001 it was the largest (3,986 / 100,000) and in 2004 it was the lowest MMR (671/100,000) than other study periods in the study period (18).

Review done in jimma hospital before 15 years back shows fluctuation of MMR in the range of (1635, 2331/10<sup>5</sup>) with total MMR of 1965/10<sup>5</sup>. Review done from 2002 – 2006 in JUSH shows fluctuation with total MMR of 888/105 in the range of (417, 1828/10<sup>5</sup>) (30–33).

Study conducted in Henan province of China shows decline in maternal death from direct obstetric causes from 1996 to 2009, with a reduction by 87.2%, compared with the reduction by 48.0% in deaths from indirect obstetric causes (24).

## **2.2 Timing of death**

Findings from study conducted in India revealed that postpartum deaths accounted for about 70% (25). Also a study conducted in maternity hospital of Nigeria, reported that about 61.9% of the maternal deaths occurred post-partum, 13.1% intra- partum and 10.7% ante-partum while 14.3% of the women died from post-abortal complications(26) .

Among the 49 maternal deaths, 6 (12%) occurred during pregnancy, 18 (37%) during labour, and 25 (51%) after birth within six weeks (27).

## **2.3 Causes of maternal death**

A study conducted in India revealed that direct obstetric causes of maternal death account 85% of death. Hemorrhage was the commonest cause of death (52.5 %). Sepsis accounted for about 13.75 % which included both puerperal sepsis due to home delivery and septic abortion due to Medical Termination of Pregnancy done outside. Hypertension or eclampsia-related deaths accounted for another 10 % of deaths, amniotic fluid and pulmonary embolism were responsible for 3.75 % each. Only one woman had died because of inversion of uterus. Indirect causes of death accounted for 15 %, out of which anemia and cardiovascular causes had constitute the majority (25).

Study carried out in Henan province of China showed that decline in MMR due to obstetric hemorrhage, pregnancy-induced hypertension and heart disease by 84.1%, 95.8% and 74.7%, respectively (p 0.0001). However, no decline in deaths due to amniotic fluid embolism was found. The proportion of direct obstetric causes dropped from 77.7% in 1996 to 46.2% in 2009 and the proportion of indirect obstetric causes consequently increased from 22.3% in 1996 to 53.8% in 2009 (24).

Similarly study conducted in maternity hospital of Nigeria, demonstrated that deaths due to direct obstetric causes were 75 (89.3%) while from indirect obstetric causes were 9 (10.7%). The

main causes of death were hemorrhage 20 (23.8%), sepsis 20 (23.8%), eclampsia 14 (16.7%), post- abortal complications 11 (13.1%) and obstructed labor 10 (11.9%) (26).

Of all the maternal deaths reported in retrospective study in Ambo hospital 97.3% of deaths were due to direct obstetric causes while only 2.7% were due to causes not directly related to pregnancy. Of the direct causes of maternal death hemorrhage constituted the commonest causes of maternal mortality (54.8%) followed by puerperal sepsis (30.2%) and hypertensive disorders of pregnancy (12.3%). Uterine rupture was the underlying cause of hemorrhage while obstructive labor and unsafe abortions were the underlying causes for sepsis. Ruptured uterus served as the major underlying cause of hemorrhage throughout the study period except in 2004. Unsafe abortion contributed the lowest proportion for maternal deaths throughout the study period (18).

Moreover study conducted in the public hospitals of Tigray regional state, Ethiopia, reported that fifty six (90%) maternal death were due to direct obstetric complications and 5 (10%) due to indirect obstetric complications. Major causes of maternal deaths were hemorrhage after delivery (PPH) and PIH (pre Eclampsia, Eclampsia) which accounts 39% and 19% respectively followed by obstructed labor (16%), sepsis (8%), uterine rupture (7%) and anemia (8%) (15).

Additionally, a study conducted in south west Ethiopia reported that the primary causes of death were: fever 14 (29%), bleeding 13 (27%), prolonged labour 8 (16%), convulsion 8 (16%), and others 6 (12%). Other causes included two abortions and one anemia while three deaths were not classified (27).

## **2.4 Factors associated with maternal death**

A case control study carried out in rural Tanzania showed that there was four times risk of maternal death in the age group 35–49 years compared to the group of 25–34 years. Thirty-nine per cent of the cases and 28% of the controls had no formal education. The woman's educational level was not significantly associated with increased risk of maternal death, whereas a two times increased risk was observed with husband's education comparing husband with no education and educated for 1 - 7 year school (28).

The point estimate for primiparas showed an increased risk of maternal death, but not statistically significant. There was no increased risk of death for multiparous women. There was

no significantly increased risk of maternal death in analyses of previous abortions, stillbirths or perinatal deaths(28). Study done in china, showed that compared to controls, dead women were have not attended ANC 22.3 times and have ANC only 1–4 times 5 times more likely they are exposed for maternal death (29).

In retrospective study of Ambo hospital about 80% of maternal deaths due to hypertensive disorder of pregnancy occurred in the primiparas. Among the 73 maternal deaths only eight (11%) had ANC, 28 (38%) had no ANC and for the rest ANC status was not mentioned. 46.6% of the mothers came from within a distance of 100 km, from Ambo hospital, 45.2% came from within 100 - 250 km, and in 8.2% of the cases, the address of the mothers were not registered. But these variables don't have statistical significance (18).

As shown in the study done in Kenyan tertiary hospital, history of pre-existing medical conditions four times, doctor attendance at birth 4.6 times, having no antenatal visits 4.1 times, being admitted with eclampsia 10.9 times, having comorbid complications on admission 9 times , having elevated pulse 10.7 times, and being referred to MTRH 2.1 times (30).

Study in public hospital of Tigray showed that being attended by midwives and nurses were protective to maternal death as compared to other skill birth attendance (Masters in integrated emergency surgery and obstetrics) and respectively. Study also revealed that being registered for ANC at least once during pregnancy were protective for maternal deaths compared to not being registered for ANC. Women who had labor pain less than 24 hours was protected from maternal death than women who had labor pain more than 24 hours (15).

The gaps identified from previous literatures are:

- Most of the literatures are reviews of maternal death which are unable to determine the predictors of maternal death
- There is a single case control study done in Tigray region hospitals but does not consider time since there is variation in care given and there is difference in level of hospital.
- Two reviews done previously in JUSH are old so recent updates are necessary
- Previous literatures did not identify timing of death except single study done in Bonke wereda (community based cross sectional study)



- They did not quantify death of women from specific cause after controlling the other causes and factors.

In summary in different parts of the world direct obstetric causes are the common causes of maternal death particularly hemorrhage and pregnancy induced hypertension. As different literatures reported that post-partum period is the common period that more women would die. There are different factors that affect maternal death: maternal education, presence of comorbidities, attending health professional, economic status, occupation, distance of health institution, parity, gravidity and ANC attendance are some of them. In Ethiopia there is conclusive evidence that Ethiopia decreased maternal death by 69% even though some institution based studies are not coinciding with the country wide study. Therefore, this study will assess trend, causes and factors associated with maternal death in the context of JUSH. In addition it confirms nationwide maternal death reduction in context of JUSH.

## 2.5 Conceptual framework

There are different factors that affect maternal death. These factors are generally categorized as socio-demographic factors, comorbidities, obstetric history and delivery history. It is adapted from UNFPA.

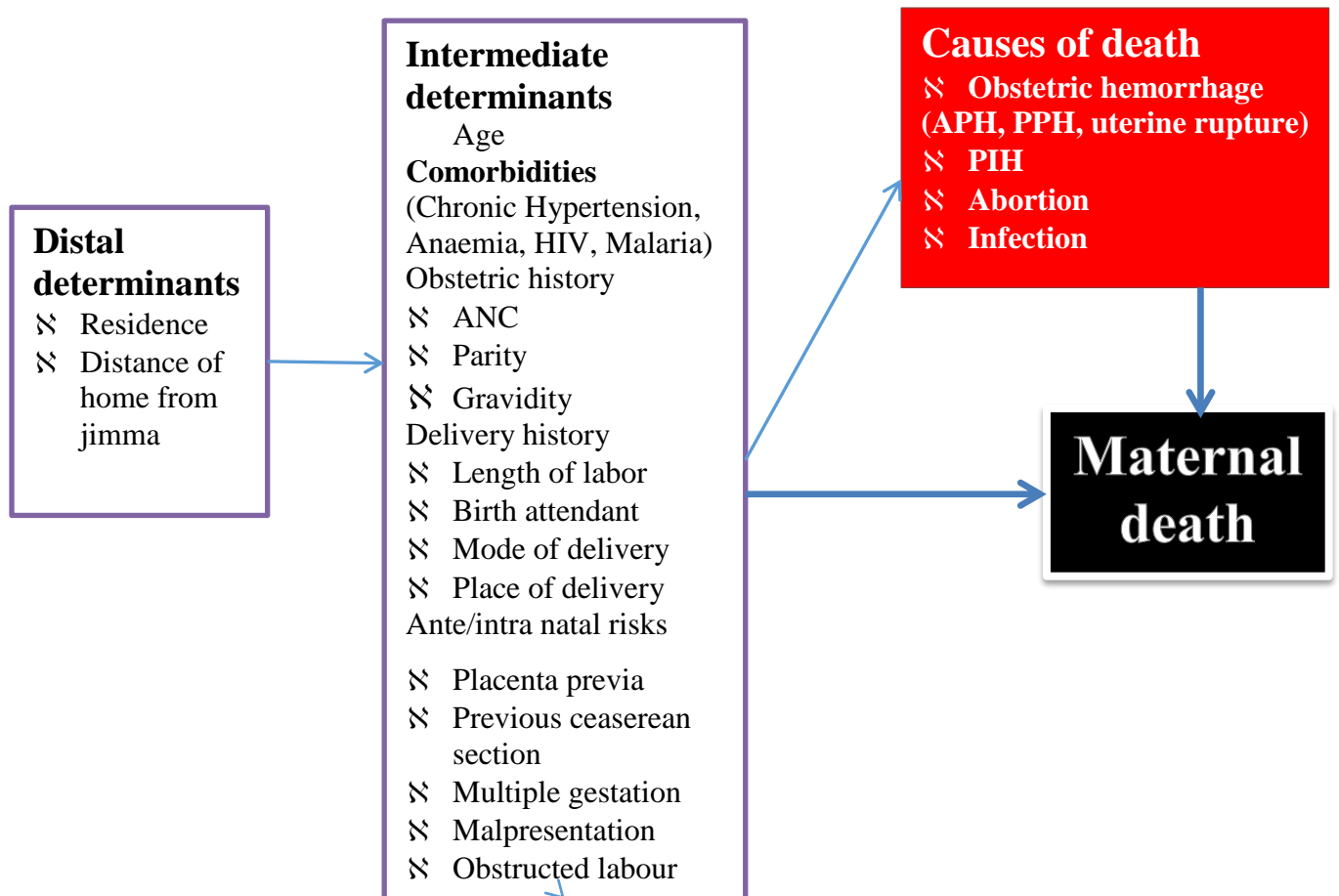


Figure 1: Conceptual framework for maternal death developed after literature review, JUSH, MAY, 2015

Source; adapted from UNFPA

## **Significance of study**

Maternal death is widely regarded as one of life's most tragic outcomes. There is a big pain in the death of a woman who is engaged in the act of creating life, and her death is an incomparable loss for any children who are left behind.

Even though, there are limited numbers of literatures in Ethiopia in general and study setup in particular, the already available literatures does not consider change of time, unable to determine the predictors of maternal death, old literatures, did not identify timing of death and did not quantify death of women from specific cause after controlling the other causes and factors.

Therefore, the aim of this study was to assess trends in maternal mortality, timing, causes of maternal death and factors affecting maternal death in case of JUSH. In addition to filling the above gaps it is important to validate the achievement made in our country in the context of JUSH in maternal death reduction (for women who utilize institutional delivery only). Information generated from this study can be used by health professionals, health care planners, managers and policy makers to save women's lives by improving the quality of care provided. It is intended that this information will help or contribute to change policies and practices that will lead to improvements in maternal health. It is also intended that this study can be used as input for JUSH, researchers and academicians.

# CHAPTER THREE: OBJECTIVES

## 3.1 General Objective

- ✚ To identify trend and causes of maternal mortality and its associated factors in JUSH, Ethiopia from January 2010 to December 2014

## 3.2 Specific objectives

- ✚ To describe the trends of maternal mortality in JUSH from January 2010 to December 2014
- ✚ To describe timing of death of mothers in JUSH from January 2010 to December 2014
- ✚ To identify causes of maternal mortality in JUSH from January 2010 to December 2014
- ✚ To determine factors associated with maternal mortality in JUSH from January 2010 to December 2014

## CHAPTER FOUR: METHODS

### 4.1 Study area and period

The study was conducted at Jimma university specialized hospital. JUSH is located in Jimma town which is around 355 Km from Addis Abeba in south west direction, Jimma zone, Oromia regional state, Ethiopia. JUSH is one of the oldest public hospitals found in the south western part of the country that runs under Jimma University. It is currently the only teaching and specialized hospital in south west part of Ethiopia. The hospital serves as referral site and provides specialized care for south-western Ethiopia with a catchment population of about 15 million. The specialized care provided for the population are in internal medicine, surgery, obstetrics and gynecology, pediatrics, ophthalmology, psychiatry and dermatology (31).

The study was conducted from March 14 – April 14, 2015 among women who visited maternal health services from January 2010 to December 2014

### 4.2 Study design

Time matched institution based case control study and retrospective review of data were supplemented for trend.

### 4.3 Population

The **source Population** of this study was

All charts of mothers who visited JUSH for maternal health service utilization.

Whereas the **Study Population** was

Cases: all charts of mothers who died during pregnancy, delivery and 42 days after delivery in JUSH from January 2010 to December 2014 Ascertainment of cases = the occurrence of death was ascertained based on the information on chart. If death is reported on the chart, it was taken as a case.

Controls: all charts of mothers who visited JUSH for maternal health service utilization from January 2010 to December 2014 and nearby survived after delivery.

## **Sample population**

The sample population was randomly selected cards of cases and controls during the study period.

### **4.4 Inclusion and exclusion criteria**

**Inclusion criteria:** cases that fulfill the standard definitions of maternal mortality given by ICD – 10 and controls which came for maternal health service utilization.

**Exclusion criteria:** cases that are registered on the log book but whose charts' were missed. Charts that didn't include the assessment of admission and status of mother (dead or alive) during discharge were excluded from the study. Family planning users, ANC users are excluded.

### **4.5 Sample size determination and sampling procedures**

#### **Sample size determination**

Sample size was determined by two population proportion using Epi info version 7 by taking the following assumptions: 95% CI, and 80% power, odds ratio of 0.06 (odds of nurses attending the delivery over odds of delivery attended by other) from study done in Tigray region, case to control ratio of 1:4 and the prevalence of exposure among controls were 6.5% (proportion of controls attended by nurse) taken from unmatched case control study done in Tigray regional state (15). A total of 600 charts, 120 cases and 480 controls were included in the study.

#### **Sampling procedures**

Charts of both cases and controls that fulfill the inclusion and exclusion criteria were selected from maternity ward, delivery ward, ICU, operation theatre, PNC ward and gynecologic ward.

First cases were identified from log book or registration book from respective wards and then sampling frame was prepared. Hundred twenty cases were selected randomly from sampling frame by using random number of cases in SPSS version 21.

After identifying cases included in the sample the time of procedures was identified for each selected cases. For each case four controls that were the nearby survived women after delivery were selected. But if there are more than four controls who are candidate lottery method is used in selection. Selected 120 maternal death and 480 controls charts were reviewed.

Charts that had missing values of more than 30% were replaced by random selection from available charts. Controls are replaced with a case.

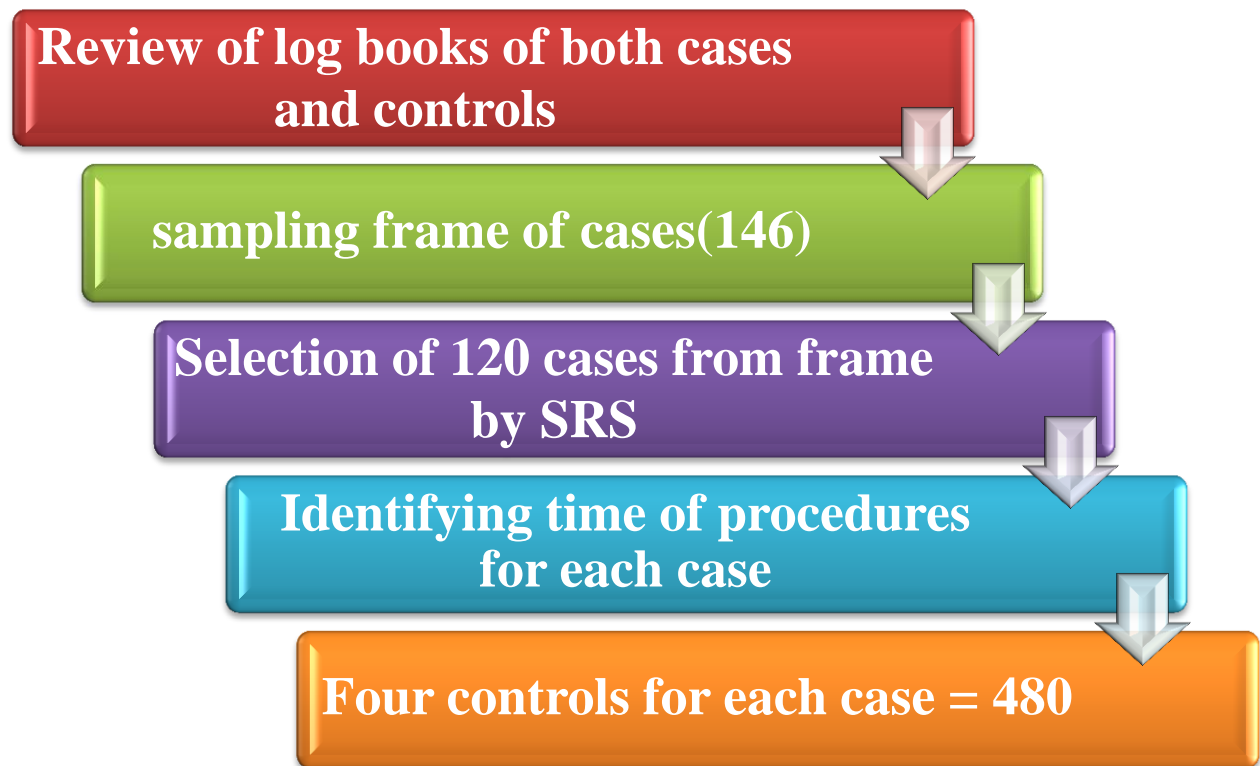


Figure 2: Schematic presentation of the sampling procedure, JUSH, May, 2015

#### 4.6 Variables

##### Dependent variable

Maternal death

##### Matching variable

Time

##### Independent variable

**Socio-demographic factors:** Age, residence, distance

**Delivery history:** Length of labor, birth attendant, mode of delivery and place of delivery

Obstetric history: ANC, parity and gravidity

**Antenatal/ intra natal risks:** Placenta previa, previous cesarean section, obstructed labour, multiple gestation and malpresentation

**Causes of maternal death:** Haemorrhage, PIH, abortion, infection, and uterine rupture

**Comorbidities:** Chronic hypertension, anaemia, HIV positive and malaria

#### **4.7 Data collection instrument**

Data collection instrument was adopted from Maternal Death Surveillance and Response Technical Guideline of Ethiopia (32). The checklist consists of socio-demographic data, obstetric and delivery history, presence of comorbidities, cause of death, antenatal and intranatal risks and presence of complications.

#### **4.8 Data collectors**

Three midwives and three health officers were recruited and trained for two days. The training covered: the contents of the tool, ethical considerations and way of extraction of necessary information from chart. Two supervisors, one midwife and one public health officer, monitored and followed data collection while the principal investigator supervised the overall data collection process.

#### **4.9 Data processing and analysis**

Data were entered into Epi Data version 3.1 and then exported for analysis to STATA version 13.0. Data were cleaned for inconsistencies and missing values. Variables that were missed in more than 40% of total sample were excluded from analysis.

Simple frequencies were done to see the overall distribution of the study subject with the variables under study and to see any missing data. Multicollinearity test was performed to see collinearity of variables using variance inflation factor (vif).

Bivariate conditional logistic regression analysis was used to determine the association between different factors and the outcome variable and to select candidate variables for multivariate conditional logistic regression. Variables that had p value less than or equal to 0.20 was entered into multivariate conditional logistic regression to identify independent predictors of maternal death.

Significant variables from multivariate conditional logistic regression model were interpreted and discussed. Confidence interval of 95% was used to see the precision of the study and the



level of significance was taken at p value  $\leq 0.05$ . The adjusted matched odds ratio with the 95% CI was reported.

## **Causal inference**

Cause of death of women was identified by the WHO applications of ICD-10 to maternal death. The distribution of cause of death was observed using frequency distribution.

Propensity score matching analysis was used to infer the cause of death. Propensity score matching analysis is one of treatment effect analysis methods which is designed for matched data. Treatment effect analysis method is designed for observing the cause or effect of variable on variable using observational data where randomization is not applicable.

It controls confounder variables by matching in exposed and non-exposed groups by calculating propensity scores of variables. Patients with the same propensity score, cause is unrelated to confounders. Therefore, the cases and controls tend to have similar distributions of measured confounders other than cause, something that we would also achieve using randomization. In the model, there is an outcome variable (in our case, maternal status), a treatment-dependent variable (cause in our case like PIH, hemorrhage...cause of death) and a treatment-independent variable (observed confounders or variables). The model estimates causation in sample (called average treatment effect in treated - ATET) and population (called average treatment effect - ATE). Causal inference is determined at the level of significance of p value  $\leq 0.05$ . The coefficient is reported and interpreted in 95% CI level of precision from ATET.

## **Maternal mortality trend**

Maternal mortality trend was done using the total number of cases occurred in the study period. Trend was shown using maternal mortality ratio. The total maternal mortality ratio in five years and each year MMR was calculated using the following formula

$$MMR = \frac{\text{total number of maternal death in the study period}}{\text{Total number of live births in the study period}} \times 100,000$$

Graphical presentation such as tables, bar chart, line graphs and pie charts was used to present the result findings of the study.

#### **4.10 Data quality assurance**

To assure the quality of data, data collectors were trained and did pretesting of the checklist tool until they became well conversant with the instrument. Every day filled checklist was reviewed and checked for completeness and relevance by supervisors and principal investigator.

After data collection, each filled checklist was given a unique code by the principal investigator. Data was entered using Epi Data version 3.1 then exported to STATA version 13.0 for analysis. Accuracy was improved through double entry, 10 % of entered data was reentered with the actual filled tool and compared the dataset using STATA. Frequencies were used to check for entry errors, missed values and outliers. Any errors identified were corrected after revision of the original data using the code numbers.

#### **4.11 Operational and definitions of terms**

**Maternal health service:** Health services including abortion, visit for pregnancy and pregnancy related complications during antenatal period, delivery and post natal care within 6 weeks.

**Time:** time at which the event occurred. Time of control is the nearby time from time of case within one day.

**Maternal death:** A maternal death is the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and the site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes (2).

**Direct obstetric deaths:** Direct obstetric deaths are those resulting from obstetric complications of the pregnancy state (pregnancy, labor and the puerperium), from interventions, omissions, incorrect treatment, or from a chain of events resulting from any of the above (2).

**Indirect obstetric deaths:** Indirect obstetric deaths are those resulting from previous existing disease or disease that developed during pregnancy and which was not due to direct obstetric causes, but which was aggravated by physiologic effects of pregnancy (2).

**Cause of death** = the causes written on the chart is considered as cause of death.

**Underlying cause of death:** It is defined as the disease or condition that initiated the morbid chain of events leading to death or the circumstances of the accident or violence that produced a fatal injury (2).

### **Level of MMR**

Extremely high MMR =  $\geq 1000/100,000$  (7).

Very high MMR = 500–999/100,000 (7).

High MMR = 300–499/100,000 (7).

Moderate MMR = 100–299/100,000 (7).

Low MMR =  $<100/100,000$  (7).

Presence of comorbidity = the presence of at least one medical disease was considered.

Prolonged labour = duration of labour more than 24 hours

### **4.12 Ethical consideration**

Prior to data collection, ethical clearance was obtained from Research and Ethics committee of the College of health sciences of Jimma University. Written permission letter was also received from JUSH CEO and other concerned bodies in the study set up. In order to establish anonymous linkage only the codes, not the names of the participant from the chart, was registered on the questionnaire. During the training of data collectors and supervisor, ethical issues was addressed as important component of the research.

### **4.13 Dissemination plan**

After successful defense reports will also be submitted to JU College of Health sciences, Oromia Health Bureau, Jimma Zone health Department, and to JUSH. Attempts will also be made to present the finding of this study on the annual and biannual meetings of Oromia health Bureau, Jimma zone health department and other meetings in the region concerned with maternal death control.

Moreover, attempts will also be made to present it on scientific conferences and publish it on national or international scientific journal.

# CHAPTER FIVE: RESULT

## 5.1. Socio - demographic characteristics

A total of 120 cases (dead women) and 480 controls (survived women) were included in the study. From the variables, for which there was a plan to collect information for, the following are incomplete in 99% of charts: ethnicity, educational status, marital status, occupation, and income. As a result they are excluded from analysis.

More than half (52.5%) of cases were in the age group 20-34 whereas nearly two third of controls were in the age group 20-34. Although about three quarter (75.83%) of cases were from rural area, more than half (54.58%) of controls were from urban residence. Forty eight (40%) of cases came from 11-50km distance whereas hundred fifty four (32%) controls came from <= to 10 km distance (Table 1).

**Table 1: Socio-demographic characteristics of women in JUSH, May, 2015**

variables	category	cases	controls	Total
age	<20	19(23.46)	62(76.54)	81
		15.83	12.92	13.5
	20 - 34	63(16.67)	315(83.33)	378
		52.5	65.63	63
	>=35	38(26.95)	103(73)	141
		31.67	21.46	23.5
residence	rural	91(10)	218(90)	309
		75.83	45.42	51.5
	urban	29(29.45)	262(70.55)	291
		24.17	54.58	48.5
Estimated km of area from jimma	<=10	12(7.23)	154(92.77)	166
		10	32.08	27.67
	11 - 50	48(25.26)	142(74.74)	190
		40	29.58	31.67
	51 - 150	26(20.31)	102(79.69)	128
		21.67	21.25	21.33
	>=151	34(31.58)	82(68.42)	116
		28.33	17.03	19.33
Total		120	480	600

Most of cases (70.8%) and more than half (51.9%) of controls were referred from health centers (Fig 3).

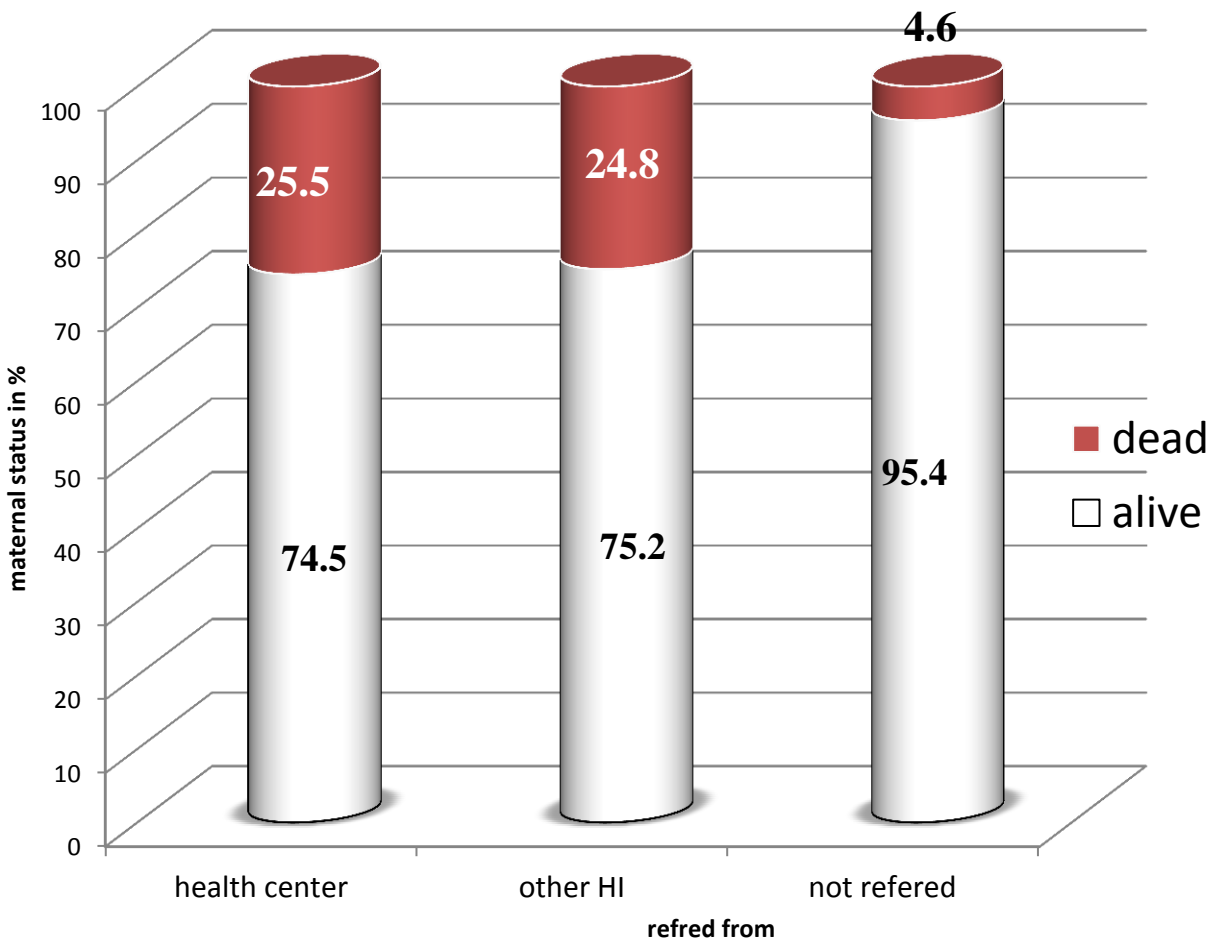


Figure 3; Referral and maternal status of women in JUSH, May, 2015

### Obstetric and delivery history

Fifty (41.67%) cases were prim-gravida women while 228 (47.7%) controls were gravida 2-4. Similarly most of cases (43.3%) were primi-paras whereas most of controls (47.7%) were para 2-4. Only 3(2.5%) cases and 12 (2.5%) controls had history of previous C/S (Table 2)

Table 2: Past obstetric history of women in JUSH, May, 2015.

variables	category	cases	controls	Total
gravidity	Primi-gravida	50(22.9)	168(77.1)	218
		41.67	35	36.33
	2 - 4	33(12.6)	228(87.4)	261
		27.5	47.5	43.5
	>=5	37(30.6)	84(69.4)	121
		30.83	17.5	20.17
parity	Primi-para	52(20.8)	198(79.2)	250
		43.33	41.25	41.67
	2 - 4	36(13.6)	229(86.4)	265
		30	47.71	44.17
	>=5	32(37.6)	53(62.4)	85
		26.67	11.04	14.17
Previous caesarean section	no	117(20)	468(80)	585
		97.5	97.5	97.5
	yes	3(20)	12(80)	15
		2.5	2.5	2.5
	Total	120	480	600

More than two third (67.5%) of cases were women who did not have ANC follow up whereas majority of controls (96.5%) had ANC follow up (Fig 4).

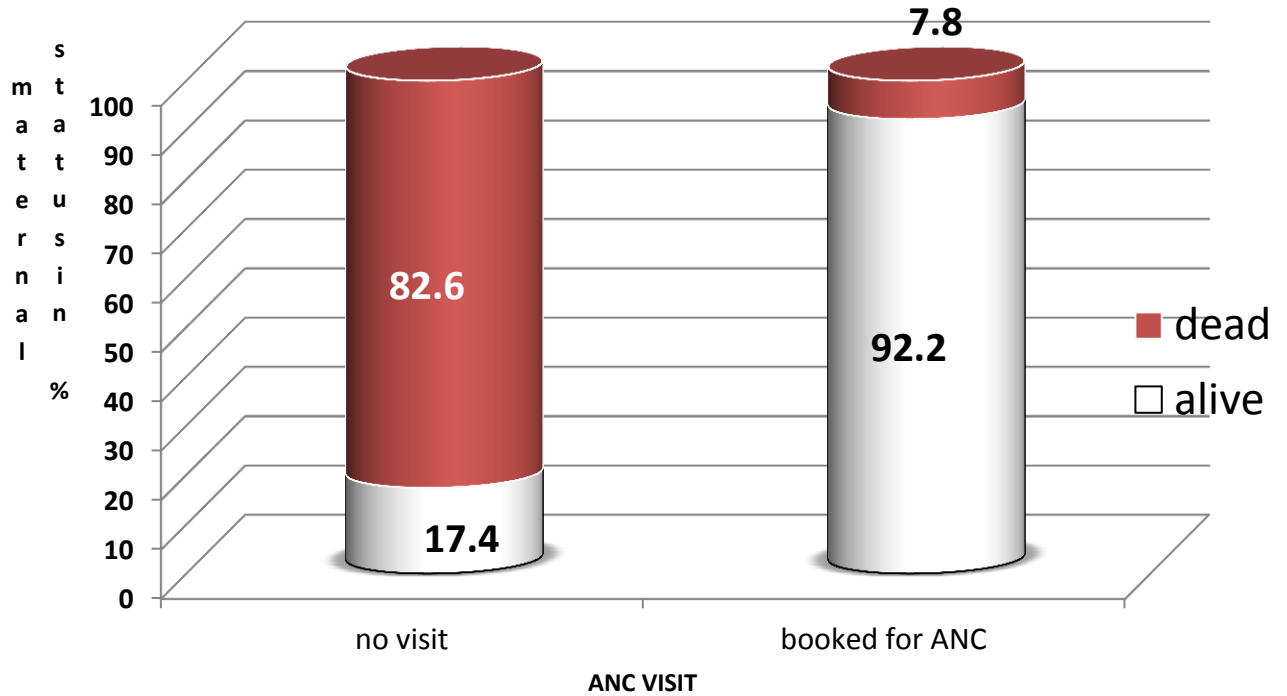


Figure 4; ANC follow up by maternal status of women in JUSH, May, 2015

Although 40 (34%) cases had obstructed labor, only 59 (12.7%) controls had obstructed labor. More than one quarter (26.7%) cases had malpresentation whereas only 13.75% of controls had malpresentation. More controls (12.3%) had prolonged rupture of membrane than cases (4.2%). Most of cases (83.3%) had prolonged labour while most of controls (82.9%) length of labour less than 24 hrs (Table 3).

Table 3; shows delivery history of women in JUSH, May 2015

variables	category	cases	controls	Total
Obstructed labour	no	79(15.86)	419(84.14)	498
		65.83	87.29	83
	yes	41(40.2)	61(59.8)	102
		34.17	12.71	17
malpresentation	no	88(17.53)	414(82.47)	502
		73.33	86.25	83.67
	yes	32(32.65)	66(67.35)	98
		26.67	13.75	16.33
PROM	no	115(21.46)	421(78.54)	536
		95.83	87.71	89.33
	yes	5(7.81)	59(92.19)	64
		4.17	12.29	10.67
length of labour	<24	20(4.78)	398(95.22)	418
		16.67	82.92	69.67
	>=24	100(54.95)	82(45.05)	182
		83.33	17.08	30.33
	Total	120	480	600

Majority (92%) of cases and controls (81%) were attended by doctors. Fifty five (46%) cases have undergone ceaserean section or hysterectomy procedures followed by assisted vaginal delivery (27%). However, more than half (53%) of controls were delivered/gave birth by spontaneous vaginal delivery (Fig 5)

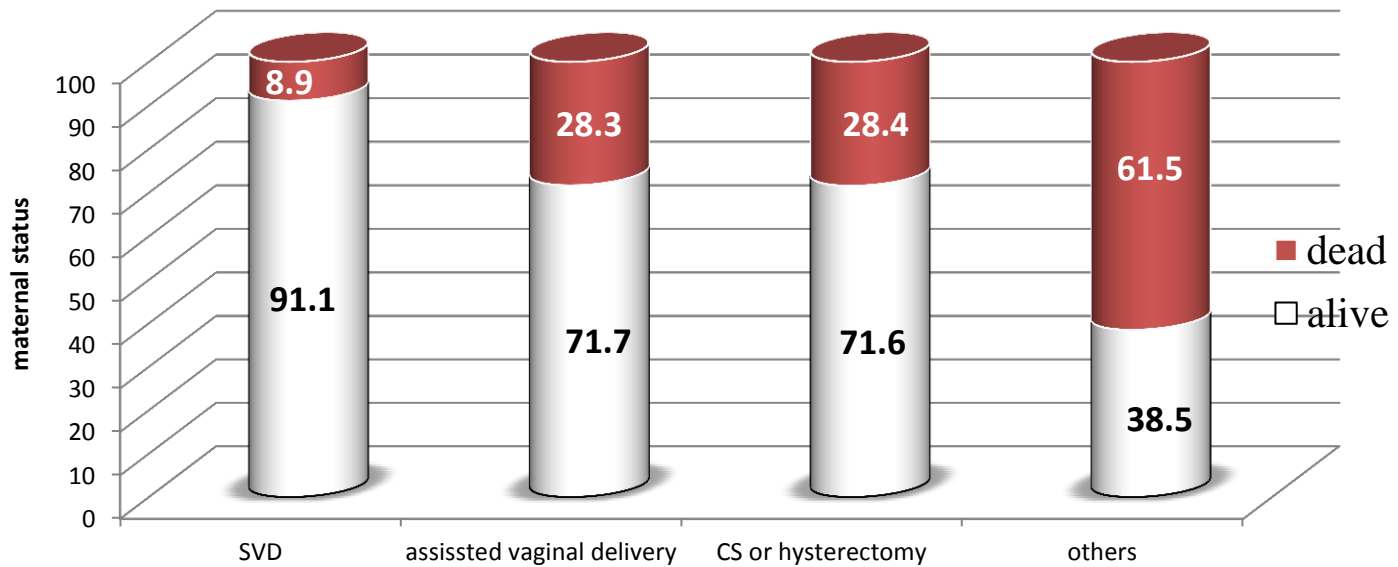


Figure 5; Mode of delivery by maternal status of women in JUSH, May, 2015



## **Pregnancy risk and complication**

In 97.5% (586) of women there are no multiple gestations. From 14 women who have multiple gestations only three (21.4%) are dead. From total deaths in occurring in women only three women (2.5%) have multiple gestations. The rest 97.5% of women are alive. Placenta previa only occur in 17 (2.83%) of women. From which 6 (32.3%) are dead. Abruptio placenta occur only in 23(3.83%) of women. From which 14 (61%) are dead which covers 12% from total death. only 9% (54) of women have APH from which 38 (70%) of them are dead. It covers 32% of total maternal death. Only 46 (8%) of women have PIH from which 23(50%) are dead in which it covers 19% from total deaths. 81% of women who dead did not have PIH.

Only 45(7.5%) of women have intra-partum or post-partum complications (chorioamnitis, wound infection and post-partum psychosis)from which 24(53%) of them are dead in which 20% of death from total death. Post term pregnancy occurred in only 26(4.33%) of women from which only 2 deaths occurred. 79 (13%) of women face other types of comorbidity from which 40(51%) of them dead which is 33% from total death.

Although 28 (23.3%) cases have experienced uterine rupture whereas only 9 (<2%) of controls have experienced uterine rupture. Similarly, though 37 (30.8%) cases have developed PPH only 5 (1%) controls have developed PPH. Seventeen (14%) cases have experienced puerperal sepsis while 7 (1.5%) controls have developed it. Even though three quarter (75%) of cases have experienced hemorrhage only 30 (6%) have experienced it. Thirty four (28%) cases had anemia whereas nearly 10% of controls had anemia (Table 4).

Table 4; Obstetric complications of women in JUSH, May, 2015

variables	category	cases	controls	Total
Uterine rupture	no	92(16.34)	471(83.66)	563
		76.67	98.13	93.83
	yes	28(75.68)	9(24.32)	37
		23.33	1.88	6.17
Post-partum hemorrhage	no	83(14.9)	475(85.1)	558
		69.17	98.96	93
	yes	37(88.10)	5(11.90)	42
		30.83	1.04	7
Puerperal sepsis	no	103(17.88)	473(82.12)	576
		85.8	98.54	96
	yes	17(70.83)	7(29.17)	24
		14.2	1.45	4
hemorrhage	no	30(6.25)	450(93.75)	480
		25	93.75	80
	yes	90(75)	30(25)	120
		75	6.25	20
anemia	no	86(16.54)	434(83.46)	520
		71.67	90.42	86.67
	Yes	34(42.5)	46(57.5)	80
		28.33	9.58	13.33
	Total	120	480	600

## 5.2. Trend of maternal mortality

There were 146 maternal deaths and 17,044 live births making the maternal mortality ratio of 857 per 100,000 in the five year period. The highest death occurred in 2010 with MMR of 1873/10<sup>5</sup> followed by of MMR of 801/10<sup>5</sup> in 2011. The lowest death occurred in 2014 with MMR of 350/10<sup>5</sup>. In 2012 MMR was 719/10<sup>5</sup> whereas it was 685/10<sup>5</sup> in 2013.

Table 5: total death and live births in JUSH, May, 2015

	2010	2011	2012	2013	2014	total
Death	58	27	22	26	13	146
Live births	3097	3372	3059	3798	3718	17,044
MMR per 10 <sup>5</sup>	1873	801	719	685	350	857

As the ratio shows there is a decreasing pattern of death (fig 6).

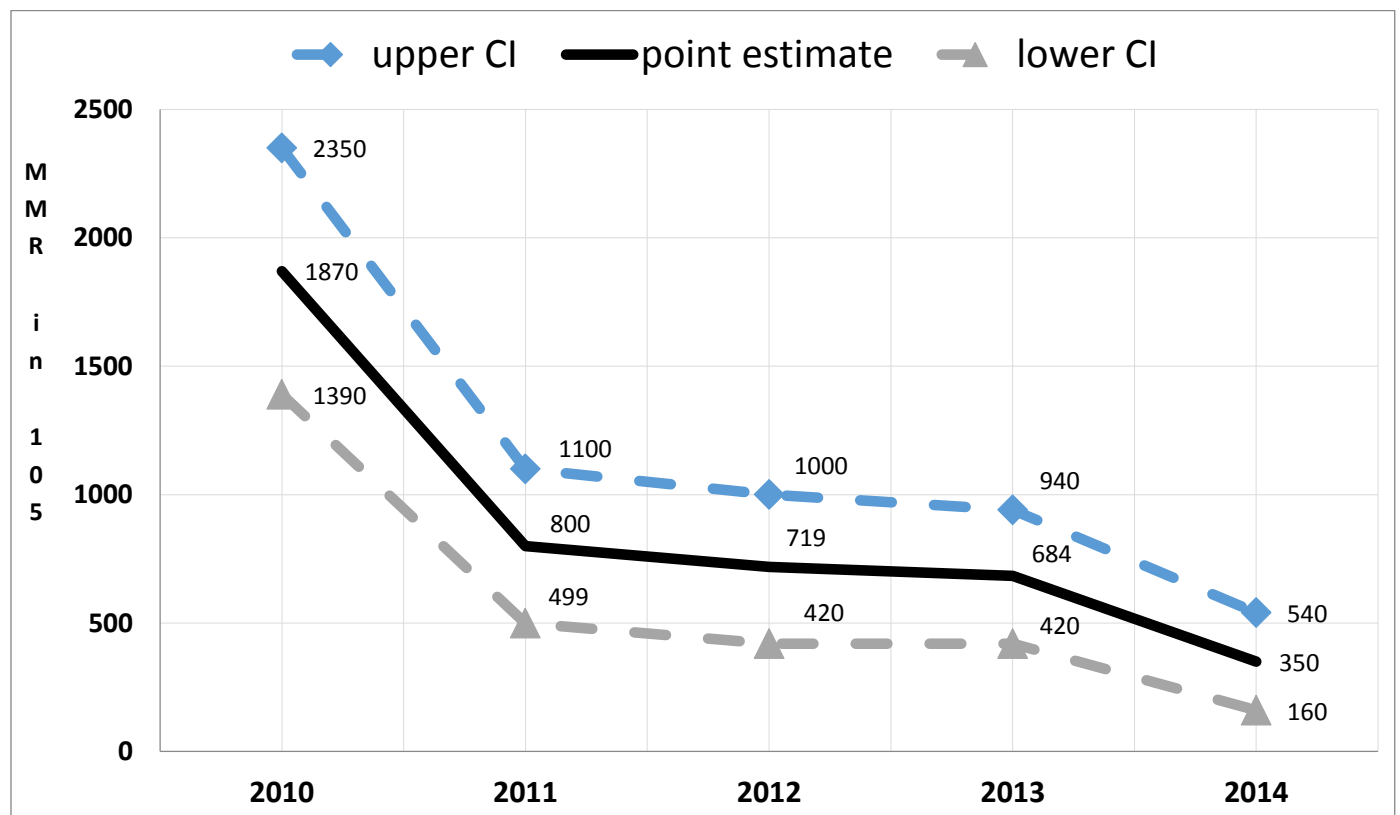


Figure 6: Trend of maternal death from 2010 to 2014 in JUSH, May, 2015

### 5.3. Timing of death

Most deaths 82 (68%) occurred during post-partum period while 25% deaths occurred during intra-partum period. Only 8 (6.7%) happened during ante partum period (fig 7). Out of 8 deaths that occurred during ante-partum period, five of them occurred during 14 – 28 weeks of ante-partum. Two deaths occurred in less than 14 weeks. Twenty eight deaths, out of 30 deaths during intra-partum, occurred during 29 – 37 weeks of intra-partum. Out of 82 deaths during post-partum period, 38 (46.34%) happened between 4 - 7 days whereas 29 (35.37%) happened within 3 days. The rest occurred in between 8 – 42 days.

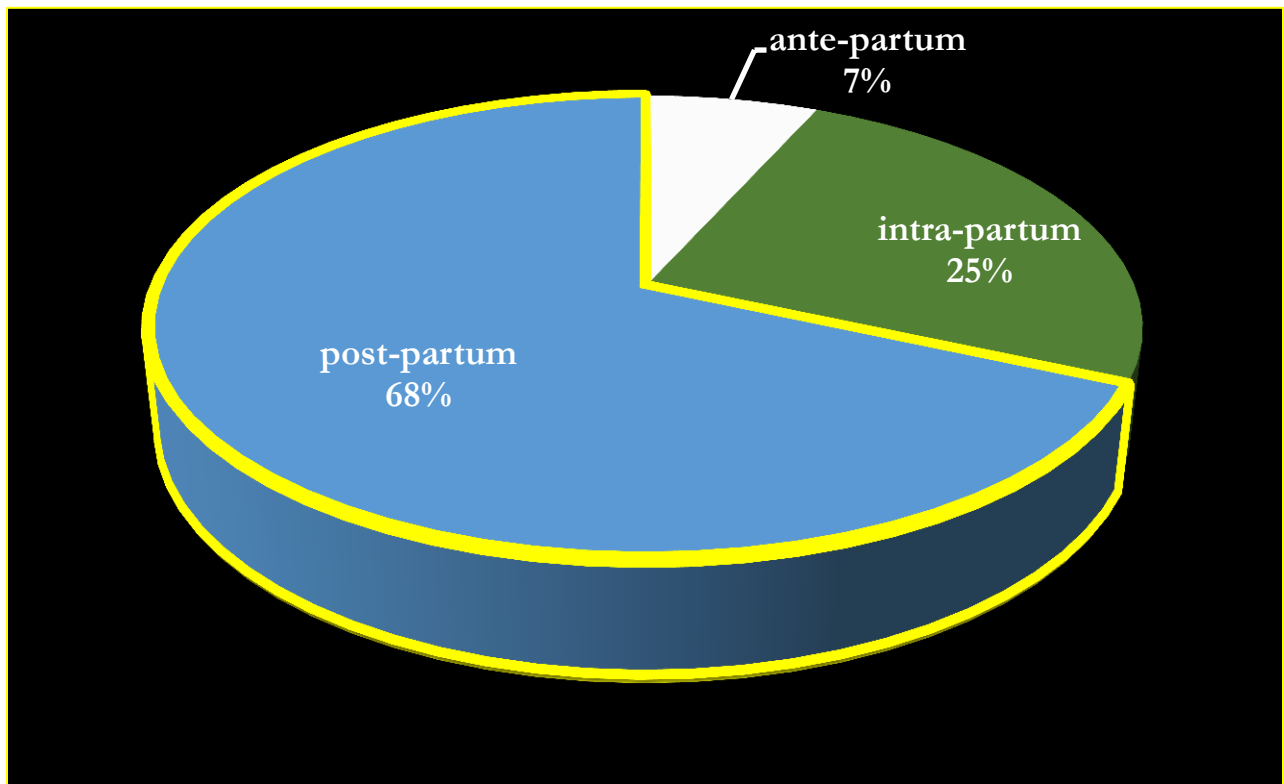


Figure 7: Timing of death of women in JUSH, May, 2015

## 5.4. Cause of maternal death

Hemorrhage was the commonest cause of maternal death accounting for more than 54% followed by pregnancy induced hypertension (20%). Eighty five percent of deaths were due to hemorrhage, anemia and PIH. Majority of (97%) of maternal death occurred as a result of direct obstetric causes (Fig 8).

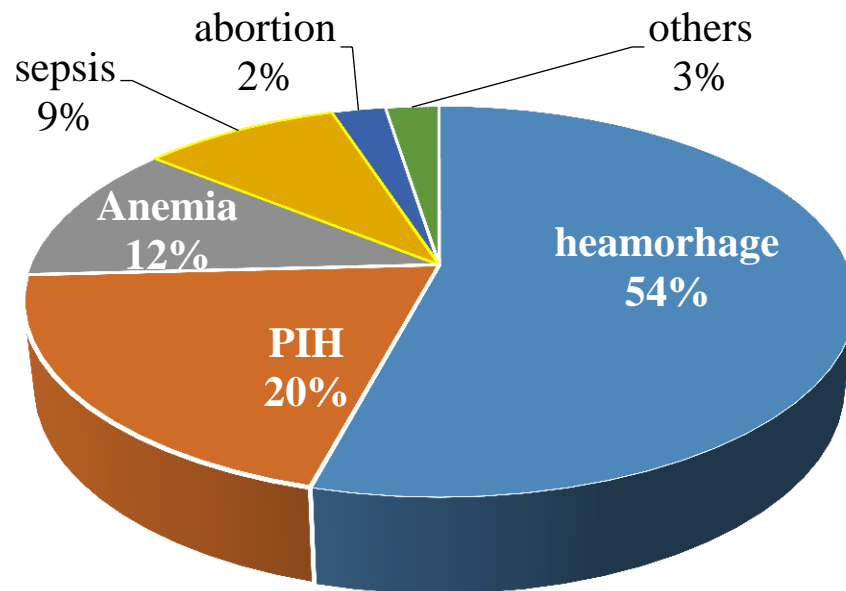


Figure 8: Cause of death of women in JUSH, May, 2015

Every cause of death has a decreasing pattern but in every year of the study hemorrhage is the leading cause of death (Fig 9).

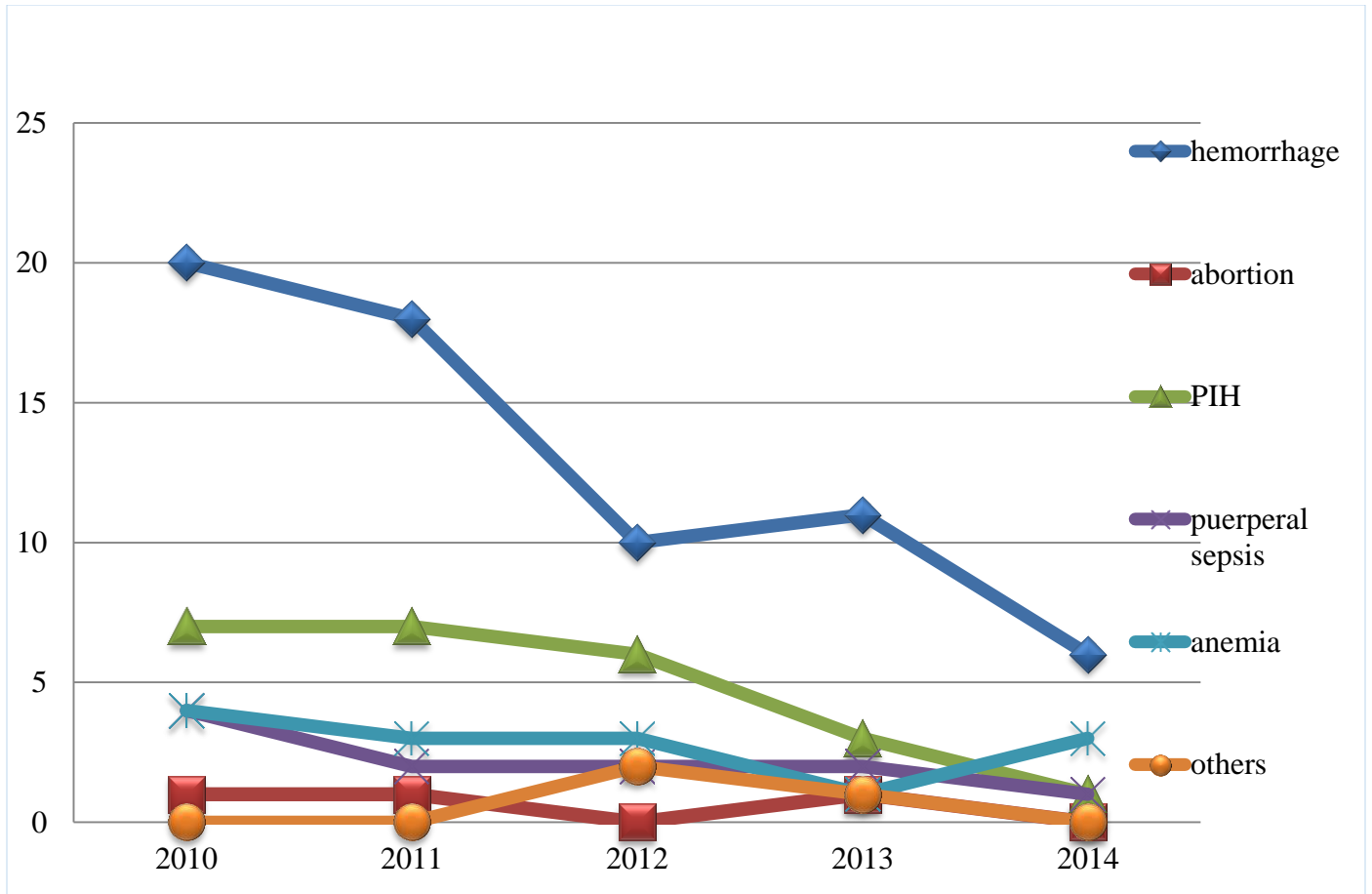


Figure 9; Trends of causes of maternal death in JUSH, May, 2015

### Result of propensity score matching analysis

Chorioamnitis, abortion and wound infection were excluded from causal inference analysis because they don't meet the criteria for propensity score matching analysis. Propensity score matching analysis showed that hemorrhage, PIH and anemia were significant causes of maternal death (Table 6)

- ✚ An increase of 1000 women who have hemorrhage increases maternal death by 477.
- ✚ An increase of 1000 women who have PIH increases maternal death by 232.
- ✚ An increase of 1000 women who have anemia increases maternal death by 110.

Table 6; Causes of maternal death in sample population in JUSH, May 8, 2015

Status**	Coefficient	AI Robust Std. Err.	z	p	[95% Conf. Interval]	
PIH	0.232	0.095	2.44	0.015	0.046	0.419
sepsis	0.129	0.104	1.25	0.211	-0.073	0.332
comorbidity	0.053	0.045	1.17	0.240	-0.035	0.141
hemorrhage	0.477	0.086	5.51	0.000	0.307	0.647
anemia	0.110	0.047	2.32	0.021	0.017	0.204

\*\* adjusted for all causes and predictor variables among cases and controls except excluded variables which does not meet the criteria of propensity score matching analysis. So it is assumed that the cases and controls have same distribution in confounders variables included in the model. Example to see PIH as a cause of death all predictor variables and other causes of maternal death are included so cases and controls have same distribution in these included variables.

## 5.5. Predictors of maternal death

Multiple gestation, post term pregnancy and previous cesarean section were excluded from multivariate conditional logistic regression analysis since they have  $p > 0.2$  in bivariate conditional logistic regression. ANC and delivery method were excluded from multivariate conditional logistic regression analysis since they affect the precisions of significant variables.

Being in the age group of 20 – 34 is protective than being in the age group of  $\geq 35$ . A one women increase in the age group of 20 – 34, decreased the odds that a woman would die by 70.1% than being in the age group of  $\geq 35$  (AMOR= 0.299, 95% CI (0.113, 0.792).

Women who came from rural area are more likely would die 2.594 times than women who came from urban area (AMOR= 2.594, 95% CI (1.001, 6.726).

Women who were referred from health center were 4.011 times more likely to die than women who were not (AMOR=4.011, 95% CI (1.113, 14.464). Similarly women who referred from other health institutions (hospital and private or NGO clinics) were 6.209 times more likely they would die than women who didn't referred (AMOR=6.209, 95% CI (1.565, 24.626) (table 7).

Women who had prolonged labour were 37.141 times more likely the women would die than women who had less than 24 hour duration of labour (AMOR= 37.141, 95% CI (13.296, 103.750). Women who had comorbidities were 9.631 times more likely they would die than women who didn't have comorbidities (AMOR= 9.631, 95% CI (3.135, 29.588) (table 7 and 8).

Table 7; Predictors of maternal death in JUSH, May, 2015

variables	category	cases	controls	Total	CMOR (95% CI)	AMOR (95% CI)
age	<20	19(23.46)	62(76.54)	81	0.840 (0.448, 1.518)	1.582 (0.434, 5.762)
		15.83	12.92	13.5		
	20 - 34	63(16.67)	315(83.33)	378	0.558 (0.356, 0.874)	<b>0.299</b> <b>(0.113, 0.792)</b>
		52.5	65.63	63		
	>=35	38(26.95)	103(73)	141	1	1
		31.67	21.46	23.5		
residence	rural	91(10)	218(90)	309(51.5)	2.250 (1.210, 4.210)	<b>2.594</b> <b>(1.001, 6.726)</b>
		75.83	45.42	42.5		
	urban	29(29.45)	262(70.55)	291(48.5)	1	1
		24.17	54.58	43.67		
Estimated km of area from jimma	<=10	12(7.23)	154(92.77)	166	0.1801 (0.0875, 0.3705)	0.499 (0.134, 1.864)
		10	32.08	27.67		
	11 - 50	48(25.26)	142(74.74)	190	0.8116 (0.4700, 1.4014)	1.226 (0.436, 3.450)
		40	29.58	31.67		
	51 - 150	26(20.31)	102(79.69)	128	0.6374 (0.3518, 1.1546)	0.539 (0.171, 1.698)
		21.67	21.25	21.33		
>=151	34(31.58)	82(68.42)	76	1	1	
	28.33	17.03	19.33			
Referral	health center	85(25.45)	249(74.55)	334	6.6667 (3.0214, 14.7102)	<b>4.011</b> <b>(1.113, 14.464)</b>
		70.83	51.88	55.67		
	Other HI	28(24.87)	85(75.22)	113	6.4467 (2.8696, 18.4521)	<b>6.209</b> <b>(1.565, 24.626)</b>
		23.33	17.71	18.83		
	not referred	7(4.58)	146(95.42)	153	1	1
		5.83	30.42	25.5		
comorbidity	No	80(15.36)	441(84.64)	521	1	1
		66.67	91.88	86.83		
	Yes	40(50.63)	39(49.37)	79	15.3090 (2.7965, 83.8048)	<b>9.631</b> <b>(3.135, 29.588)</b>
		33.33	8.13	13.17		
Parity	Primi	85(25.45)	249(74.55)	334	6.6667 (3.0214, 14.7102)	0.498 (0.031, 7.927)
		70.83	51.88	55.67		
	2 - 4	28(24.87)	85(75.22)	113	6.4467 (2.8696, 18.4521)	0.329 (0.042, 2.593)
		23.33	17.71	18.83		
	>=5	7(4.58)	146(95.42)	153	1	1
		5.83	30.42	25.5		
Gravidity	Primi	50(22.9)	168(77.1)	218	0.667 (.396, 1.124)	1.565 (0.108, 22.634)
		41.7	35	36.3		
	2 - 4	33(12.6)	228(87.4)	261	0.333	1.489



		27.5	47.5	43.5	(0.195, 0.571)	(0.207,10.687)
	>=5	37(30.6)	84(69.4)	121		
		30.8	17.5	20.2	1	1
attendant	doctors	110(22.09)	388(77.91)	498	2.7196 (1.3473, 5.489)	1.028 (0.277, 3.821)
		91.67	80.83	83		
	Others	10(9.85)	92 (90.25)	102	1	1
		8.33	19.17	17		
obstructed labour	No	79(15.86)	419(84.14)	498	1	1
		65.83	87.29	83		
	Yes	41(40.2)	61(59.8)	102	3.4686 (2.1787, 5.5220)	0.695 (0.259, 1.869)
		34.17	12.71	17		
Malpresentation	No	88(17.53)	414(82.47)	502	1	1
		73.33	86.25	83.67		
	Yes	32(32.65)	66(67.35)	98	2.3736 (1.4459, 3.8966)	0.873 (0.301, 2.535)
		26.67	13.75	16.33		
Duration of labour	<24 hrs	20(4.78)	398(95.22)	410	1	1
		16.67	82.92	69.67		
	>=24 hrs	100(54.95)	82(45.05)	182	22.2254 (12.1072, 40.7996)	<b>37.141</b> <b>(13.296, 103.750)</b>
		83.33	17.08	30.33		
Anemia	No	86(16.54)	434(83.46)	520	1	1
		71.67	90.42	86.67		
	Yes	34(42.5)	46(57.5)	80	3.5058 (2.1426, 5.7363)	2.204 (0.855, 5.679)
		28.33	9.58	13.33		
PROM	No	115(21.46)	421(78.54)	536	1	1
		95.83	87.71	89.33		
	Yes	5(7.81)	59(92.19)	64	0.293 (0.134, 0.759)	0.220 (0.036, 1.329)
		4.17	12.29	10.67		

## CHAPTER SIX: DISCUSSION

### 6.1. Trend of maternal death

Maternal death in our country has a decreasing trend as depicted by different reports and reviews. According to 2013 combined reports by WHO, UNICEF, the World Bank and UNFPD Ethiopia shows a decreasing pattern of maternal death from 720 in 2005 to 420/105 in 2013. Comparing this national figure with Finding from this study revealed high MMR (857/105) in JUSH compared to the above national figure. Even compared to 2011 finding of EDHS (676/10<sup>5</sup>) still death in JUSH is higher (7, 16). The observed disparity might be due to the fact that DHS is done on country wide representative sample while this study is done at hospital in which most risky women may come and inflate the number of death or this figure may represent females that came for institutional delivery (14%). The other reason might be MMR can be affected by the denominator in which if women will not come for delivery (poor health seeking behavior) the denominator becomes low so that the ratio is inflated. The difference with international organizations report might be because of use of multi-level regression adjustment to estimate MMR for Ethiopia which is not fully based on actual death of mother.

Review of different community and hospital based studies by Ahmed Abdela shows a decreasing pattern of maternal death. Review done in jimma hospital before 15 years back shows fluctuation of MMR in the range of (1635, 2331/10<sup>5</sup>) with total MMR of 1965/10<sup>5</sup> which is higher than this finding. Review done from 2002 – 2006 in JUSH shows a decreasing pattern with total MMR of 888/105 in the range of (417, 1828/10<sup>5</sup>) which is higher than our finding. Review in Ambo hospital before 10 years back shows fluctuation from (671, 3981/10<sup>5</sup>) with total MMR of 1852/10<sup>5</sup> which is higher than our finding. (7,19,30–33).

Decrease in occurrences of death from previous years in JUSH particularly after 2010 might be because of increasing awareness of community about institutional delivery, organizational and policy factors. Organizational factors might be service expansion and human power expansion at JUSH, increasing availability and accessibility of HI. The other factor might be after 2010 in our country there was country wide mobilization to decrease death of mother with slogan of “no mother should die while giving birth.” In the other extreme it might be because of under

reporting of death due to fear of bad criticism and captivity health professionals and HI. The major implication of this finding for safe motherhood practice, there is decrease of maternal death in JUSH even if the CI of 2011 is not significant. These things might have an impact on decrement of maternal death in JUSH.

## **6.2. Timing of maternal death**

Most (68%) of maternal death occurred in post-partum period which is higher than finding from south west Ethiopia in Bonke wereda in which 51% of maternal death occurred in post-partum period. This might be because of difference in number of maternal death included in the study, 49 deaths was included in Bonke wereda but in this research 120 maternal death were included in the study. The other reason might be because of recall bias introduced in south west Ethiopia study since it is retrospective cross sectional house hold survey. However study from maternity hospital of Nigeria shows about 61.9% of the maternal deaths occurred in post-partum period which is lower than this finding. This might be because of only 84 maternal deaths in two year study period were included with this number and study period if it is data of five year it might be higher than this research finding (22,23). Higher number of maternal death in post-partum period implies that the management following delivery and during delivery might be poor. Prolonged period of labour due to OL or due to not having timely intervention might contribute a lot for death occurring in post-partum period.

The second period in which higher number of death occurred is the intra-partum period (25%). It is smaller than finding from Bonke wereda, south west Ethiopia which was 37%. This difference might be because of difference in site of delivery, 97% of delivery in JUSH is HI delivery in contrary to study of Bonke wereda, south west Ethiopia in which 92% of delivery occurred in home so that in home delivery complications are not managed well so high number of death may occur in intra-partum period. But it is much higher than from findings of maternity hospital of Nigeria which is 13.1%. This difference might be because of high antepartum death (10.7%) and death because of post-abortal complications (14.3%). in maternity hospital of Nigeria in which 25% of women died before reaching to intra-partum period but in our set up antepartum death including abortion complication is only 7%. This might be because of high prevalence of death associated with abortion relative to JUSH. The other reason might be absence of blood bank, difference in size and level of hospital and difference in the number of

health professionals (low number) during the study period in maternity hospital of Nigeria might contribute to poor quality of care. The other reason might be dramatic reduction of maternal death related with abortion due to the introduction of misoprostol or safe mother hood services in our country.

Ante partum death occurred in south west Ethiopia is 12% which is higher than this research finding 7%. There might be difference in awareness, this might create poor follow up of women during ante partum in south west Ethiopia study (26,27). These imply that proper care during antenatal period, reduce home delivery, intra-partum period and after abortion save the lives of many women in antenatal and intra partum period. In general the major reason of inflated postpartum death and relative small number of death in intra-partum and post-partum in JUSH as compared to Bonke wereda study is set up difference in which health institution death represents for 14% of females who utilize institutional delivery but the study of Bonke wereda represents 86% of females who did not utilize institutional delivery.

Implications of these findings are

- Management after terminating pregnancy might be poor or the women might not utilize postpartum care service.
- The risk of death during intra-partum period is high when the delivery is at home.

### **6.3. Causes of maternal death**

Most (97%) of maternal death was due to direct obstetric causes in which hemorrhage is the leading followed by PIH, which is consistent with studies done in different countries including in our country. Systematic review of causes maternal death done by WHO in the world shows nearly 73% of all maternal deaths between 2003 and 2009 were due to direct obstetric causes. Hemorrhage was the leading direct cause of maternal death worldwide, representing 27.1% (19.9–36.2) of maternal deaths. But in this finding hemorrhage is two times above this figure this might be because of the review was inclusive of developed regions in which indirect causes of death are higher. This might result under representation. PIH was the second most common direct cause worldwide (14.0%, 11.1–17.4) which is comparable figure (34). In Ghana hemorrhage (22.8%) was cause of maternal mortality which is lower by more than half from 54%. This might be because of in Ghana indirect causes are higher than direct causes like

infectious disease and the other reason is measurement difference in this research hemorrhage includes abortion but in Ghana it does not (39). The other might be abortion related death of mother in JUSH is minimal but in Ghana it is the major causes of death.

Study by Asheber Gaym also shows abortion complications, ruptured uterus, puerperal sepsis, postpartum hemorrhage and preeclampsia/ eclampsia were the five major causes of maternal mortality. But there is marked reduction in abortion related mortality after 2000. Which is true also in JUSH with 2% of abortion related death (37). The same finding is also there in Tigray study major causes of maternal deaths were hemorrhage and PIH which accounts 46% and 19% respectively which is almost comparable finding and minimal abortion related death (15).

Propensity score matching analysis for causal inference of death shows only hemorrhage, PIH, and anemia are significant causes of maternal death estimating for the sample after controlling all variables (confounders). But from all causes hemorrhage is grave; if there is 1000 women who had obstetric hemorrhage almost half (477) of them would die. It is a significant cause of death might be because of most women (72%) came from rural area so that they might have poor awareness about danger signs and might have also delay in seeking care. It might be also because of delay in intervention which is evidenced by 71% of women who had hemorrhaged experienced prolonged labour. The other reason might be poor first aid management at primary health institutions since 90% of women who had hemorrhage are referred cases from health institutions. Consequences of no timely intervention are shock and cardiac arrest at last death within short period of time.

#### **6.4. Factors affecting maternal death**

The commonest age group in which most maternal death (52.5%) occurred is 20 – 34. Most controls (65.63%) are also found in this age group. Likewise study done in Tigray regional states' hospitals in Ethiopia, most deaths (55%) occur in age group of 20 – 34 but it is not significant predictor. This might be because of representation of maternal death by less than half from this finding. When we compare this finding with study done in Tanzania Muhimbili national hospitals in 2011 most deaths (74.5%) occurs in age group of 20 – 34. This difference might be because of over representation of 20-34 due to high sample (141 deaths) and it might be because of poor quality of care given like inadequate or no blood transfusion. Even though most death occurred in this age group it is protective than being in the age group of  $\geq 35$ . A one

women increase in the age group of 20 – 34, decreased the odds that a woman would die by 70.1% than being in the age group of  $\geq 35$  with AMOR of 0.299 and 95% CI (0.113, 0.792) (15,18,30,36). This finding implies that even though high maternal death occurred in this age group from total deaths, it is favorable age group when we compare death ratio within the age groups. From the total sample included in the age group of 20-34 only 16.7% are dead which is less than age group of  $< 20$  (23.5%) and  $\geq 35$  (26.9%). Favorability of 20-34 is also seen in Tigray study in which only 15% of women in this age group are dead compared to 27.3% in  $< 20$  and 36.5% in  $\geq 35$  age group.

Three fourth of women who came from rural area are died as per the finding of this research. They would die 2.594 times more likely than women who came from urban area with AMOR of 3.572 and 95% CI (1.001, 6.726). Even though it is not significant predictor, study from Tigray region shows 75.6% of women who died came from rural part of area. This might be because of women who came from rural area are at higher risk than who came from urban women which is evidenced by from women who don't have ANC follow up 72.4%, from women who were grand multi parity 72.9%, from women who had APH 70.4%, from women who had PPH 69%, from women who had prolonged labour 62.6% and from women who had uterine rupture 78.4% of them came from rural area.

These imply that women who live in rural area are poor at utilization of maternal health services might be due to different reasons like awareness problem or inaccessibility or unavailability of maternal health services.

Around 94% of maternal deaths are referred cases. Referred cases from health center and other HI are 4.011 (95% CI (1.113, 14.464)) and 6.209 (95% CI (1.565, 24.626)) times more likely they would die as compared to women who are self-referred respectively. Study done in tertiary hospital of Kenya shows referred cases would die two times than who don't referred AOR of 2.1 and 95% CI (1.0–4.3) (30). This might be because of cases are referred to a higher health institutions when it is complicated. This implies that there may be unnecessary delay from health institutions and from the family which is evidenced by 90% of referred women have prolonged labour.

When the duration of labour of women is 24 hour or more 37.141 times more likely the women would die than women who had less than 24 hour duration of labour with 95% CI (13.296, 103.750). OL is the underlying factors for different kind's risks during intra-partum period. Majorly it might lengthens the length of labour. Most (69%) of women who had OL had prolonged labour or unnecessary delay from patient side or HI which is evidenced by 90% of referred women have prolonged labour. The other reason might be around 40% of women came from more than 51km so it lengthens time without intervention. Research finding from Nigeria maternity hospital AMOR - 2.86 and 95% CI (1.39, 5.9) shows prolonged labour is the major risk factor for maternal death. Study from Tigray shows women whose length of labour is < 24 hours are protected from death than women whose length of labour is  $\geq$  24 hour with AOR of 0.27 and 95% CI (0.07-0.89) (15,22,35). The major consequence following prolonged labour is uterine rupture – 78% women who had uterine rupture prior they are exposed for prolonged labour. These findings imply that prolonged labour is the major risk factor and exposes the women for another risk factor like uterine rupture. The other implication is OL and referral might be the great contributors for prolonged labour.

Seventy nine women (13%) had any type of comorbidities. They are 9.631 times more likely they would die than women who don't have comorbidities with AMOR of 9.631 and 95% CI (3.135, 29.588). In Kenya tertiary hospital also shows presences of comorbidities are significant predictors with AOR of 3.0 and 95% CI (1.7–5.3) (30). It is known that pregnancy by itself is immune suppressive conditions if there is an additional disease it is dangerous. In this research half of women who had comorbidities are died.

## **Problem faced, strength and Limitation of study**

### **Problem faced**

- ✚ Poor registration
- ✚ Poor documentation of charts and log books
- ✚ Registration of different age for a single person
- ✚ Unreadable hand writings
- ✚ Not writing women on the day of admission and discharge on the log books
- ✚ Not writing discharge summary sheet

### **Strength of study**

- ✚ Free of recall bias
- ✚ Time matching (indirectly controls for quality of care, expansion of services...)
- ✚ Application of propensity score matching analysis and WHO application of ICD-10 for maternal death for causal identification
- ✚ Study design – case control is preferable for rare event like maternal death and for determining associated factors.

### **Limitation of study**

- ✚ Selection bias due to intentional selection of controls
- ✚ Does not observe effect of some of socio demographic variables like economy, education...due to 99% missingnes of socio demographic variables.
- ✚ Wider confidence interval – due to rarity of events and lower sample size
- ✚ In causal inference estimation the treatment independent variables are not adjusted for socio-demographic variables.



## **CHAPTER SEVEN: CONCLUSION AND RECCOMENDATIONS**

### **CONCLUSION**

From previous times the number of maternal death has a decreasing pattern. As shown by the MMR within the five year of study the number of maternal death has a decreasing trend. Even though MMR has a decreasing trend it is still high as compared to national figure and it is in range of very high maternal death classification as per WHO classification. Most of the women died in post-partum period particularly in between 4-7 days.

Most maternal death occurred because of direct obstetric causes. Hemorrhage is the leading cause of death in every year of study and it is a cause for more than half women death. PIH and anemia were the other major causes of maternal death. In causal inference estimation: hemorrhage, PIH and anemia were the significant cause of maternal death.

Women who reside in rural area, presence of comorbidities, women who referred from health institutions and women who had prolonged labour increases the likelihood of maternal death. Whereas being in the age group of 20 – 34 was the protective.

## RECOMMENDATION

To decrease the number of maternal death multi-sectorial collaboration is important. Everybody starting from a single individual to the higher officials and organizations has a responsibility to alleviate the problem. Based on the findings from this study the following recommendations are made:

1. To Jimma zone health department:
  - ✓ JZHD should follow, monitor and evaluate IEC/BCC provided by wereda health offices and health institutions to increase awareness of the community in rural part of area about complications of pregnancy and strengthen the referral system to avoid delay in intervention or to avoid prolonged labour.
2. To JUSH:
  - ✓ JUSH should strengthen service provision to reduce death in intra-partum period and post-partum period (particularly after operative delivery) and to avoid prolonged labour.
  - ✓ JUSH should improve the registration system of events and place for the placement of patient charts.
3. To health professionals:
  - ✓ Health professionals should have to improve timely intervention given for women referred from health institutions.
4. To HEWs:
  - ✓ They should have to improve awareness of the rural community about pregnancy complications and simultaneous comorbidities.
5. To academicians and researchers:
  - ✓ They should dig out associated socio-economic factors for maternal death
  - ✓ They respond, why most referred cases will die? Why women who came from rural area would die most as compared to urban? Why most women would die in post-partum period?

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**Annex:** checklist for extraction of information from chart

**Data collector name** .....

**Sign**.....**card no.** .....**Code no.** .....

**Part one; Identification/ Back ground information**

S. No	Question	Response
1.	Age	_____ (years)
2.	Time of death or birth	Time/date/month/year _____
3.	Ethnicity	1. Oromo 2. Dawuro 3. Kefa 4. Amhara 5. Other(specify) _____
4.	Residence	_____
5.	Estimated kilometre of residence (filled by supervisor)	_____
6.	Educational status	1. Illiterate 2. grade completed _____
7.	Marital status	1. Single 2. Married 3. Divorced 4. Widowed
8.	Occupation	1. House wife 2. employed 3. Unemployed 4. Others (specify) _____
9.	Monthly income if possible	_____ birr

**Part two; Obstetric and delivery history**

S. No	Question	Response
1.	Gravidity	_____
2.	Parity	_____
3.	Attended ANC?	0. No 1. Yes
4.	If yes, number of visits	_____
5.	Length of labour	0. <24 hour 1. ≥24 hour
6.	Birth attendant	1. Doctors 2. Midwives 3. Nurses 4. Msc surgery and obst. 5. Other(specify) _____
7.	Mode of delivery	1. Spontaneous Vaginal delivery 2. Vaginal delivery with episiotomy 3. Instrumental delivery 4. Ceaserean section
8.	Obstetric complications	1. Haemorrhage 2. PIH 3. Abortion 4. Infection 5. Obstructed labour 6. Uterine rupture 7. Other(specify) _____
9.	Presence of comorbidities	1. Chronic Hypertension 2. Anaemia 3. HIV positive 4. Malaria 5. Other(specify) _____

10.	Status of mother	0. Dead 1. Alive
11.	If 0 for no. 10, cause of death	1. Haemorrhage 2. PIH 3. Abortion 4. Infection 5. Other(specify)_____
12.	If 0 for no. 10, state of pregnancy at the time of death	1. Antepartum 2. Intra partum 3. Postpartum 4. Post abortion 5. Ectopic
13.	If 1 or 2 for no. 11, gestational age at the time of death	_____weeks
14.	If 3 or 4 for no. 11, number of days at the time of death	_____days
15.	Antenatal/ intra natal risks	1. Placenta previa 2. Previous cesarean section 3. Multiple gestation 4. Malpresentation 5. Other (specify)_____
16.	Is it a referred case?	0. No 1. Yes
17.	If 1 for no. 16, Referred from	1. Health centre 2. Hospital 3. Private clinics