

FACTORS CONTRIBUTING TO MATERNAL MORTALITY IN SUDAN

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SUDAN

49th International Course in Health Development
September 2012- September 2013

KIT (ROYAL TROPICAL INSTITUTE)
Development Policy and Practice
Vrije University Amsterdam

TITLE: FACTORS CONTRIBUTING TO MATERNAL MORTALITY IN SUDAN

A thesis submitted in partial fulfilment of the requirement for the degree of Master of Public Health

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Declaration:

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49th International Course in Health Development (ICHHD)
September 19, 2012 – September 6, 2013
KIT (Royal Tropical Institute)/ Vrije Universiteit Amsterdam
Amsterdam, the Netherlands
September 2013

Organised by:

KIT (Royal Tropical Institute), Development Policy & Practice
Amsterdam, the Netherlands

In co-operation with:

Vrije Universiteit Amsterdam/ Free University of Amsterdam (VU)
Amsterdam, the Netherlands

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DEFINITIONS:

Acceptability: The degree to which a service meets the cultural needs and standards of the community (1).

Accessibility: The extent to which a service is easy to use for its intended clients. This depends on many factors including the cost, the distance, and organization of the service delivery (1).

Adolescent Birth Rate: Births per 1000 women age 15-19 years (2).

Adult illiteracy: Percentage of the population 15 years and older, who cannot, with understanding, read and write a simple statement about their everyday life (3).

Affordability: The extent to which the intended service's clients can pay for it. This depends on income, service's cost, and the financing mechanisms (1).

Contraceptive Prevalence Rate: Percentage of married or cohabiting women of reproductive age (15–49 years) using any method of contraception (2).

Cost Sharing: Methods of financing health care which require some direct payments for the services by the clients (1).

Crude Birth Rate: The number of live births in a year expressed as per 1,000 people (3).

Economic Growth: Quantitative change or expansion in a country's economy .Economic growth is conventionally measured as the percentage increase in gross domestic product (GDP) or gross national product (GNP) during one year (3).

Emergency Obstetric Care: Services provided to treat and manage pregnancy and childbirth complications. It is of two types: 1. Basic emergency obstetric care which provided at first level of care and includes: administering antibiotics, oxytocin and anticonvulsants to manage bleeding, infections and fits; manually removing the placenta; removing retained uterine products following miscarriage or abortion; assisting with vaginal delivery; and performing newborn resuscitation. 2. Comprehensive emergency obstetric and newborn care, typically delivered in district hospitals, includes all basic functions above, plus caesarean section, and safe blood transfusion (4).

Equity: The quality of being fair or equal; equality of status in respect to some identifiable and controllable quality of importance, such as health, access to services or exposure to risk. Equity in health implies that ideally everyone should have a fair opportunity to attain their full health potential and more pragmatically, that no one should be disadvantaged from achieving this potential (5).

Gate keeping system: It is the system responsible for controlling patients' flow from the lower level of health care to the higher (6).

Growth Domestic Product: The total money value of all final goods and services produced in an economy over a period of one year (3).

Gender In-equality Index: A composite indicator that reflects gender-based inequalities in three dimensions: reproductive health, empowerment, and economic activity (7).

Human Development Index: A composite of several social indicators that is useful for broad cross-country comparisons. It assesses long-term progress in three basic dimensions of human development: a long and healthy life, access to knowledge and a decent standard of living (7).

Infibulation: It is type 3 of female genital mutilation (FGM). It implies excision of parts or all of the external genitalia and stitching/narrowing of the vaginal opening (8).

Life Expectancy at Birth :The number of years a newborn baby would live if, at each age he/she passes through, the chances of survival were the same as they were for that age group in the year of his/her birth (3).

Maternal Mortality : The death of a woman during pregnancy or within 42 days of its termination; irrespective of the duration and site of the pregnancy; from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes (9).

Maternal mortality Ratio: The number of maternal deaths during a given time period per 100 000 live births during the same time period (9).

Opportunity Cost: The value of the best alternative which is forgone in order to get or produce more of the commodity under consideration (1).

Population Growth Rate: The increase in a country's population during a certain period, usually one year, expressed as a percentage of the population when the period began (3).

Poverty Line (national): The income level below which people are defined as poor. The definition is based on the income level people require to buy life's basic necessities: food, clothing, housing, and satisfy their most important socio-cultural needs (3). According to Sudan standard, it is the percentage of people with the value of monthly total consumption below 114 SDG (10).

Total Fertility Rate: The average number of children a woman will have during her lifetime (3).

Under-five Mortality Rate: It is the probability that a newborn baby will die before reaching age of 5 years expressed in 1000 live births (3).

Unmet Need for Contraceptives: The percentage of women aged 15 to 49, married or in union, who report the desire to delay or avoid pregnancy but are not using any form of contraception (2).

Years of Life Lost: It is an indicator for measuring the burden of the diseases. It implies years of life lost due to premature mortality (11).

ACKNOWLEDGEMENT

First of all, I would like to express my gratitude to Netherlands Fellowship Program (NFP) for rewarding me this scholarship to attend the 49th International Course on Health Development.

I am so grateful to all KIT teaching and administration staff and my ICHD colleagues for being my second family during the whole study period. My supervisor and backstopper deserve special thanks for their continuous guidance and unlimited assistance.

I would also like to express my appreciation and sincere gratitude to my family and friends for all support and encouragement they provided.

ITRODUCTION

Since I realized that I am a female I started to worry about my maternal future. This was simply because I frequently used to hear about a kind relative or a nice neighbour who died during pregnancy or while giving birth to a child. Moreover; I started to worry about my mother whenever she got pregnant. At that time; for me childbearing meant death until proven otherwise.

All my worries and fears have led me to the Faculty of Medicine, University of Khartoum. When I joined the medical school in 1995, I was really driven by my desire to help women. During my study times, I was so interested in Obstetrics and Gynaecology. This made me realize that pregnancy is a risky physiological process but we should make it safe. Later on; I discovered that most of pregnancy and delivery complications are preventable. So I kept on asking myself why women in Sudan die during pregnancy and delivery. Six years later, I was graduated from the medical school and I did most of my internship in the obstetric departments. During that period, I discovered that our health facilities were not well equipped and our health personnel were limited and not adequately trained. Then, I thought that was the problem: quality of care!

Two years later, I started working in public health when I discovered that it was not only about quality but also health seeking behaviour and accessibility. After joining (KIT) for my master, I started to believe in gender inequity and lack of women empowerment as the main woman's health problems.

ABSTRACT

INTRODUCTION:

Maternal mortality is one of the major health problems in Sudan. Maternal mortality ratio is estimated at 216 deaths per 100.000 live births. However; huge regional and urban-rural disparities exist. The majority of the deceased arrived late to health facilities or died in the community. Despite the efforts exerted since signing the millennium development goals, Sudan is still far from achieving the fifth goal's targets. Lack of accurate information needed for proper planning is among the reasons hampering the progress in reducing maternal mortality.

OBJECTIVES:

This study aims at exploring factors contributing to high maternal mortality in Sudan and providing recommendations to help in improving maternal health.

METHODOLOGY:

The study is based on literature review. Both published and unpublished literatures were used. Analysis of literature was done by using a modified version of the Three Phases of Delay Model developed by Thaddeus and Maine's in 1994.

FINDINGS:

Multiparous, poor, rural and women with low education level are at high risk of maternal death in Sudan. Direct obstetric causes are responsible for the majority of deaths. Factors related to late recognition of the obstetric problems, delay in seeking and accessing emergency obstetric care were found to play a paramount role in maternal mortality. Health services related barriers are significantly contributing to each phase of delay.

RECOMMENDATIONS:

To reduce maternal mortality in Sudan, strong political will and commitment are required. Extensive efforts should be exerted in creating community's demand to emergency obstetric care and improving geographical and financial accessibility. Women empowerment is a key to reduce maternal deaths.

KEY WORDS: Sudan, maternal mortality, health seeking behaviour, access, EmOC

WORD COUNT: 12078

APPREVIATIONS

AfDB	African Development Bank
AMSTL	Active Management of the Third Stage of Labour
ANC	Antenatal Care
CBS	Central Bureau of Statistics
CHW	Community Health Worker
CIA	Central Intelligence Agency
CPR	Contraceptive Prevalence Rate
C/S	Caesarean Section
EmOC	Emergency Obstetric Care
FGM/C	Female Genital Mutilation/Cutting
FMoH	Federal Ministry of Health
FP	Family Planning
GAVI	Global Alliance for Vaccines and Immunization
GDP	Growth Domestic Product
GII	Gender In-equality Index
HDI	Human Development Index
HRH	Human Resources for Health
IDPs	Internally Displaced Persons
IHME	Institute of Health Metrics Evaluation
IMCI	Integrated Management of Childhood Illnesses
KAP	Knowledge, Attitude and Practice
KIT	Royal Tropical Institute
MDGs	Millennium Development Goals
MDR	Maternal Death Review
MI	Medical International Corps
MMR	Maternal Mortality Ratio
MWA	Maternity Waiting Area

NCDs	Non- Communicable Diseases
NGO	Non-Governmental Organization
NHA	National Health Account
OCHA	Office for the Coordination of Humanitarian Affairs
OoP	Out of Pocket
PAC	Post-Abortion Care
PHC	Primary Health Care
PIH	Pregnancy Induced Hypertension
PNC	Postnatal Care
SBA	Skilled Birth Attendants
SES	Socio-economic Status
SSA	Sub-Saharan Africa
SHHS2	Sudan Household Health Survey (second round)
RH	Reproductive Health
TBA	Traditional Birth Attendants
TFR	Total Fertility Rate
THE	Total Health Expenditure
UN	United Nations
UNDP	United Nations Development Program
UNFPA	United Nations Population Fund
UNICEF	United Nations Children Fund
VMW	Village Midwife
VU	Vrije University
WB	World Bank
WHO	World Health Organization
WWCI	World Weather and Climate Information
YLL	Years of Life Lost

CHAPTER 1: BACKGROUND:

This chapter displays background information about Sudan to enable the reader to understand the context of the country.

1.1. GEOGRAPHY AND CLIMATE:

Sudan is a sub-Saharan African country. It extends over a surface area of about 1.9 million km² and shares open borders with seven countries: Egypt, Libya, Chad, African Central Republic, Republic of South Sudan, Ethiopia and Eretria (12).

Although it is generally a flat terrain (13); the country is characterized by different topographic features including harsh deserts in the north, high mountains in the west and east in addition to the rain forests along its southern borders (14).

The climate ranges from arid in the north to tropical in the south-western part where the amount of rainfall increases and duration of the rainy season prolongs to up to five months (15).

1.2. DEMOGRAPHY:

According to the results of the fifth national census, the total population of Sudan is about 32 million with an annual growth rate of 2.5%. More than 60% of the population is rural while nomads represent about 7% of total population (16).

Crude birth rate was estimated at 33 per 1000 population in 2011 (17). The country is characterized by a young population as 43% of its population is below 15 years of age. Male to female sex ratio is estimated at 1.05 (16)¹. Life expectancy at birth is about 62 years (7).

1.3. SOCIO-CULTURAL SITUATION:

Sudan is characterized by a huge cultural and ethnic diversity (18). However; Arab culture dominates and most of the Sudanese tribes speaks Arabic. Over 97% of the population are Muslims (12). With 60 % of households having an average size of seven members or more and 2 % with fifteen members or more, it is clear that most of the country population is living in big or extended families (10).

Sudan is situated in the low human development category. Its human development index (HDI) value positions the country 171 out of 187 countries. This situation is caused by the minimal progress the country made in health, income, and education (7). In addition to the governance problems; Sudan's performance in the social sector has been adversely affected by the prolonged civil conflicts with the South and the armed groups in the Eastern region and Darfur (19). Besides the economic burden and loss of millions of lives (20), these conflicts resulted in about 2.3 million internally displaced persons (IDPs) most of them are women and children (21).

Poverty level is high in the whole country with some variations between states. The average poverty rate is 47% with some states having a rate as high as 63%. This is exacerbated by the high level of unemployment which is a big problem especially among women. According to findings of the Sudan National Baseline Survey, 53% of the households reported receiving no income during the year preceding the survey (10).

¹ 2008 census data includes South of Sudan as part of the old Sudan

Illiteracy: Adult illiteracy is estimated at 38%. Urban illiteracy is 21% compared to 49% for the rural one (20).

Gender: The whole country shows a marked gender inequity against women in health, education and work opportunities. Sudan's gender inequality index (GII) puts the country in position 129 out of 148 countries. The high ratio of maternal mortality is a clear demonstration of health in-equity. While the total literacy rate for adult males is 73%, it is estimated at 52% for females. Furthermore; women contribute to only 23% of the country labour-force and occupy 24% of the total parliament's seats (7).

1.4. ADMINISTRATIVE SYSTEM:

Sudan is governed by a federal system dividing the country into fifteen states. Each state is divided into a number of localities (districts) giving rise to 144 in total. This creates three levels of administration: federal, state, and local. Those states vary greatly in the social and economic development including income level, availability of basic services and distribution of communication networks, and infrastructures (10).

1.5. ECONOMY:

Sudan is a low middle income country (22). However; due to its variable natural resources it has great economic opportunities (18). Over the past decade, Sudan witnessed a notable economic growth caused by investment in oil production. Gross Domestic Product (GDP) has grown from \$10 billion in 1999 to \$ 60 billion in 2008 (23). Unfortunately, this growth deteriorated from 5% in 2010 to 2.5% in 2011. In addition to the impact of the global economic and financial crisis, this decline is caused by loss of a considerable proportion (75%) of the country oil revenues after independence of South Sudan (24). All sectors are supposed to be adversely affected by this decline especially the service ones (12).

1.6. HEALTH SITUATION:

Overview: Sudan's health situation in general is characterized by poor indicators (25). The country is among the highest ten countries in the number of under-five children death with a mortality rate of 103 deaths per 1000 live births (26). Although the epidemiological profile of the country is dominated by communicable diseases; Sudan is suffering a double burden of both communicable and non-communicable diseases (NCDs). While the top causes of years of life lost (YLLs) are communicable diseases (11); NCDs started to increase in incidence during the past few years contributing to about 56 % of the annual deaths (27).

Reproductive Health (RH): Although the situation varies between states and exhibits urban-rural disparities, reproductive health is one of the poorest situations nationwide. It is characterized by a moderate to high maternal mortality ratio (MMR), and prevalent violence against women in form of domestic violence, Female Genital Mutilation/Cutting (FGM/C) and early marriage (28).

As shown by the results of the second round of Sudan Household Health Survey 2010 (SHHS2), total fertility rate (TFR) is 5.7 children per woman. Use of contraceptive methods was found to be rare. The contraceptive prevalence rate (CPR) is 9% (29). This poor CPR places Sudan with the countries having the lowest prevalence worldwide (30). Early childbearing is an evident problem in the country where 16% of women aged 15-19 years

were found to begin childbearing before age of 15 years (29). This pattern is associated with rural residence, low woman's education, and low socioeconomic status (SES) (28). The proportion of pregnant women covered with antenatal care (ANC) reaches up to 74%. However; less than 50% of women had 4 visits or more during the last pregnancy (29). In a study investigating the use of ANC services in Eastern Sudan, authors reported that only 11% of the participants had 4 ANC visits or more (31). Home is the popular place for delivery in Sudan where more than 75% of deliveries take place. The percentage of deliveries assisted by skilled birth attendants (SBAs) was estimated at 73%. FGM/C is one of the commonest practices in Sudan. It has a prevalence of 88% among women 15-49 years old (29). The percentage of women using postnatal care (PNC) services was estimated at only 18% (32).

Table 1: Reproductive Health Indicators, Sudan 2010

INDICATOR	VALUE		
	RURAL	URBAN	TOTAL
TFR (per woman)	6.2	4.8	5.7
Childbearing before age of 15 years (%)	19.2	10.9	16.3
CPR (%)	5.4	17.4	9
Unmet need for contraception (%)	28.7	29.3	28.9
ANC (1 visit) coverage (%)	70.4	84.3	74.3
SBAs at Delivery (%)	66.1	89.4	72.5
Home Delivery (%)	83.4	56.5	76
Caesarean Section (C/S) Rate (%)	4.5	12.3	6.6
MMR (per 100.000 live births)	225	194	216

Source: Sudan Household Health Survey, 2010 (29)

RH Services:

Health Policy: Maternal health represents an essential element of all national health plans and strategies developed during the last 10 years. It was identified as a health sector priority in the national 25 years strategic plan 2003-2027 (33). It was also well addressed in the five years (2007-2011) sector strategy calling for investing in health to achieve the millennium development goals (MDGs) (34). Besides the national RH policy, the national RH department developed many strategies to hasten maternal mortality reduction. These include: the national strategy for RH (2010-2016), the national strategy for scaling up midwifery services (2010), and the roadmap for reducing maternal and neonatal mortality (2010-2015) (28) (35).

Service Delivery: For safe motherhood, the World Health Organization (WHO) recommended four essential services: Family planning (FP), ANC, skilled birth attendance, and emergency obstetric care (EmOC) (36). In Sudan, these services are mainly provided by the public sector through the primary health care (PHC) facilities (37). These facilities include the basic health units, the health centres as a primary level of care and the rural hospitals as a secondary level. Although small in number, the state and specialized hospitals also provide maternal health services (32).

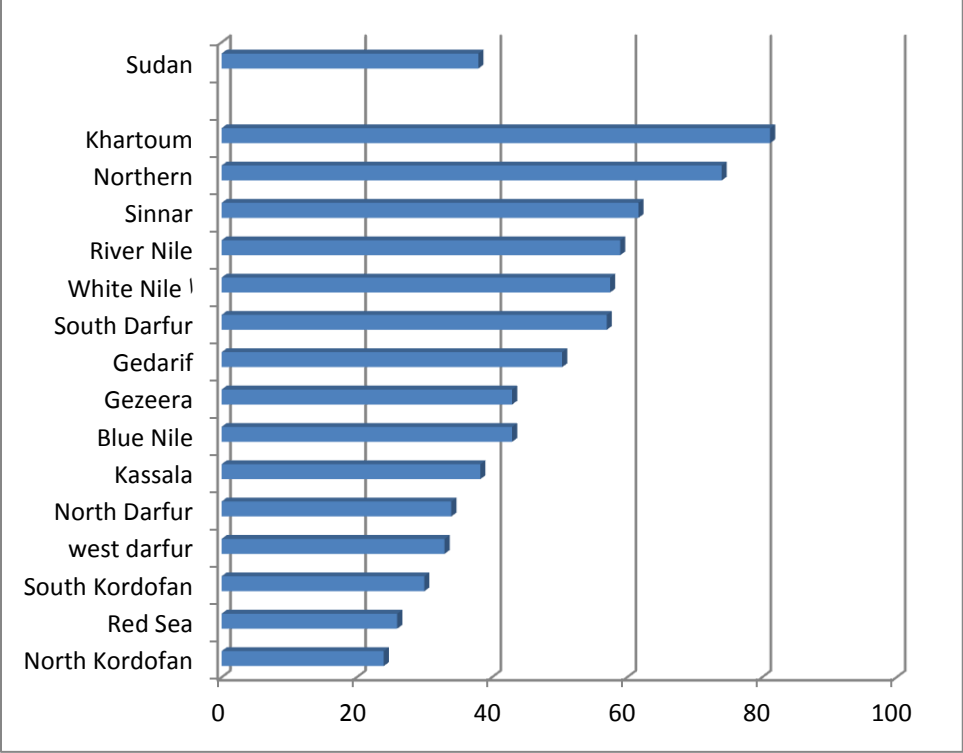
The findings of the PHC mapping indicated that the average of population covered per a PHC facility is about 6500 with a range reaching up to 13500 populations per facility. Proportion of population with no access to PHC services within 5 km was estimated at up to 42% in

West Darfur state. 55% of the targeted facilities provide ANC services while the basic emergency and the comprehensive emergency obstetric care services are provided in 66% and 46% of facilities respectively (38).

Health Expenditure: According to the national health account (NHA), only 8.7% of the total government expenditure was spent on health. Furthermore; expenditure on PHC services was estimated at 6% of total health expenditure (THE). Out of pocket (OoP) represents about 65% of THE (23). Although the exact budget allocated to RH services is unknown; it is claimed that RH services are under-financed (32).

Human Resources for Health (HRH): Sudan is one of the countries suffering a critical shortage of HRH. It has an overall density for doctors, nurses , and midwives of 1.2 per 1000 population far less than the WHO minimum standard of 2.3 per 1000 (39).Village midwives (VMWs) have a significant role in promoting RH especially in remote and rural areas where they represent the main care providers (35). However; only 38% of villages are covered with midwives (38).

Figure1: Coverage (%) of Village Midwives per State, Sudan 2010



Source: PHC Health Facility Survey, FMOH 2010 (38).

In addition to staff shortage and uneven distribution, a survey conducted in seven states revealed major gaps in the capacity of health workers in relation to delivery management. According to the authors, only 55% of care providers received training on abortion management. About 25% of the providers did not receive any training on active management of the third stage of labour (AMTSL) during their basic training. Moreover; about 66% of them did not receive any training on administration of magnesium sulphate (40).

Essential Medicines and Supplies: The quality of RH services in Sudan is undermined by critical deficiency of some essential drugs and supplies. An RH survey targeting seven states showed that in many hospitals, necessary safe blood supplies were not available for women in need of transfusion. Moreover; means of referral (ambulances and telecommunication services) of emergency cases were also lacked. For instance; in Kassala state, means of referral were found in only 9% of the surveyed facilities (35). Another survey revealed that laboratory services were appropriate in only 34% of facilities in nine states. Adequate medicines' supply was only found in 53% of the surveyed facilities (41).

CHAPTER 2:

This chapter presents the problem statement, justification for selecting the problem under study, objectives, and the methodology used in conducting the study including the analytical conceptual framework.

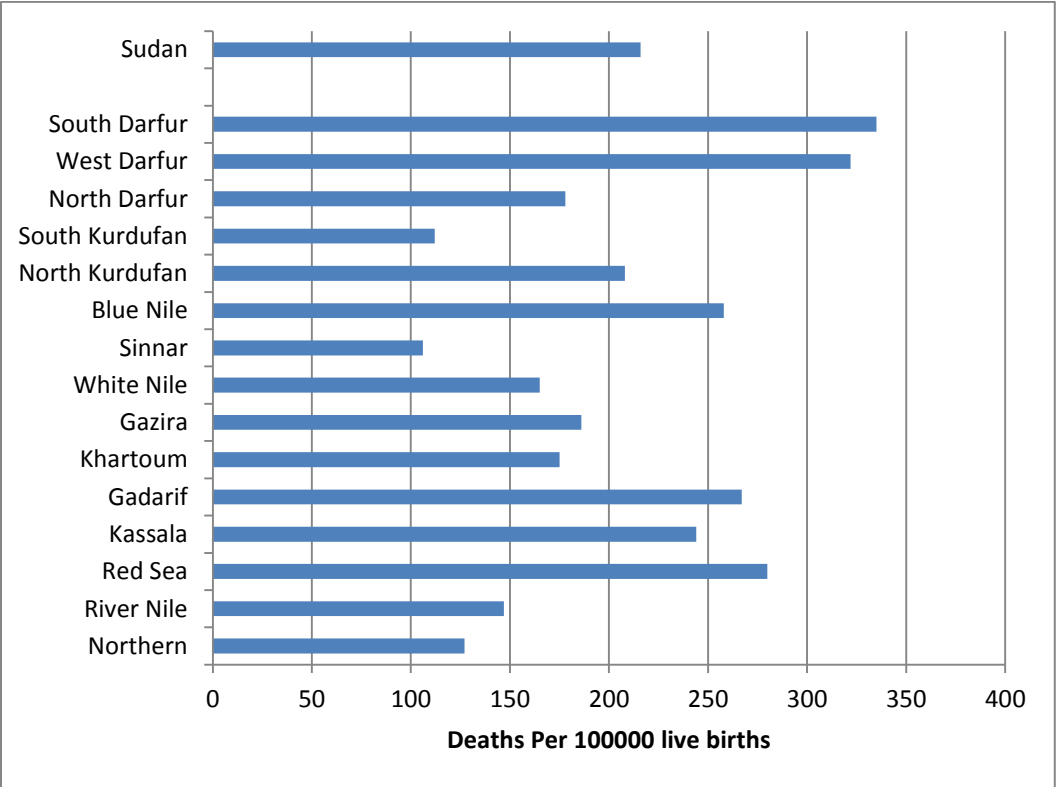
2.1. PROBLEM STATEMENT

Maternal mortality is considered one of the major global health concerns especially in developing countries. Although declined by 47% over the last two decades, still 287000 deaths occurred globally in 2010 of which 99% occurred in developing countries (9).

With more than half of the total global deaths, Sub-Saharan Africa (SSA) contributed to the highest share of maternal mortality (9). MMR in SSA is estimated at 500 deaths per 100000 live births (42). Hence; maternal death is considered the 3rd common cause of death among women in Africa. It is also one of the top 5 causes of deaths in general population as it contributes to 14% of total deaths (43).

Sudan was considered one of the top ten countries with regard to maternal mortality worldwide when MMR was estimated at 730 per 100.000 live births (9). However; the results of SHHS2 showed a marked reduction in MMR from 638 deaths per 100000 live births in 2006 (44) to 216 in 2010 (29). Although not fully explained by the health authorities, this reduction might be attributed partially to the recent health policies (free of charge health care for pregnant women 2008) and the other health interventions implemented by the government (28). Separation of South Sudan which has the highest maternal mortality in the world (45) might also contribute to this reduction. Nevertheless; the difference in the methodology and the geographical coverage between the two rounds of Sudan Household Health Survey makes it difficult to compare the results or even to follow the mortality trends (28). Generally speaking; this MMR is still considered far from the MDG5 target of 134 deaths per 100000 live births (46). Moreover; MMR ranges from 127 to 335 deaths per 100.000 live births (29) indicating that still some states have high levels of maternal deaths. Despite these huge regional variations; a small urban-rural disparity was reported (29). However; some sources pointed to a huge urban-rural discrepancy (35). A mortality survey conducted in Eastern Sudan also showed this disparity. While the urban MMR was estimated at 369 deaths per 100000 live births the rural one was 872 (47). Obviously; these high levels of mortality indicate a huge gap in utilization, access and quality of maternal health services (35) (40) (36).

Figure 2: Maternal Mortality Ratio per State, Sudan 2010



Source: Sudan Household Health Survey, 2010 (29).

The national maternal death review (MDR) 2010 reported that 84% of the notified deaths occurred in health facilities while the remaining happened at home or in the way to facilities (48). This proportion usually includes three categories of cases: women who arrive too late to benefit from emergency care, women who arrive with complications who could be saved if they received proper timely care, and women admitted for normal delivery who subsequently develop serious complications and die (49). According to the national MDR, 70% of deaths fitted the first category and died within the first 24 hours of admission (48). Another MDR conducted in River Nile State, Northern Sudan, revealed that more than 55% of cases were admitted from home in critical situations (50). A mortality survey conducted in Kassala, eastern Sudan, showed that 68% deaths occurred in the community (47). Both situations (late presentation to health facilities and community death) may indicate late detection of the obstetric problems, poor health seeking behaviour or lack of timely access to the services or altogether. UNFPA stated that two-thirds of maternal deaths in Sudan are attributed to delay in seeking health care and accessing health facilities (35).

2.2. JUSTIFICATION:

Maternal mortality is not just a public health problem; it is also an indicator of gender inequity and women’s right violations (51). As in many parts of the world, magnitude of the problem in Sudan shows an obvious disparity between urban-rural areas, women with different level of education, and rich and poor people (35) (52). This indicates that poverty,

health, and education inequalities play important roles in creating such morally unacceptable situation (53) (54) (55). Furthermore; maternal mortality is also considered as a human right issue that includes women's right to life and security, health, education and right to equality and non-discrimination (56).

Based on its big magnitude in the country, maternal mortality puts serious development impacts on the family, community and national levels (57) (35). Due to disruption of families and loss of the main caretakers, maternal death increases the risk of child's mortality especially infants and young children (58). In Sudan, a highly significant correlation was detected between maternal mortality and death of children 0-4 years of age (59). In some communities, women play an important role as the sole breadwinner hence, their death would adversely affect those communities leading to increased poverty level (60). Furthermore; maternal mortality is considered among the significant causes of low economic productivity and reduced GDP (57). This might be due to the fact that women used to participate actively in economic productivity especially in agriculture and grazing sectors (61).

Due to availability of cost-effective interventions, the majority of maternal deaths are preventable. It is estimated that around three-quarters of maternal mortality can be avoided if women have an access to quality health services in particular the EmOC (53). In Sudan, more than 60% of maternal deaths are due to easily preventable conditions (35). Averting maternal death is possible even in resource-limited settings. However; this necessitates availability of accurate information on which effective interventions and strategies can be based (61).

Sudan government has committed itself to many global initiatives addressing the maternal health including safe motherhood initiative in 1987 and the MDGs in 2000. Moreover; extensive efforts were exerted in the health sector over the last decade including development of policies and implementation of strategies (35). However; the country is still far from achieving MDG5 targets (9). This might be partially due to lack of information (61). Understanding the underlying factors that contribute to this high burden of maternal mortality is very crucial for health planning and resources mobilization (28). Unfortunately, limited data are available and a few researches were conducted in Sudan to explore the circumstances leading to this problem. So; I hope this research helps in creating some knowledge to clarify the mystery surrounding this major public health problem.

2.3. OBJECTIVES:

General:

This study aims at identifying factors contributing to maternal mortality in Sudan in order to make applicable recommendations to help in reducing the magnitude of maternal death.

Specific:

1. To describe the epidemiological characteristics (distribution, and determinants) of maternal mortality in Sudan.
2. To investigate factors leading to delay in identification of the obstetric complications.

3. To explore factors affecting care seeking behavior in relation to maternal services.
4. To identify barriers that lead to delay in timely access to EmOC services.
5. To formulate valid recommendations to help in improving maternal health in Sudan.

2.4. METHODOLOGY:

This study is based on literature review of relevant published and unpublished documents about factors contributing to maternal mortality in Sudan. The search's strategy included: reviewing relevant databases, conducting manual searches, contacting experts in the field, and scanning the reference lists of the retrieved articles, reports and books.

Internet search was done by using Google and Google Scholar search engines to access Federal Ministry of Health (FMoH), WHO, United Nations Population Fund (UNFPA), World Bank (WB) and United Nations Development Program (UNDP) web sites. External databases (Pub med, ScienceDirect and Scopus) were accessed through KIT and VU libraries. This search process yielded a large amount of documents. Relevant documents were selected by reading the abstract, executive summary, and the conclusion. Grey literature used in this review included programs and researches reports. These were obtained by contacting key persons in FMoH.

Key words: The following words were used individually or in combination to search for literature: Sudan, developing countries, Arabic region, maternal mortality, EmOC, interventions, obstetric problems' identification, health seeking behaviour, utilization, and access.

Search Language: search was confined to Arabic and English documents.

Time Limit: initially search was limited to recent documents (2003 and up to date), then timely open search was conducted to obtain more literature about Sudan.

Limitation of the Study: This study is limited by the fact that it is completely built on literature review. Due to the scarcity of published literature on Sudan, some of the documents used are grey literature (theses and draft reports). Furthermore; studies and research articles exclusive to maternal mortality in Sudan are very few. This in turn, led me to use studies conducted for other health aspects for example: malaria and child health. Moreover; the studies conducted in Sudan were either qualitative or descriptive studies. They covered just parts of the country and were mostly hospital based. So; their evidence is not strong enough and not representative to the whole country.

Analysis: This study is using a modified Thaddeus and Maine's model (The Three Phases of Delay) as a conceptual framework to analyse factors contributing to maternal mortality in Sudan. This model was basically designed to investigate the factors affecting the period between the onset of an obstetric complication and its outcome (62). According to the model, maternal mortality is a result of three phases of delay:

1. Delay in decision to seek health care on the part of the woman, the family or both. It is caused by economic, social, cultural and organizational (health services related) factors.

2. Delay in reaching an adequate level of health care. This is caused by factors related to both geographical and financial accessibility to EmOC services.
3. Delay in receiving appropriate care at health facilities. This is affected by factors related to the quality of the existing EmOC services.

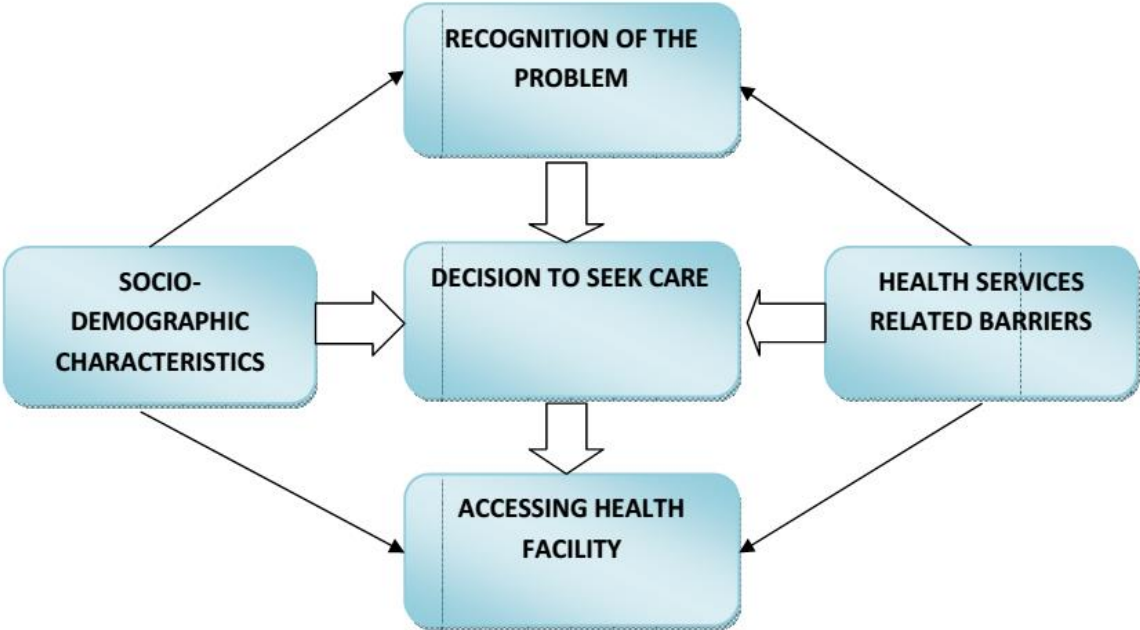
Interestingly; these phases affect each other in the sense that factors from the second and third phase are influencing the first one. For instance, geographical accessibility, affordability, and quality of care are significant disincentives to seeking health care (62). Though the interaction between them is complicated, these delays are not necessarily connected to each other. For instance; a delay in one phase may or may not prolong the delay in another. However; usually a mixture of factors across the three phases leads to maternal death (63).

Nevertheless; the period targeted by this model does not allow analyzing the indirect obstetric causes of mortality, which may contribute to up to 40% of deaths in Sudan (48). Moreover; it does not enable the investigator to study the pre-pregnancy risk factors: for example; nutritional status, and medical history...etc. Furthermore; it does not offer a space for investigating the woman's socio-demographic characteristics that might affect each phase of delay, for instance; age, parity, education, residence, and SES. These characteristics are very crucial for prioritization and identification of the target population.

Detection of the danger signs of obstetric problems by the pregnant woman, her family or the birth attendant is an important step preceding care seeking. However; the model included this step as part of the health seeking behavior. To my understanding; this should be considered separately as the delay in it might not lead to a delay in seeking EmOC.

Based on the above points, I modified the model in a way that will help in understanding the overall picture of maternal mortality in Sudan. Furthermore; I find it more logical to use the first two phases of the original model in addition to recognition of the obstetric problems in this research. This is because, in addition to the community deaths, the majority (about 70%) of the deceased presents lately at health facilities indicating a delay in one or another of these phases. Moreover; I found that health services related barriers are linked to each phase of the delay. So; I put them in a separate box to indicate their importance. However; I will discuss them under each delay. By doing this, we will be able to target at risk women by relevant interventions to reduce at least two-thirds of maternal deaths in Sudan.

FIGURE 3: MODIFIED THREE DELAY'S MODEL



CHAPTER 3: RESULTS

This chapter presents the different findings extracted from literature for the epidemiology of maternal mortality in Sudan in addition to factors contributing to each phase of delay.

3.1. EPIDEMIOLOGY OF MATERNAL MORTALITY:

According to the national MDR 2010, the majority of the notified deceased were multiparous (2-5 children) women between 21-30 years of age (48). Almost similar results were reported in a mortality survey investigating causes of maternal mortality in Kassala, Eastern Sudan. More than 40% of the deceased were between 21-30 years of age and 50% of them were multiparae (47). In River Nile state, northern Sudan, the majority of the deceased (67%) were between 26-35 years of age and 44% of them were multiparae (50). Multiparity as a risk factor for maternal mortality was also reported in another MDR conducted in Darfur (64). However; a hospital based study investigating risk factors of maternal mortality in Kassala, reported a significant association between maternal death and primiparity. Moreover; this study could not prove any significant association with the woman's age (65). Another MDR conducted in Medani hospital, central Sudan, detected primiparity in about 35% of deaths (66). Nevertheless; the results of these hospital based studies cannot be generalized because the majority of deliveries in Sudan occur at home (29). Rural residence was found to be associated with maternal deaths in three hospital based studies (65) (67) (50). Kassala's mortality survey showed a percentage as high as 83% for rural maternal deaths (47). The association between maternal mortality and illiteracy was found to be significant in three studies (65), (47), (68). Interestingly; high illiteracy rate among the women's husbands were mentioned in one study (47).

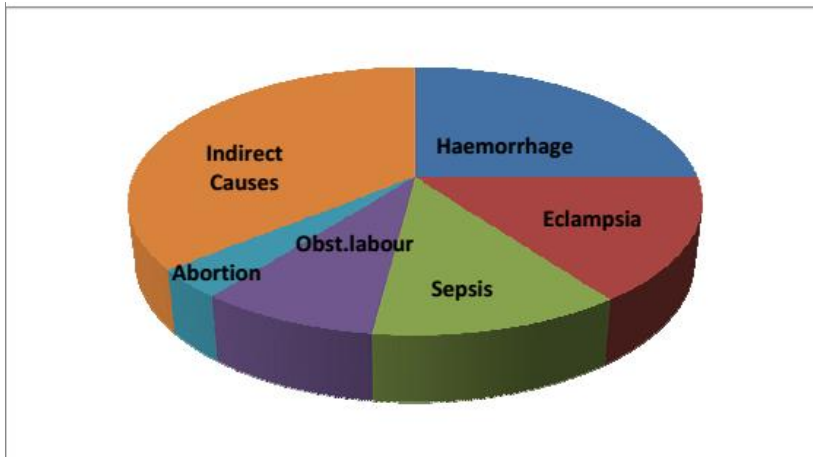
Predictors of utilization of other maternal services might also be used as a proxy to risk factors associated with maternal mortality. For instance; in a study conducted in Khartoum state to investigate utilization of FP methods, the authors reported a significant association between woman's literacy and use of modern contraceptive methods (69). Another study conducted in Darfur came up with the same finding (70). A study exploring determinants of home deliveries in Khartoum state showed a significant association between home delivery and illiteracy (71). SHHS2 results showed that women with higher level of education are more likely to deliver at health facilities (29). A survey investigating utilization of ANC in Khartoum state confirmed a strong association between poor ANC use and illiteracy (72). Similarly; SHHS2 revealed an association between ANC use and the woman's education level (29). On the other hand; significant correlations were detected between maternal mortality from one side and home delivery and early marriage from the other (59). Also a significant association with lack of antenatal care was reported in many studies (65) (47) (68).

Typically; the relation between maternal mortality and the SES is not well documented in Sudan. However; one hospital based study conducted in Khartoum state showed that all the deceased were of low SES (67). On the other hand; a significant association between SES and utilization of other maternal services is well documented. In this respect; strong associations between low SES and poor FP, ANC, and institutional delivery use were detected (69) (71)

(29) (72). Nevertheless; the relation between poverty and maternal mortality is complicated and cannot be explained by low uptake of maternal services only (49).

Etiologically; the direct obstetric causes contribute to over 60% of maternal deaths in Sudan. Haemorrhage, sepsis, pregnancy induced hypertension (PIH), obstructed labour and unsafe abortion are topping these causes (48) (65) (66) (47) (67). Nevertheless; in River Nile state the direct causes contribute to more than 70% of the total deaths (50). These causes are associated with many risk factors including high fertility, early marriage and childbearing and high prevalence of FGM (28) (59) (67) (73).

FIGURE 4: CAUSES OF MATERNAL DEATHS, Sudan 2010



Source: *Maternal Death Review 2010* (48).

Regarding time of death, about 75 % of maternal mortality in Sudan occurs during delivery and the immediate postpartum period (29). A study conducted in Darfur reported that just less than 60% of deaths occurred during delivery and the postpartum period (64). In Kassala and in Medani, postpartum death was estimated at about 64% of maternal deaths (65) (74). However; another study conducted in Kassala and the River Nile MDR showed that more than 70% of deaths occurred in the postpartum period (47) (50).

3.2. PHASES OF THE DELAY:

Based on the literature, the majority of maternal mortality in Sudan can be attributed to three phases of delay:

3.2.1. Delay in Recognition of the Obstetric Complications:

Early recognition of the danger signs of obstetric complications is an essential step to manage them. These signs may appear at any stage of childbearing: pregnancy, delivery, and postpartum (75). Failure to recognize these signs may occur at the level of the pregnant woman, her family or the birth attendant (76). This will lead to a significant delay in receiving the necessary care and might lead to woman's death (77). Factors leading to this delay include:

Lack of Knowledge: Lack of information needed to recognize warning signs of the obstetric complications has a negative impact on maternal survival (78). At the level of the pregnant woman, low recognition rate was detected in a survey investigating women attending ANC in Kassala. The authors reported that the majority (88%) of the participants were not aware of the danger signs of pregnancy (77). In an RH knowledge, attitude and practice (KAP) study

conducted in Darfur, the author reported that almost 20% of women could not mention any pregnancy danger sign while almost 50% were hardly able to mention one or two (79). On the contrary; Kassala's mortality survey showed that the obstetric problems were recognized in 75% of the investigated deaths by the family members or the birth attendants (47). Seventy percent of the participants in a KAP survey conducted to explore the health seeking behaviour of the Sudanese communities had some knowledge about the pregnancy's danger signs. Nevertheless; awareness about the individual signs was found to be low. For instance; bleeding was mentioned by 45% of the respondents and oedema by only 32%. (80). It is worth mentioning that none of the aforementioned studies investigated knowledge about postpartum warning signs.

On the other hand; many deliveries in rural areas are attended by either TBAs or VMWs (40). Despite their work experience; TBAs usually lack formal training (35). Therefore; they are unable to identify danger signs and hence delay referral of patients to health facilities (81). In a survey conducted to explore knowledge and practice of TBAs in Kassala, only 10% of TBAs were found to be aware of the pregnancy danger signs and less than 25% referred a woman with an obstetric complication to health facilities in the year preceding the study (82). Another survey showed that VMWs were having extremely low knowledge about danger signs of the obstetric problems. In South Darfur, only 20% of VMWs were able to identify severe headache as a pregnancy warning sign. In South Kordufan, only 1% identified high pulse rate during delivery as a danger sign (40).

Services Related Factors: PHC providers' ability to identify danger signs of labour was also found to be deficient in some states. In South Kordufan, only 23 % of health workers were able to detect the signs of prolonged labour. In south Darfur, only 14% of care providers considered a low systolic blood pressure during delivery as a warning sign (40). This delays either the proper management or referral of the woman to the higher level of care (83).

Although its role in reducing the maternal mortality is controversial, ANC can help in early detection of the obstetric problems (84). Moreover; ANC should provide the women with the knowledge needed to recognize the signs of obstetric complications in order to seek timely care (85). However; a huge gap in ANC quality was identified across Sudan. SHHS2 showed that the blood pressure was measured for only 58% of the pregnant women. Urine and blood tests were done for about 57% and 56% of pregnant women respectively (29). The Sudanese communities KAP survey showed that only 8% of the women attending ANC received counselling (80). Moreover; some studies showed low quality of the counselling provided to women during the ANC sessions (40) (77).

3.2.2. Delay in Decision to Seek Care:

Health seeking behaviour has been defined as any action taken by individuals who consider themselves having a health problem or an illness in order to find an appropriate treatment (86). Factors affecting seeking health care are usually referred to as barriers to the use of health services (62). These constraints include geographical, economic, socio-cultural, and organizational barriers (87). Interestingly; these factors are closely interrelated and linked to

each other the thing that makes it difficult to attribute the delay to one factor or another (62).

In Sudan, health seeking behaviour seems to play a crucial role in maternal mortality. Although the national MDR suffers from under-reporting and poor community notification (28), its findings supported this notion. Besides 20% community deaths, the majority of the deceased presented very late to PHC facilities and were admitted in critical situations (48). This suggests a delay in either seeking health care or accessing health facilities (49). Kassala's mortality survey showed that delay in seeking health care was detected in about 74% of the investigated maternal deaths (47). In general; the factors contributing to this delay include:

Geographical Barriers:

Geographical accessibility has two aspects: the distance to the nearest health facility and the travel time. An inverse relationship between the distance or travel time to health facilities and utilization of services exists (88). Distance seems to be important as an actual barrier to reach health facilities and as a disincentive to seeking care (62).

In a survey conducted in Khartoum state to investigate health seeking behaviour in relation to child's sickness, about 40% of the respondents mentioned that their choice to use a certain health facility was made as a function of its proximity to their homes (89). Similarly; 50% of the participants in the Sudanese communities KAP survey stated that their preference is based on proximity (80). Distance, bad roads, lack of transport and the rainy season were reported as important disincentives for seeking care in more than 50% of the maternal deaths in Kassala state (47). The results of Darfur KAP survey showed that lack of transportation was a major barrier to seek RH services (79). Short walking time to health facility was also proven to be associated with utilization of health services in Khartoum state. In a survey investigating factors influencing utilization of ANC, the authors found that women who had a short walking distance to health facilities were three times more likely to use ANC services than women who had to walk for 30 minutes or more (72). In another study examining factors affecting under-five immunization; short walking time was found to be associated with proper vaccination's status (90). It was also documented that long distance to the facility is significantly associated with poor uptake of FP services (91). A study exploring determinants of facility based delivery showed that the distance had a negative impact on demand to facility delivery (71). When added to the distance, lack of security has a negative influence on the decision to seek care especially in conflict affected states e.g. Darfur (92).

Cost:

Affordability: Costs of services, transport, and admission represent major concerns for many people in developing countries (88). The authors of the Sudanese communities KAP survey reported that the majority of female participants did not seek care due to distance barriers and financial constraints (80). In Kassala, unavailability of the emergency services in nearby health facilities coupled to inability to pay the costs at tertiary hospitals was mentioned among the major barriers responsible for delay in seeking care (47). According to Malik et al., lack of money was significantly associated with late seeking care for severe malaria (93).

In a survey investigating the treatment seeking behaviour for malaria in children under-five years of age in western Sudan, caretakers were found to use self-medication to avoid cost of transport to health facilities. Furthermore; preference of a treatment option over another was also made on cost basis (94). In a study investigating the prevalence of self-medication with antibiotics and antimalarials in Khartoum State, the authors reported a prevalence of about 74%. Inability to pay for consultation and laboratory fees were among the main reasons behind that behaviour (95). In an experimental study conducted in Sinnar state, Central Sudan, the authors identified an increase in treatment seeking and utilization of malaria services by children and pregnant women linked to exemption from user's fees. Utilization improved significantly with increasing the level of the exemption provided. Before the trial, people used to wait for 3-4 days before going to health facilities or buy medicines directly from the drugs' sellers (96). In a survey conducted in Khartoum state, financial constraints were found to be the commonest cause of not seeking health care mentioned by more than 53% of children's caretakers (89). The transportation cost was found to be one of factors having negative impacts on seeking facility based delivery in Khartoum State. However; this study could not prove a significant association between the cost of the delivery itself and preference of home delivery (71). For IDPs in Darfur, lack of money was found to be a significant disincentive for seeking RH services (79).

Opportunity Cost: Seeking health care might be a time consuming process for both the patients and the relatives (97). So; economically productive women may delay decision to seek care for fear of losing their income. Health workers of a non-governmental organization (NGO) in Darfur recognized a marked decrease in attending the clinics during the planting and harvesting seasons as women are busy with their crops (92). Similarly; in another survey, women in Darfur declared that they did not seek care at health facilities because they were too busy working as labourers (98).

In many occasions the subsistence activities (cooking, caring for the children or elderly members of the family) are among the gender roles assigned for the women. Woman's commitment to these activities may delay decision to seek health care (99). Although it is not documented in Sudan's literature, this commitment was found to delay decision to seek ANC in Nepal (100).

Illness Perception:

Nature and severity of the illness represent major determinants for seeking care especially among poor and less educated people (80). This was documented by Malik et al. as the majority of patients in their study admitted that they sought care only when their conditions worsened (93). According to Alfadil, a considerable proportion of mothers (37%) did not seek care for their children's illness because they perceived the illness as a minor one and could be treated at home (89). In a community based survey conducted in an urban area in Eastern Sudan, the authors detected a change in the health seeking behaviour of caretakers based on the severity of their children's illness. They found that urgency to seek care, selection of the type of care providers (professional or traditional), and even the medicine preference were made as a function of severity of the illness (101). Added to that; Malik et al. reported

that the time of the day (day or night) at which the illness occurred was found to play a role. Participants stated that they would never seek care for an ill child at night (94). This might be due to security issues, lack of transport or limited facilities' operating time.

A similar perception is found all over the Arabic World in relation to maternal conditions. The communities perceive pregnancy and childbirth as normal events that do not necessitate seeking medical care or attendance of skilled providers (102) (103). In a survey conducted in Kassala to investigate utilization of ANC services, the authors reported that about 36% of women did not attend ANC because they perceived their pregnancy as normal (31). In the Sudanese communities (KAP) survey, 20% of female respondents were found to have this perception (80). In a refugee camp, women stated that they would only seek care from the village midwives when they perceive their conditions as serious (104). Ibnaouf et al. reported that 7% of their study's participants did not seek ANC services because they perceived their pregnancy as not complicated. Moreover; having an experience with pregnancy (being pregnant before) was one of the disincentives documented in this study (72). In Khartoum state, authors reported that preference of home delivery increased significantly with the order of birth (71). This experience's perception would be of a special importance when coupled with the MDR's finding that most of the deceased were multiparae. Furthermore; many women consider maternal death as unavoidable and perceive it as a God's will. This perception is common in the Arab region and might be based on religious misinterpretations (102). It was found to cause a significant delay in decision to seek care for an obstetric emergency among the refugees in Eastern Sudan (104).

Cultural Barriers:

Women status: like any Arabic country; the society in Sudan is a patriarchal one in which the woman has a subordinate position (105) (102). This situation adversely affects the woman decision-making's power inside her family or in the community as whole (106). Consequently; the majority of decisions including the health ones are mainly made by the husbands or male members of the family (47). In South Sudan², lack of woman's decision-making power was found to delay seeking health care, even in emergency situations (107). In a study investigating factors associated with teenage pregnancy in Kassala, the authors attributed the strong association between teenage pregnancy and lack of ANC to the low decision power those teenagers own (108). A survey conducted in Darfur showed that 27% of women did not receive ANC because their husbands did not allow them to go to health facilities. Furthermore; two-thirds of participants declared their need to have permission from a family member before seeking care (60). In a child health survey, some of the women mentioned the need to have the husband's permission before seeking care as a cause of delay (89). Husband's objection was also mentioned by the women as one of the main reasons for not using contraceptive methods in Kassala and Khartoum (109) (91). In Kassala's mortality survey, the authors reported that waiting for the husband's permission led one of the deceased to bleed for seven hours before death (47). Moreover; the RH related decisions and beliefs were made and imposed in many occasions by mothers-in-law or older women

²The survey was conducted before South Sudan independence

(103). Those older women's perceptions and traditional practices may participate in delaying the decision to seek any type of modern medical care. As an example, in Sudan after the first childbirth the decision to do re-infibulation is made by the woman's mother (110). In Nepal; mothers-in-law were found to have a negative influence on decision to use ANC (100).

Preference of Home Delivery: According to the experience of Medical International Corps (MI), an NGO working in Darfur, women perceive giving birth outside the home as shameful. They also perceive being assisted by a male as unacceptable. Therefore, they prefer to have home delivery attended by an older female relative or a TBA. Besides inability to identify and manage the obstetric complications, some of these TBAs may delay referral to the health facility for fear of losing payment for delivering the child at home (92). In another study, the author attributed this preference in the Arab countries to the woman's wish to give birth in presence of relatives and friends (102). In Canada, some of the Sudanese immigrant women expressed their dissatisfaction with the supine position recommended for labour in the health facilities. They preferred the traditional kneeling or squatting positions instead (103). This may be a motive for many rural women to avoid giving birth in health facilities.

Post-Partum Traditions: According to my experience, many rural women in Sudan believe that they should not leave their houses for any reason unless they complete forty days after delivery. This may lead to a delay in seeking care when either the mother or the neonate is sick. However; I could not find from the literature evidence supporting this claim.

Re-infibulation after childbirth is a common procedure in parts of the country where the infibulation itself is widely practiced (73). As it is illegal, it is usually performed by the TBAs or the VMWs at home (8). Therefore; women in these areas prefer to deliver at home. Consequently; if an obstetric complication occurs, the woman and her family will delay seeking care for fear of being blamed by health workers (73).

Services Related Factors:

Lack of knowledge about availability of the service in a nearby facility may also delay seeking health care. The results of the Sudanese communities KAP study showed that only 40% of the female respondents knew about availability of the ANC service in the nearest health facility. Moreover; the majority of women across the country did not know about availability of PNC services (80). Interestingly; the lowest levels of knowledge were found in the states which are characterized by high MMR (e.g. Darfur and Blue Nile). In a study investigating barriers to FP in Khartoum, about 12% of participants did not know about availability of the service (91).

Perceived quality: is one of the commonest barriers for seeking care found in Sudanese literature (89) (72) (94). About one third of the respondents of the Sudanese communities KAP survey stated that their choice of the health facility was based on quality of the services (80). In another study, more than 50% of the respondents mentioned that their choice of using certain health facilities was guided by factors related to the services' quality (89). Although the dimensions of quality of care extend beyond acceptability and accommodation (111), perceived quality of health care is centred on these two dimensions by many people. Health worker's attitude and gender, and the waiting time are among the commonest

elements of perceived quality documented in the Sudanese literature. In an effort to investigate causes making home delivery more popular in Sudan, the Sudanese communities KAP survey reported some quality related reasons. Being more comfortable was the commonest declared reason mentioned by more than 60% of the female respondents indicating dissatisfaction with the facility delivery. About 5% of the respondents mentioned absence of men as the main reason of their preference (80). In an RH situation analysis, the authors reported that women from conservative tribes in Eastern Sudan refuse to be seen by male health providers. This behaviour was found to be more prevalent in the rural areas and lead to a significant delay in decision to seek care (107). Generally; women in the Arab region do not prefer males as RH providers and this may lead to a protracted delay in seeking maternity care (112). In Darfur, husbands refused referral of their wives from home to clinics for fear of examination by male providers (92).

Good health worker's attitude was also reported as a significant cause for selecting a certain health facility to seek care in (89). In Darfur, IDPs mentioned poor health worker's attitude as a disincentive for seeking care. They even assumed that unfriendly health workers would prescribe wrong medicines to them (79). In another study in Darfur, female respondents also mentioned poor health workers' attitude and long waiting time as barriers to seek care in the clinics of the camps (98). However; Ibnaouf et al. could not detect a significant association between waiting time and utilization of ANC (72). Inconvenient operating hours may also be one of the barriers limiting the use of health services (113). Nevertheless; explicit evidence from Sudan literature associating utilization of the health services to the operating times is not present.

Lack of trust in the intervention's outcome was also reported as one of the disincentives. One study showed that 13% of the respondents did not seek ANC because they perceived it as of no benefit (31). This may be caused by the bad experience that women had with the health facilities. For example; some of the Sudanese immigrant women in Canada were trying to avoid delivery in health facilities for fear of unnecessary C/S (103)³.

Policy: Seeking non-skilled care might be a result of the non-inclusive health policies in Sudan. This is evident in case of abortion which is legally forbidden unless there is a life threatening condition or in case of rape (114). In this situation, abortion seekers avoid health facilities for fear of being arrested. They either seek traditional care or use local remedies to abort themselves (115). In a study investigating abortion care in Khartoum state, the authors reported that 97% of women seen in the post-abortion care (PAC) clinics were suffering post-abortion complications (115). Another study conducted in three eastern states showed that in about 15% of the cases of PAC their pregnancies were unwanted. Induced abortion was detected in about 8% of total cases of which 14% was induced by TBAs and in 33% by using non-medical therapies (116). However; all these statistics about abortion might be underestimation due to the cultural and political sensitivity of the issue (28).

³Most of the women participated in this study were from south Sudan

3.2.3. Delay in Accessing Health Facilities:

Geographical Barrier: Timely access to health facilities is an important determinant of survival of women with obstetric complications (53). Besides its role as an actual barrier to access, the distance was found to complicate timely referral of emergency cases between facilities (88).

In Sudan, residents of remote and rural areas used to have a longer distance to the nearest health facilities (38). Because of this, many women face difficulties in timely access to local health facilities (107). In a hospital based study, the authors reported that distance and lack of transportation were among the major causes of late presentation of patients with severe malaria (93). In Gedarif state, Eastern Sudan, long rainy season was responsible for delayed access in 70% of maternal deaths. In 20% of the deaths, lack of transportation was the major cause of delay (117). Bad roads, existence of seasonal rivers, and unavailability of means of referral to the higher level of care were also identified in about 55% of cases of maternal deaths in Kassala (47).

Financial constraints: may cause a substantial delay in accessing health facilities. Nevertheless; it is difficult to separate its role as a disincentive for seeking health care from its role as an actual barrier for access (62). Moreover; due to feasibility reasons, financial constraints are not well documented as barriers to access health care. However; as health workers we know from our experience that women come to the facilities and leave without receiving proper care because they could not afford the consultation or the prescriptions' costs. In a survey conducted to evaluate the impact of the free pregnancy care policy in Northern Sudan, the average cost of the normal delivery in PHC facilities was estimated at around 93\$. According to the authors, 66% of the participants stated that they could not afford to pay this cost without exemption. The percentage was even higher for women delivered in rural hospitals (87.5%). Furthermore; the cost of the C/S was estimated at about 136\$ and it could be higher in rural hospitals. Most of the cost was found to be spent on consultation fees and transport to health facilities (52). The cost of delivery's service was found to determine the women's choice in relation to the birth attendants. In a community based study in Darfur, the respondents mentioned that they prefer to deliver with assistance of TBAs because they are affordable (98). Inability to pay the cost of facility's services was one of the reasons reported by Kinaro et al. as a cause of seeking unsafe abortion services in Sudan (115). In a study evaluating the impacts of the cost sharing policy implemented in the country since the 1990s, the author pointed to the policy's role as an economic barrier to accessing health care especially for people in the middle and lower income groups (118). In another survey about childhood illnesses, inability to afford the transportation and admission cost of a sick child was mentioned among the major causes of denying referral to a higher level health facility. Moreover; transport cost was found to be twice as much in rural as in urban areas (119).

Cultural Barriers: In addition to the need of permission, in Sudan as in many Arab countries, rural women need a male guardian to secure transportation and to accompany them to health facilities. This may lead to a remarkable delay, especially when the public clinics have limited operating hours (112).

Services Related Barriers:

Lack of Preparedness: Counselling on birth preparedness is an essential element of ANC. It is intended to prepare the pregnant woman and her family for the childbirth and its consequences. It makes them aware about the delivery plan and about when and where to seek emergency care when needed (75). However; a survey covering seven states showed that only 25% of clients were counselled on facility delivery and 31% were advised about how to get to a health facility if a problem emerges (40). Another study conducted in Kassala reported that 63% of women were told about the delivery plan although the time of the whole ANC visit was about 5 minutes (77).

Service Quality: Bypassing the health facilities by clients due to quality concerns may also affect timely access to health services. In Sinnar's trial, absence of health workers was stated as a reason of bypassing the nearest health centre by patients to receive treatment in the city hospital (96). A similar finding was documented in a hospital based survey on children presented with pneumonia. 30% of the study participants declared bypassing the nearby health facilities for quality concerns (120). This supports the idea that quality perception might take priority over the distance one (62).

Opening Hours: Due to unpredictability of the obstetric complications, health services should offer a full day of obstetric care provision (40). Nevertheless; a survey conducted in six states found a huge difference in the opening hours between urban and rural PHC facilities in favour of the urban ones (121). Moreover; only 29% of the health facilities in nine states were found to work 24 hours per day (40). This will make some health facilities inaccessible out of their opening hours and increase the travel time and cost needed to reach the operating facilities.

CHAPTER 4: DISCUSSION:

This chapter communicates the findings shown in the previous chapter and addresses some of the interventions used to overcome each phase of delay.

4.1. EPIDEMIOLOGY:

There is an ample of evidence that the poor, rural, multiparous women with low education are at high risk of maternal mortality in Sudan. This situation matches the inverse care law which states that people much in need of health care gets less of it (122). These socio-demographic characteristics were found to influence each phase of delay. For instance; when the woman and her family are unable to secure the cost of the health service, transport, and admission they will be reluctant to seek or access health care. Moreover; rural residence is closely linked to poverty in Sudan. Development, Infrastructures, paved roads, work opportunities and health services are all concentrated in urban areas and around the big cities (123). This situation makes rural women suffer twice: they suffer lack of satisfactory health services and suffer high cost and time needed to travel to urban areas to receive care. So; it is not surprising that the urban residents are using the health services more frequently than their rural counterparts (97) . On the other hand; illiteracy is closely associated with inability to detect the obstetric warning signs and poor health seeking behaviour. This is due to lack of access to health information, and hence low level of knowledge about the potential risk of the whole childbearing process and availability of the services as well. In Sudan, low level of education among rural women is caused by early marriage and childbearing which lead to school dropout (108). This might contribute to high fertility due to lack of knowledge about contraceptives or low decision power to use family planning services. This in turn makes the woman at high risk of maternal death.

Direct obstetric causes contribute to over 60% of the total maternal deaths in Sudan. Haemorrhage, sepsis, pregnancy induced hypertension, unsafe abortion, and obstructed labour are the most prevalent causes. This high prevalence is associated with many risk factors including: high prevalence of female genital mutilation, early childbearing, high fertility coupled with various barriers to utilizing maternal health services including family planning and institutional delivery. The restrictive abortion law and lack of awareness among women about their legal rights to access post-abortion services could contribute significantly to the magnitude of abortion fatality (115).

More than 75% of maternal mortality in Sudan was found to occur during labour and in the postpartum period. However; the majority occurs after delivery. This might indicate poor quality of the delivery services or under-utilization of health services during this period.

4.2. PHASES OF THE DELAY:

The three phases of delay model is very useful in identifying the various factors leading to under-utilization of the health services in general and the emergency obstetric care in particular. However; these factors are context specific. They differ greatly from one region to another especially in Sudan. This contextualization is important to consider when setting priorities and planning for health interventions. With some modification in the original model, the following contributory factors were identified in relation to Sudan's context:

4.2.1. Delay in Recognizing the Obstetric Complications:

Awareness about the danger signs of the obstetric complications seems to be low among the pregnant women and the community as whole in Sudan. This is expected because the female's illiteracy rate is high leading to limited access to health information. On the other hand; a considerable proportion of deliveries in Sudan are attended by traditional birth attendants or village midwives who have shown limited health knowledge and capacities. This leads to late recognition of danger signs of the obstetric problems and hence delayed management or referral.

In order to overcome this problem, different countries used different interventions. For instance; in Egypt where the MMR was reduced by almost half, a home visits based program was part of the package contributed to this reduction. Health educators and outreach workers from local NGOs were trained to conduct home visits and educate communities on pregnancy, delivery and postpartum warning signs. They also gave advice to women on seeking antenatal care and emergency obstetric services (124). This can be implemented in Sudan especially in the conflict zones where many of NGOs are now working. In Guatemala, a radio health education program was implemented. It aimed at increasing women's awareness about the danger signs of the obstetric problems and to teach them what to do after detecting these signs. This program has participated effectively in increasing women's knowledge and abilities to deal with the emergencies (125). This can also be tried in Sudan by making use of the high coverage of the local radio channels. In Brazil and Guatemala, a training program on detection of the obstetric problems was provided to the TBAs. Upon evaluation; a significant increase in the number of cases referred to health facilities by TBAs was detected (125). These training programs are necessary to build the capacity of non-skilled birth attendants and link them to the health system (82).

4.2.2. Delay in Decision to Seek Care:

Decision to seek health care in case of obstetric emergencies is obviously affected by the perceived distance, financial affordability, illness factors and traditional beliefs. Woman's low status in the Sudanese patriarchal society limits her capacity to make healthy decisions. Furthermore; the community itself is unaware about the potential risk of pregnancy and labour. This thing leads to an obvious mismatch between the actual risk and the perceived one (76). These two factors together are the leading causes of late seeking EmOC in most of the occasions.

In Nepal, a birth preparedness program was implemented in a rural district for one year. It aimed at promoting preparation and decision-making for childbirths by pregnant women and their families. Such a program could help in reducing maternal death by many ways: increasing health awareness among the pregnant women and their families, encouraging facility delivery, stimulating preparedness for emergencies. Upon evaluation, a positive change was detected in the community's knowledge, households' practices and the use of some health services. However; no change in EmOC use or skilled birth attendance was shown (126). If this program was implemented over a long period, it might help because changing people's behaviour and attitude requires longer time (97). A Similar program was

implemented in Sierra Leone, where it participated in improving community's knowledge about the importance of facility delivery and the danger signs of pregnancy, and childbirth (127). In Netherlands and Malaysia, skilled birth attendants were made available to home delivery. Those attendants are capable of providing preventive care and some of the emergency aid. This strategy has contributed to marked reduction in maternal mortality. However; it requires good linkage and means of referral to health facilities to succeed (84). An electronic health program was piloted in one Rwandan district to track the expected pregnancies. Community health workers and supervisors were trained on using mobile phones to register and follow the pregnant women. Over one year period; the program managed to detect 75% of the expected pregnancies. Moreover; it helped in identifying some of the high risk pregnancies and referring them to EmOC facilities. Upon evaluation, the district reported zero maternal death (128). Although it is easy to implement, this type of programs lacks sustainability and necessitates a good system of supportive supervision, which is currently unavailable in Sudan (32).

4.2.3. Delay in Accessing Health Facilities:

Long distance and travel time complicate both access to health facilities and referral of emergency cases. The impact of geographical inaccessibility can be clearly manifested in the regional variations and the urban-rural health inequalities (112). Inaccessibility in Sudan has been created by sparsely distributed PHC facilities across the country (25). Moreover; bad roads and lack of transportation aggravate the situation by prolonging the travel time to facilities especially during the rainy season. The situation is much worsened by lack of security in the conflict affected zones (Darfur, South Kordufan and Blue Nile states) where many of maternal deaths occur (29).

In order to improve geographical accessibility to obstetric care, maternity waiting areas (MWAs) are established near health facilities to accommodate high risk women during their last weeks of pregnancy (129). In Ethiopia, a study was conducted to evaluate the outcomes of women admitted to an established MWA over a 22 years period. A marked difference in mortality between women admitted to the rural hospital through this MWA and those admitted directly from home was detected (130). This could be of benefit in case of Sudan where seasonal inaccessibility hits many parts of the country (117) (47).

In India, an effective public-private partnership has been established to provide the emergency referral services by contracting some NGOs. This participated with other interventions to reduce the MMR in one southern region by almost 75% over 10 years (131). Western countries like Sweden, England, and Netherlands managed to increase accessibility to skilled delivery services by increasing the production of midwives (132). Sudan has developed a national strategy for scaling up midwifery services (133). However; production of sufficient numbers of midwives, retention, and motivation after deployment are the main challenges limiting implementation of the strategy (39).

Financial constraints cause a significant delay in accessing health care in Sudan. Inability to pay may affect a considerable proportion of Sudan's population due to the high poverty level and the high out of pocket expenditure (23). Even when the service is free, many families in

developing countries encounter problems in securing the other costs (134). This makes the service inaccessible to many women especially when their families are not well prepared for the medical emergencies. Rural residents bear the huge burden of this suffering due to their low socio-economic status (135). Moreover; most of the rural households are not covered by health insurance schemes as they are not formally employed (118). Besides the long travel distance; the cost of transport in the rural areas is higher than in the urban ones. In Dinajpur district, Bangladesh, Safe Mother Initiative was implemented during 1998-2001. A community support system was one of the initiative's components. One of the system's objectives was securing emergency funds to cover transport and obstetric service's costs through community collective efforts. This has helped many women to access timely emergency obstetric services (136). Such type of community health funds is important to encourage in Sudan. It will help in identifying women in need and provide them with the necessary financial support. Moreover, it will increase community's feeling of solidarity and responsibility.

The national delivery exemption policy in Ghana has led to an obvious increase in utilization of delivery services. The evaluation revealed that the women in the lower wealth quintiles made use of the policy (137). In Sudan, a similar policy was issued in 2008. Upon evaluation in 2010, some implementation gaps were identified. The exact target group was poorly defined, specification of package of care was unclear, and the allocated fund was inadequate. Despite these gaps, an improvement in the uptake of delivery services was detected (52).

4.3. HEALTH SERVICES RELATED FACTORS:

Health services related factors are many and play roles at different phases of delay. Lack of effective antenatal counselling and education represents a missed opportunity to increase women's awareness about the pregnancy's danger signs. This might be due to lack of trained personnel and understaffing of health facilities especially the rural ones (32). Another factor is the birth attendants' substandard knowledge that contributes to late recognition of the obstetric complications and sometimes delays referral. Regular in-service training programs focussing on the obstetric danger signs might help in scaling up the knowledge of the birth attendants (40).

Due to the perceived poor services quality, lack of responsiveness and some policy barriers many women are not seeking facility care. Keeping high quality standards especially in rural and remote areas represents a major challenge due to inadequacy of the staff number and quality, unavailability of medical supplies, and lack of regular supervision. On the other hand; obstetric services are characterized by high cultural sensitivity. So; lack of services' acceptability by the community might be an important disincentive for utilization (32). To improve responsiveness and quality of obstetric care in Dinajpur district, a facility based intervention was one of the components of the Safe Mother initiative. A gender sensitive approach for managing the obstetric problems was developed. Furthermore; health workers were trained on interpersonal communication skills. A special attention has been made to the waiting time and cleanliness of the health facilities. Upon evaluation, the district showed

significant increases in the number of the facility deliveries (from 2.4% to 20.5%) and the percentage of met need for obstetric care (from 16% to 40%) (136).

Restrictive abortion law is an example of the policy barriers that may cost many women their lives. In Sudan, women mostly seek unsafe abortion for unwanted pregnancies. Furthermore; fear of being reported hinders them from seeking health care when they develop post-abortion complications. In Romania, MMR witnessed a six folds increase during the period of criminalizing abortion. However; the country showed 50% drop in maternal mortality just one year after legalization (138).

CHAPTER 5: CONCLUSION & RECOMMENDATIONS:

In order to avert maternal mortality, we need to understand and respond to all barriers that put women at high risk of maternal death. Although the existing evidence is insufficient, this study identified some of the important factors that contribute significantly to maternal mortality in Sudan. These factors are responsible for delaying recognition of the obstetric problems, seeking health care, and access to obstetric services. Despite its importance as a cause of considerable delay; the quality of the emergency obstetric care is not tackled by this study. Nevertheless; some of the quality's issues were addressed as part of the other phases of delay.

The study's findings show that multiple interacting factors contribute to maternal mortality in Sudan. These factors represent socio-cultural, economic, geographical, and organizational barriers. Rural women seem to be significantly disadvantaged. This situation is attributed to the obvious urban-rural inequalities in education, income, and health. Gender inequity and low women's decision-making autonomy worsen the overall situation and put negative impacts on women's health. In addition; health services related barriers were found to add to each phase of delay. They act as explicit barriers to utilization of maternal services. Moreover; health services are not used in the best way to help in overcoming the already existing barriers and enhancing services' utilization.

On the other hand; the literature shows many successful stories from countries managed to reduce the maternal death by using different packages of cost-effective interventions. In case of Sudan, we need to prioritize creation of community's demand to maternal health services in general and to institutional delivery in particular. To do so; a suitable package of health interventions is required to target women at high risk of maternal death and their communities. The package should be tailored in a way insuring high community acceptability so as to encourage utilization. Therefore; health authorities should involve the community in planning for health care and respect their cultural beliefs and preference as much as possible. This requires active participation of women as well as men in this process. Simultaneously; health promotion interventions are required to change the negative health seeking behaviour and encourage better health practices. These should be coupled with interventions to improve both financial and geographical inaccessibility. In line with that; I hereby recommend the following:

- Prioritizing maternal health and putting maternal mortality on the agenda to gain more political and community support. Making the change in maternal health situation requires political will and strong leadership to stimulate active participation of all stakeholders including the private sector and encourage creation of effective partnerships. Strong leadership will ensure high level of coordination, transparency, and accountability. Increasing community's awareness in relation to the maternal mortality is a key to solve the problem.
- Supporting exploratory RH research and strengthening maternal health information system especially the maternal audit are mandatory to evaluate the exact magnitude

of the problem and to understand its drivers. This will help in raising decision-makers' and community's awareness and guide knowledge based health planning.

- Promoting human's rights, empowering women and enhancing equitable access to income, education, and information to enable women to make healthy decisions to safe their own lives and their babies' lives as well. Concurrently; the country efforts should continue to be exerted on MDG 1 (Eradication of Extreme Poverty and Hunger) and MDG2 (Achieve Universal Primary Education). These MDGs are complementary to the efforts of reducing the magnitude of maternal mortality.
- Long term communication strategies should be put in place. Focus should put on advocating for maternal health and changing the community's health seeking behaviour by providing information, education, and communication means. Involvement of the health workers, community and religious leaders, and local NGOs in development and implementation of these strategies is crucial to ensure sustainability and maximize their health impacts. This necessitates making good coordination with the existing communication channels (mass media, print channels and traditional media), effective partnerships with the private sector and allocating enough budget and time for implementation.
- Improving distribution of PHC facilities to enhance geographical accessibility and eliminate the regional inequality. Moreover; nomads and remote areas' residents should be provided with outreach services and maternity homes to help women in accessing timely care. Simultaneously; increasing production of qualified and competent midwives is mandatory to increase the number of deliveries attended by skilled providers. Good retention strategies and performance based incentives should be arranged to support the rural health workers and keep them motivated.
- Revisiting the free of charge treatment policy in order to seal the gaps and improve the financial accessibility. More resources should be allocated to EmOC providing facilities, so as to avail affordable services to all pregnant women and encourage facility deliveries. Moreover; we need to consider the other costs because it is clear that the situation will not improve by only abolishing the service's fees. Still many women will not be able to use the service due to high transport cost. Therefore; community's participation in establishing emergency obstetric funds should be encouraged in order to support those women.
- Eliminating the health services related barriers is fundamental to improve utilization of maternal services. This requires creating supportive legislative and regulatory frameworks, building the capacities of birth attendants and other maternal health care providers, availing regular supply of essential drugs and commodities, strengthening the referral system, and improving responsiveness of the health system. It would be useless to create demands to health services if they are not available or not providing good quality care.

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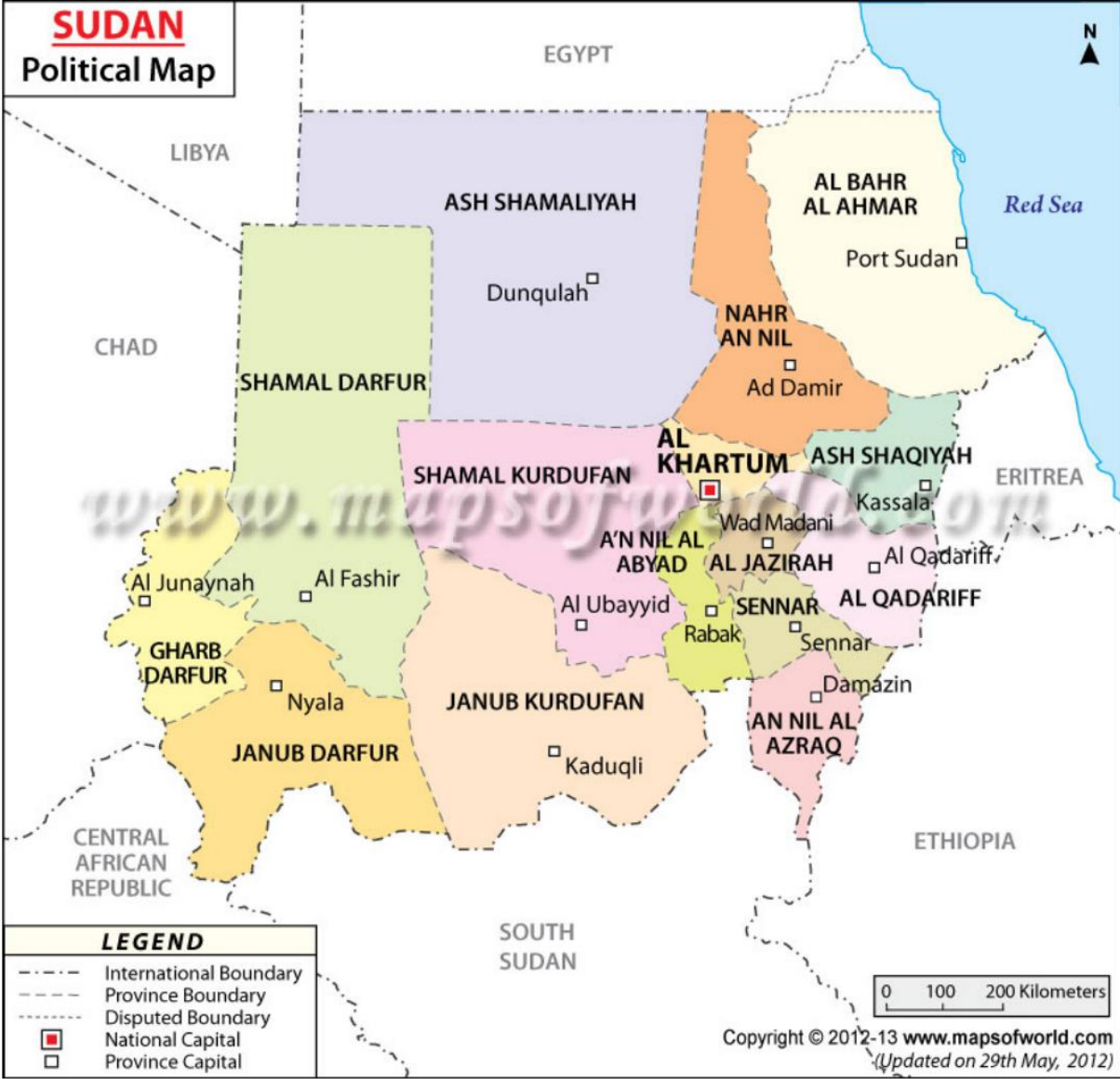
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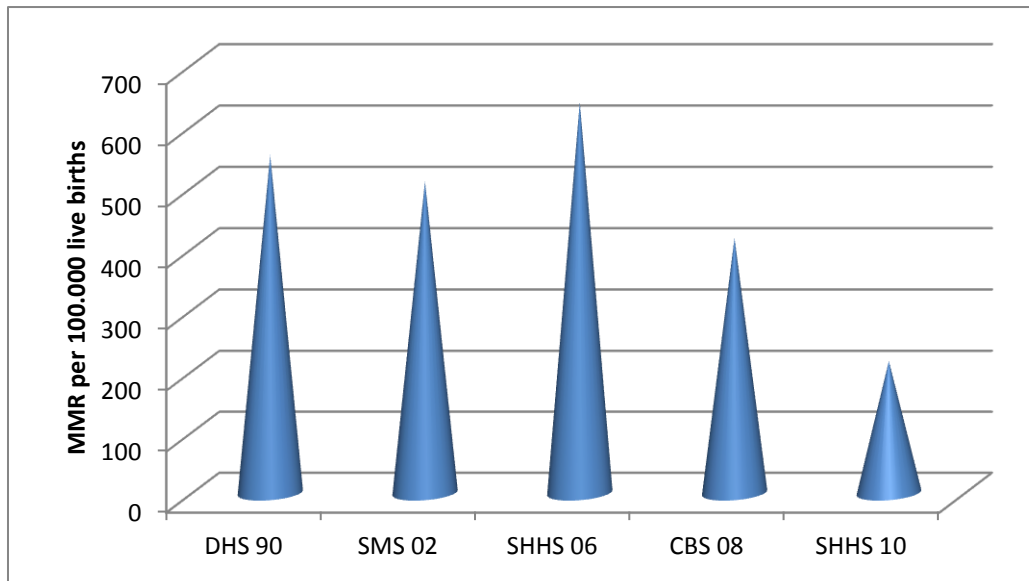
ANNEXES

ANNEX 1: SUDAN POLITICAL MAP



SOURCE: Map of the World: <http://www.mapsofworld.com/sudan/sudan-political-map.html#>

ANNEX2: MATERNAL MORTALITY SUDAN (1990-2010)



SOURCE: Demographic Health Survey 1990⁴, Safe Motherhood Survey 2000⁵, Sudan Household Health Survey 2006, Sudan Fifth National Census 2008, Sudan Household Health Survey 2010

⁴ For both North and South Sudan

⁵ For both North and South Sudan

ANNEX 3: SUDAN MDGs STATUS 2012

MDG	INDICATORS	SUDAN	TARGET 2015
Eradicate Extreme Poverty & Hunger	Estimated Poverty Incidence (% Of Total Population)	46.5%	23%
	Prevalence Of Child Malnutrition (Underweight For Age; % Under 5)	32.2%	16
	Proportion Of Population Below Minimum Level Of Dietary Energy Consumption	28%	14%
Achieve Universal Primary Education	Gross Primary Enrolment Ratio	67%	100%
	Adult Illiteracy Rate	62%	25%
Promote Gender Equality and Empower Women	Ratio Girls To Boys In Primary Education	64% to 69%	-
	Share Of Women In Employment	23%	-
	Percentage Of Women In National Assembly/Council Of States	24%	-
Reduce Child Mortality	Under-5 Mortality Rate (Per 1,000)	78	41
	Infant Mortality Rate (Per 1,000 Live Births)	57	53
	One-Year-Olds Immunized Against Measles	85%	100%

SOURCE: UNDP 2012 http://www.sd.undp.org/mdg_fact.htm