Maternal and child healthcare services in South Sudan: the factors associated with non-use of antenatal care, skilled birth attendants, facility delivery services and child survival.

Ngatho Samuel Mugo

Thesis by published and unpublished works

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This thesis is dedicated to my beloved parents:

Samuel Mugo Jwedho and Ayul Otig Twong

My sibling:

Halima, Marry, Jokbabott, Rebecca, Nygaith, Sharjowk, Elizabeth and Nabiel

Statement of Authentication

This thesis is submitted to the University of Sydney, Australia, in fulfilment of the requirement for the degree of Doctor of Philosophy.

The work presented in this thesis is, to the best of my knowledge and belief, original except as acknowledged in the text. I hereby declare that I have not submitted this material, either in full or part, for a degree at this or any other institution.

Signature:

Date: August 30, 2017

Author's Contribution

The candidate conducted the work presented in this thesis and it was under the supervision of Professor Michael J Dibley, Sydney School of Public Health, University of Sydney; Dr. Kingsley E Agho, Senior Lecturer, School of Social Science and Health, Western Sydney University; Dr. Ashraful Alam, Postdoctoral Research Associate, Sydney School of Public Health, University of Sydney and Professor Anthony Zwi, School of Social Sciences, University of New South Wales.

For all the quantitative and qualitative analysis presented in this thesis the candidate planned the research, designed the studies, analyzed the data, interpreted results and drafted and revised the manuscripts for submission to peer-reviewed. For the qualitative analyses, the candidate also prepared the protocol and data collection tools, trained the field staff, participated in data collection, data management and in data analysis and report writing. The candidate wrote and compiled this thesis.

Ethical Clearance

Ethical clearance was not required for the secondary data analyses using the South Sudan Household Health Survey second round data presented in Chapter 3-6. However, the dataset of South Sudan Household Health Survey was not available as a public domain survey dataset in 2013. The first author requested the access to the data from Director of Health Social and Demographic Statistics and from the Ministry of Health of South Sudan, and access was granted to use the data for research. Currently the de-identified data is available in the public domain.

Ethical clearance for the qualitative study presented in this thesis Chapter 7-8 was obtained from the ethical review committee of the Department of Policy, Planning, Budgeting and Research of the Ministry of Health, Government of South Sudan (MoH-GoSS), Juba, the Republic of South Sudan. All study participants provided a verbal informed consent for their participation in the study.

Abstract

Objectives

The aim of this body of research is to examine the factors associated with non-use of maternal and child healthcare services in South Sudan. The specific aims include examining the associations between socio- demographic, economic and physical accessibility factors on utilization of maternal and child health care services. It also investigated the barriers facing healthcare providers to deliver appropriate services to their clients and the extent to which these barriers are associated with use or non-use of antenatal care, skilled birth attendants, facility delivery and neonatal services.

Methods

This research constituted both quantitative and qualitative methods. For the quantitative analyses, data were obtained from the South Sudan House- hold Health Survey second round (SSHHSII) carried out in 2010 that used the Multiple Indicator Cluster Survey (MICS) methodology developed by UNICEF. We examined data for 3504 (weighted total) women aged 15-49 years who gave birth in the 2 years prior to the survey; and 8125 (weighted total) singleton live born children under the age of five years, who were born within 5 years prior to the survey. The logistic regression analysis (Chapter 4, 5 and 7) and multinomial logistic regression analysis methods (Chapter 6) were used. All statistical analyses were carried out using STATA/MP version 12. For the qualitative analyses, data were derived from a study conducted in Juba County, Central Equatoria State, South Sudan. The study participants involved were mothers and their partner, healthcare providers and trained traditional birth

attendants. About 63 in-depth interviews were audio recorded and then transcribed. All the data were manually managed, and a list of topical codes was developed followed by a content and thematic analysis (Chapter 8 and 9).

Results

Chapter 3 Identified the barriers and challenges of promoting maternal, newborn and child health (MNCH) gains, and identifies priorities that will contribute to addressing the Millennium Development Goals and the emerging health priorities for the post-2015 development agenda.

Chapter 4 indicates that the prevalence of nonuse of antenatal care services in South Sudan were significantly higher among mothers who were in polygamous relationships, illiterate mothers, mothers who had limited knowledge of a newborns' danger signs and those residing in Warap and Jounglei states.

Chapter 5 shows that the use of skilled birth attendantsat delivery was determinate by household wealth, place of residency, access to at least 1–3 antenatal care (ANC) visits during pregnancy, maternal education and mothers who experienced three and more complications during pregnancy**.**

Chapter 6 indicates higher odds of unattended home birth among never-married single mothers, uneducated mothers, those mother with first birth order, those who never attended ANC visits and those who experienced lower quality of ANC services. In addition, household poverty, lacking knowledge about obstetric danger signs, and lacking experience with pregnancy complications were associated with unattended home birth.

Chapter 7 identifies the determinants of neonatal, infant and under-five mortality in South Sudan. The risk of under-five mortality was found higher among low socioeconomic groups that included urban dwellers, children born to

teenager mother, those born to mothers who ever had a child that died later, and male children.

In **Chapter 8** the data from the qualitative study shows the challenges and barriers facing healthcare providers to deliver appropriate maternal and child health care services. The major barriers to health services provision were poor management of staff, stock out of medical supplies, lack electricity and water supply. In addition, lack of supervision, few training opportunities and low salaries were the major elements for health workers' de-motivation and low performance. Furthermore, security instability as a result of political and armed conflicts further impacted on their services delivery.

Chapter 9 identifies a combination of physical environment, socioeconomic factors or healthcare's characteristic as contributory factors to a higher percentage of mothers giving birth at home unattended. Sudden labor and lack of safety and security were the main reasons for home delivery in this study. In addition, lack of essential medicines, supplies and equipment were linked to individual mother's dissatisfaction with services they received. Furthermore, lack of access to transport and out of pocket fees for accessing the services further delayed women reaching health services for delivery or complications.

Conclusion

The findings in this thesis highlight the urgent need to implement strategies that address barriers to access to maternal and child health care services in South Sudan. At the facility level, investment is needed to upgrade the existing health system infrastructure, ensuring adequately resourced services, training opportunities for the health workers and reliable disbursement of staff salaries

are essential. Implementing strategies that target women at the community level, such as, deploying community health workers to identify women who need care, could increase the number of women who deliver with skilled birth attendant (SBAs). The government needs to address the socio-economic factors that prevent women from using maternal health services and provide free reproductive services and conditional cash transfers to encourage women to deliver with SBAs either at home or in a health facility. Implementing a cash transfer program targeting poor families to keep their daughters in school and unmarried throughout their secondary education is essential. Wider socio-political aspects such as safety and security must be considered in the long-term policies of the Government of South Sudan that will have direct and indirect impact on the use of maternal and child health services

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I acknowledge my co-supervisor and mentor Professor Anthony Zwi and my mentor A/Prof Pascal Carrive for their advice, encouragement and support even before I started my PhD and for helping me to discover my passion to help women in developing countries. I am grateful to all co-authors, contributors, reviewers and editors for their input and feedback.

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health care center for their support to organize the fieldwork and assistance with data collection. The Sydney School of Public Health at the University of Sydney for provided partial support for the data collection.

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Abbreviations

ANC	Antenatal care
EmOC	Emergency Obstetric Care
FBOs	Faith Based Organization
GNI	Gross National Income
GoNU	Government of National Unity
GoSS	Government of South Sudan
HDI	Human Development Index
MDG	Millennium Development Goal
MICS	Multiple Indicators Survey
MNCH	Maternal Neonatal and child health
MoH	Ministry of Health
MMR	Maternal mortality rate
MMR	Maternal mortality ratio
NGOs	Non-Governmental Organizations
PHCCs	Primary Healthcare Centers
PHCU	Primary Healthcare Unites
SDGs	Sustainable Development Goals
SBAs	Skilled birth attendants
SSHHSII	South Sudan House- hold Health Survey second round
Trained-TBAs	Trained traditional birth attendants
UNICEF	United Nations International Children's Emergency Fund
USD	United States Dollar

WHO	World Health Organization

SECTION I: Overview

Chapter 1: Introduction

1.1 Rational

Maternal mortality the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes remains a major challenge worldwide.[1]

In 2015, about 830 women died every day from preventive cause during and following pregnancy and childbirth[2]. Among the global figure of daily maternal deaths, 550 occurred in sub-Saharan Africa, 180 in Southern Asia, and only 5 in developed countries. [2] The leading cause of death and disability among women of reproductive age are due to preventable or treatable cause of complications during and following pregnancy and childbirth. [3] Haemorrhage, hypertensive disorders, and sepsis were account for over half of maternal mortality between 2003 and 2009 as indicated in Figure 1-1. [4]

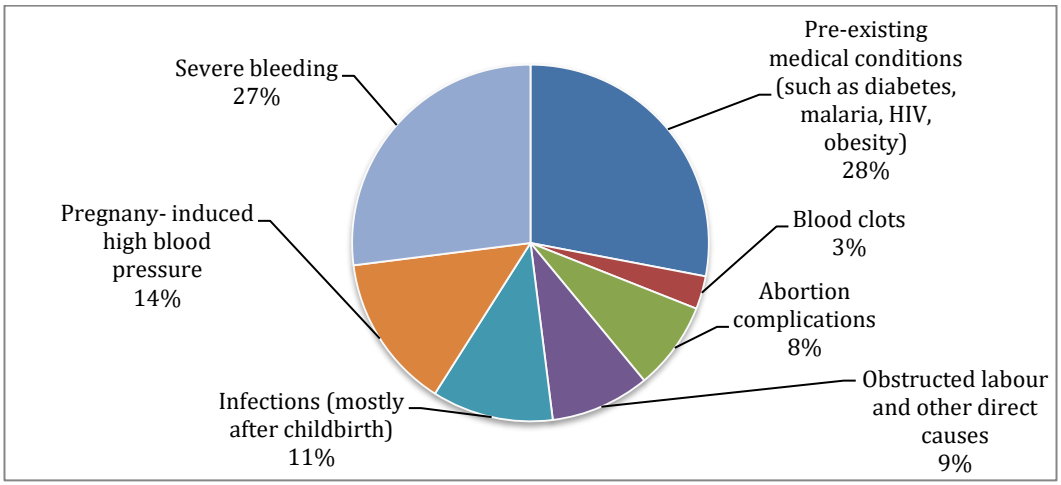


Figure 1-1: Global estimates for causes of maternal mortality 2003–2009 *(Source: WHO, 2016)*[5]

In response to the high rate of maternal mortality the global health community has made an effort to reduce maternal mortality through a sequence of initiatives, such as the Safe Motherhood movement that begin in 1987. [6] Reduction of maternal mortality has received further attention after it became one of the eight Millennium Development Goals [MDG 5] [7] that is to reduce the maternal mortality ratio (MMR) by three-quarters from 1990 to 2015.[8] Figure 1-2 shows the trends in maternal mortality over the MDG period.

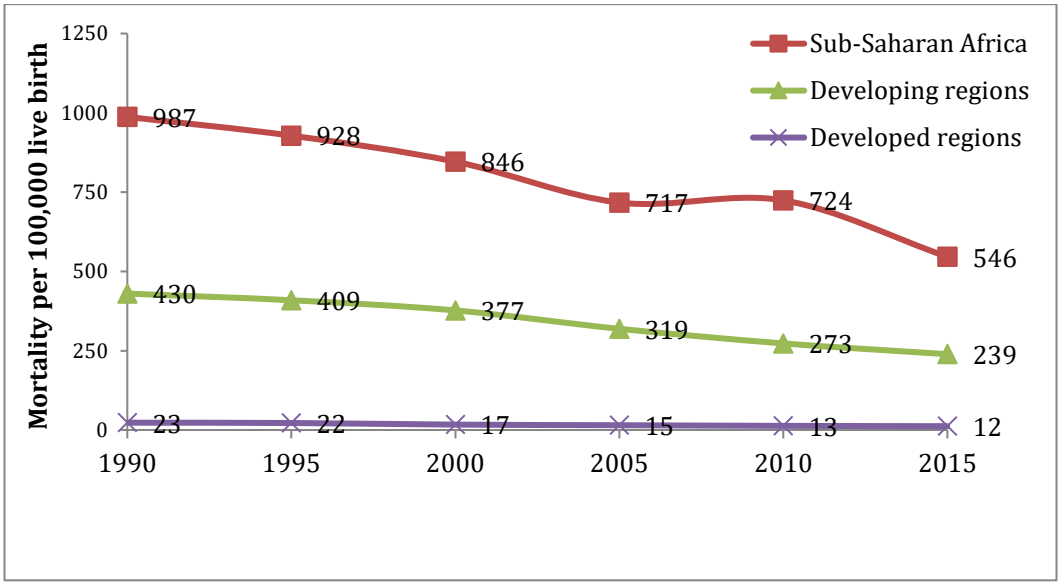


Figure 1-2: **Trends in estimates of maternal mortality ratio (per 100 000 live births), 1990–2015** *(Source: WHO, 2015)*[2]

Over the period of 25 years the MMR fell by 44% from an estimated 385 maternal deaths per 100 000 live births in 1990, to 216 in 2015.[2,9] This translates to a decrease of over 43% in the estimated annual number of maternal deaths, from 532 000 in 1990 to 303 000 in 2015. [2] However, the global decline of maternal mortality rate fell short of the target of 70 maternal deaths per 100,000 live births envisaged during the MDG era. [2,9] Developing regions showed a slow

decline over the same period and account for 99% (302 000) of global maternal deaths, with sub-Saharan Africa alone accounting for roughly 66%(201 000) maternal deaths. [2]

Evidence indicates that most maternal deaths could have been prevented if all mothers had access to antenatal care (ANC) during pregnancy, were attended by a skilled birth attendant (SBAs) who was able to deal with complications during childbirth, and had appropriate care and support in the early postpartum period. [2] [8,10] It is also well established that the provision of effective care for all mothers and her newborn child at the time of birth in facilities could prevent an estimated 113 000 maternal deaths, 531 000 stillbirths and 1.3 million neonatal deaths annually.[5]

Yet, in many low-income countries access to and use of maternal and newborn health interventions is lower among socioeconomically disadvantaged subgroups.[2,8,11] is estimated that in developing regions only 52 percent of pregnant women receive the recommended number of four antenatal care visits during pregnancy.[8] In term of access to skilled care at birth the percentage of deliveries attended by a skilled attendant globally increased from 59 to 71 percent from 1990 to 2014 during the MDG era.[8] However, more than one in four newborns and their mothers still have no access to essential medical care during childbirth.[8] In a setting affected by conflicts, displacement, and natural disasters access to life saving interventions for mothers and their newborn children are often underutilized.

The world youngest country, South Sudan is a fragile and war-affected country that gained independence in 2011.[12] The prolonged conflict, which has lasted over two decades, has significantly hindered progress with maternal mortality reduction due to a breakdown of the health system.[13] In 2015 South Sudan was rated as one of the top five Sub-Sahara African countries' with the highest maternal mortality estimated at 789 per 100,000 live births (see Figure 1-3).[2,14]

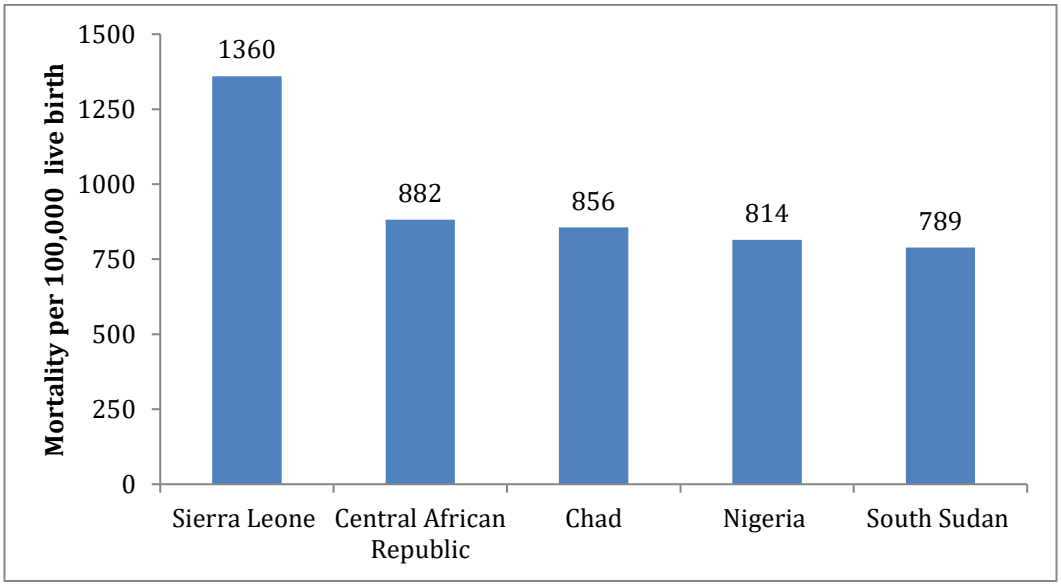


Figure 1-3: **Sub-Sahara African countries' with the highest maternal mortality ratio (per 100 000 live births), 2015** *(Source: WHO, 2015)*[2]

According to an estimate developed by World health Organization as indicated in Figure 1-4, the trend in maternal mortality for South Sudan has improved from 1730 maternal death per 100,000 live births in 1990 to 789 in 2015.[2] However, the lifetime risk of maternal death, which is the probability that a 15 years old women will eventually die from maternal causes, in South Sudan is still very high with 1 in 50 deaths in 2015 compared to 1 in 180 in other developing

countries verses 1 in 4900 in developed countries.[2,15] A combination of physical environment, social, economic factors, and an individual's characteristics increases the lifetime risk of maternal mortality among women of reproductive age.

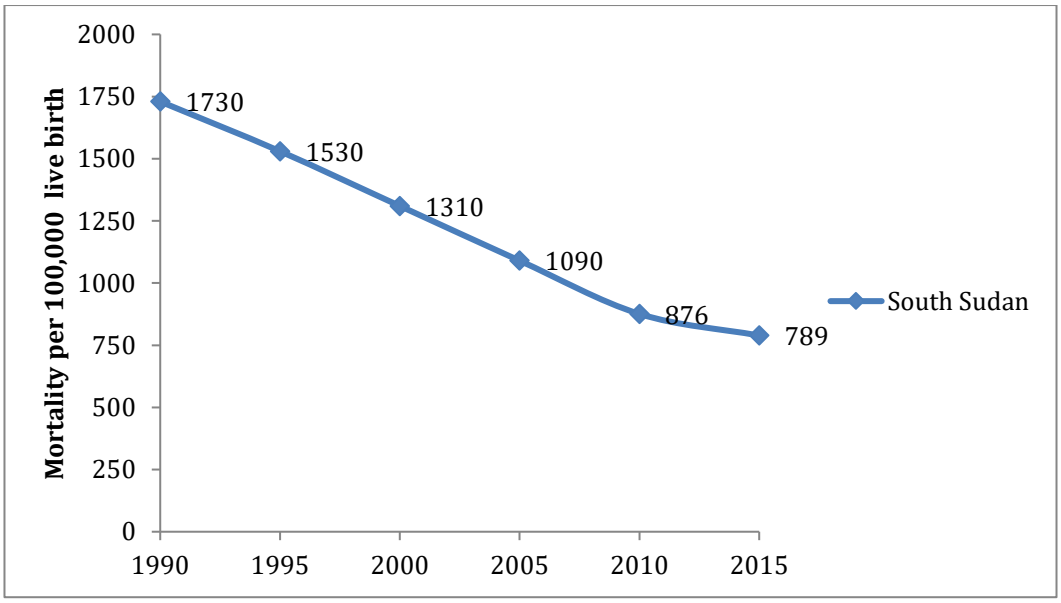
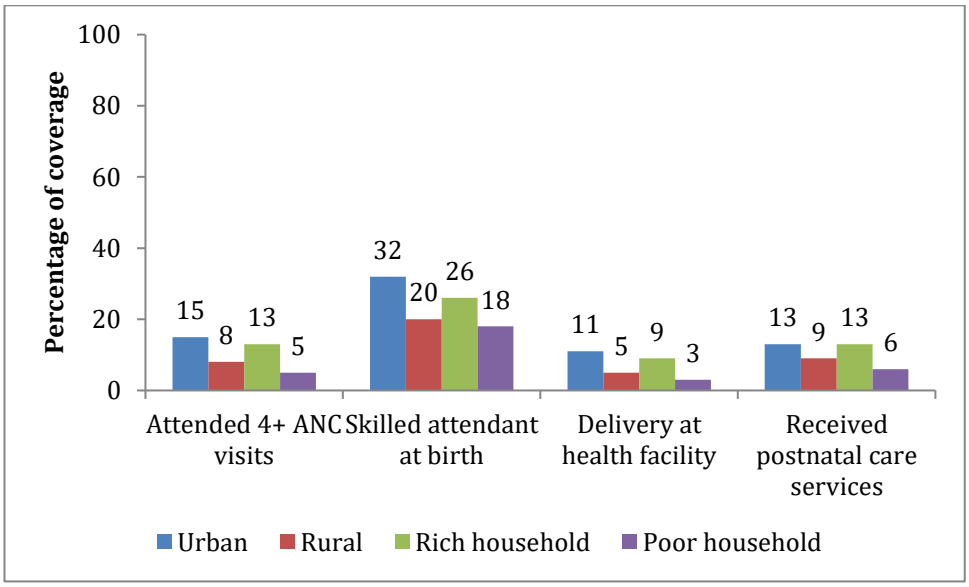


Figure 1-4: Trends in estimates of maternal mortality ratio (per 100 000 live births), for South Sudan, 1990–2015 *(Source: WHO, 2015)*[2]

In order to lower the high death among women of reproductive age and for their newborn children, the Government of South Sudan made a commitment to implement free access to maternity and child healthcare services and increased access to good quality emergency obstetric care services.[16,17] However, the coverage of maternal and neonatal health care services is generally very low with a high level of inequality in South Sudan as indicated in Figure 1-5.



Note
Rich households: Wealthiest 67% of households (highest and middle income tertiles combined);
Poor households: Poorest 33% of households (lowest income tertile)

Figure 1-5: **Inequality in coverage of maternal healthcare services by place of residence and wealth quintiles** *(Source: South Sudan household survey, 2010)*[18]

According to an estimate developed by World health Organization as indicated in Figure 1-4, According to analyses of the 2010 South Sudan household survey only 18% of pregnant women attended the recommended number of four antenatal care visits and 41% of deliveries were attended by skilled birth attendants.[19,20] As a result of low utilization of maternal healthcare services only 19% of deliveries took place at a facility as oppose to eight in ten births (81%) taking place at home.[18] Of the home deliveries, 19% were unassisted, 45% were assisted by an unskilled birth attendant and only 36% were assisted by an SBA (See Figures 1-6).[21]

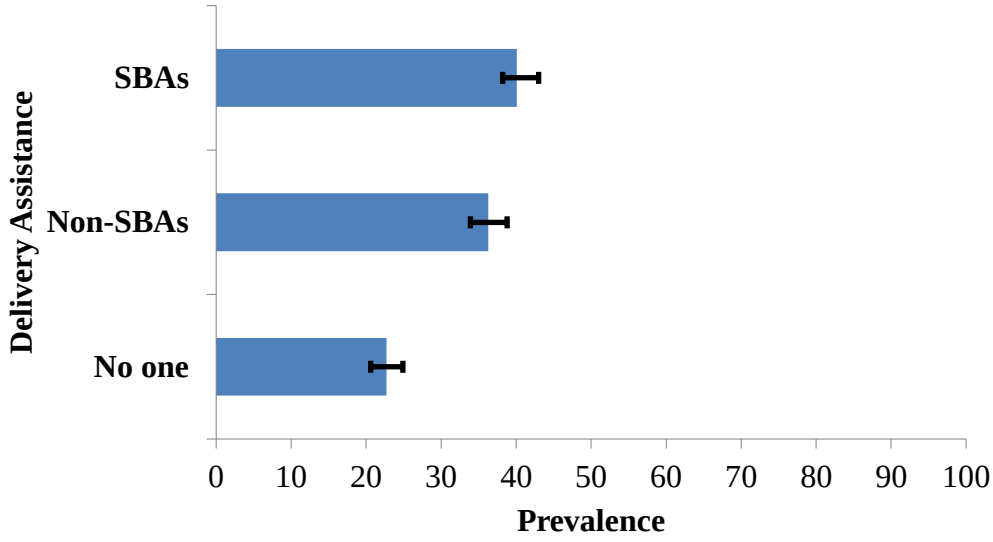


Figure 1-6: The prevalence and 95% confidence interval of home delivery by different type of birth attendants in South Sudan *(Source: South Sudan household survey, 2010)*[21]

The above evidence on low coverage of maternal and child healthcare services highlighted the urgent need to understand the key determinants of non-use of maternal and child healthcare services in South Sudan. Therefore, the findings from this study well help public health researchers and policy makers to develop programs aimed at improving access and utilization of maternal healthcare services in order to prevent maternal deaths in pregnancy, at delivery and post-delivery.

1.2 Research aims

The aim of this research to examine the associations between a range of risk factors and non-use of maternal and child healthcare related services in South Sudan.

The specific aims are:

i. To identify relevant peer-reviewed and grey literature on the barriers and challenges of MNCH in South Sudan and its relationship to conflict and health system development (**Chapter 3**),
ii. To examine the prevalence of non-use of ANC services, and the associated risk factors (**Chapter 4**),
iii. To identify potential factors associated with non-use of skilled birth attendants at delivery in South Sudan (**Chapter 5**),
iv. To investigate the factors associated with delivery in the absence of any assistance and delivery by unskilled birth attendants compared to deliveries attended by an SBA (**Chapter 6**),
v. To examine determinates of neonatal, infant and under-five mortality using the WHO model of social determinates of health inequality (**Chapter 7**),
vi. To explore the challenges confronted by the health care providers to deliver adequate quality health services to mothers in South Sudan (**Chapter 8**), and
vii. To understand the community members' experience, perceptions and the barriers in relation to accessing and utilizing maternal healthcare services in South Sudan (**Chapter 9**).

1.3 Main approaches

In this thesis both quantitative and qualitative methods are used to answer the research questions.

Quantitative analyses

All the quantitative data analyses presented in the thesis were obtained from the South Sudan Household Health Survey second round (SSHHSII) carried out in 2010. Further detailed information about the SSHHSII is discussed in Chapter 2 of this thesis.

In the main body of the thesis, quantitative methods are used in four manuscripts Chapter 4-7. Various statistical methods that include logistic regression analysis (Chapter 4, 5 and 7) and multinomial logistic regression analysis methods (Chapter 6) are used to answer the research questions in each analysis. The detailed information about analysis methods are discussed in each chapter.

Qualitative analyses

Data for all the qualitative analyses were derived from the findings of in-depth one-on-one interviews conducted in Juba County, Central Equatoria State, South Sudan. Three health services located in Juba town (Juba Teaching Hospital), Kator (Juba Military Hospital), and Munuki (Nykory Primary Health Care Center) were purposively selected for their better security and ease of accessibility.

The information was collected from mothers and their spouses receiving health services for their newborn children, health professionals including gynecologists, pediatricians, midwives/nurses and trained traditional birth attendants (Trained-TBAs), who were attending to the needs of mothers and or to their newborn children at these facilities. A total of 63 in-depth interviews were conducted with

30 mothers, 15 men and 18 healthcare providers. All the data were manually processed, and a list of topical codes was developed followed by a content and thematic analysis. The detailed information about analysis methods is discussed in Chapter 8 and 9 of this thesis.

1.4 Thesis outline

The thesis consists of five sections. **Section 1** is an overview of the research and includes the introduction (**Chapter 1**) and the background of the research (**Chapter2**).

Section II includes 4 chapters, which examined factors associated with non-use of maternal and child healthcare related service in South Sudan. **Chapter 3** evaluates the relevant literature on MNCH needs and challenges in South Sudan (manuscript 1)[22]. The subsequent chapters present the finding for analysis of 2010 SSHHSII dataset. **Chapter 4** examined the prevalence of nonuse of antenatal care services in South Sudan (manuscript 2).[20] **Chapter 5** discusses the factors associated with the use of skilled birth attendants at delivery (manuscript 3).[19] **Chapter 6** assesses the factors associated with home delivery in the absence of any assistance and delivery by unskilled birth attendants compared to deliveries attended by an SBA (manuscript 4). [21]

Section III consists of **Chapter 7**, which examined determinants of neonatal, infant and under-five mortality in South Sudan (manuscript 5). [23]

Section IV discusses delivery and access barriers to health care services in South Sudan using qualitative data. **Chapter 8** explores the challenges confronted by the health care providers to deliver adequate quality health services to mothers (manuscript 6).[24] **Chapter 9** explores the community members' experience, perceptions and the barriers in relation to accessing and utilizing maternal healthcare services in South Sudan (manuscript 7). [25]

Section V includes the final chapter (**Chapter 10**), which summaries the main findings, the strengths and limitations of the research, and recommendations for policy and public health researcher.

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Chapter 2: Research Background

2.1 South Sudan

South Sudan is the world's newest nation that emerged from over 50 years of civil war and conflict and gained its independence from North Sudan in 2011.[1] [2] The country is situated in the Sahel region of northeast Africa and lies between 25° to 30° east longitude and 4° to 12° north.[3,4] South Sudan is a land-locked country and covers a geographical area of approximately 640,000 square kilometres. Its borders with the Republic of Sudan to the north, Central African Republic to the west, Democratic Republic of the Congo to the South West, Kenya and Uganda to the south and Ethiopia to the east (figure 2-1).[4] The capital city of South Sudan is Juba, which is located in the southern state of Central Equatoria.[5]

Figure 2-1 **Map of South Sudan** *(Source: United Nations, 2011)*[6]

According to the 5th Sudan Population and Housing Census report the estimated population of South Sudan was around 8.26 million, with an average population growth rate of 2.2% per annum.[7] Other estimates indicate that the population is more likely between 11 million and 13 million.[7,8] It is also estimated that 35% of the population of South Sudan is below the age of 15 years, indicative of an exceedingly young population (see Figure 2-2). [9]

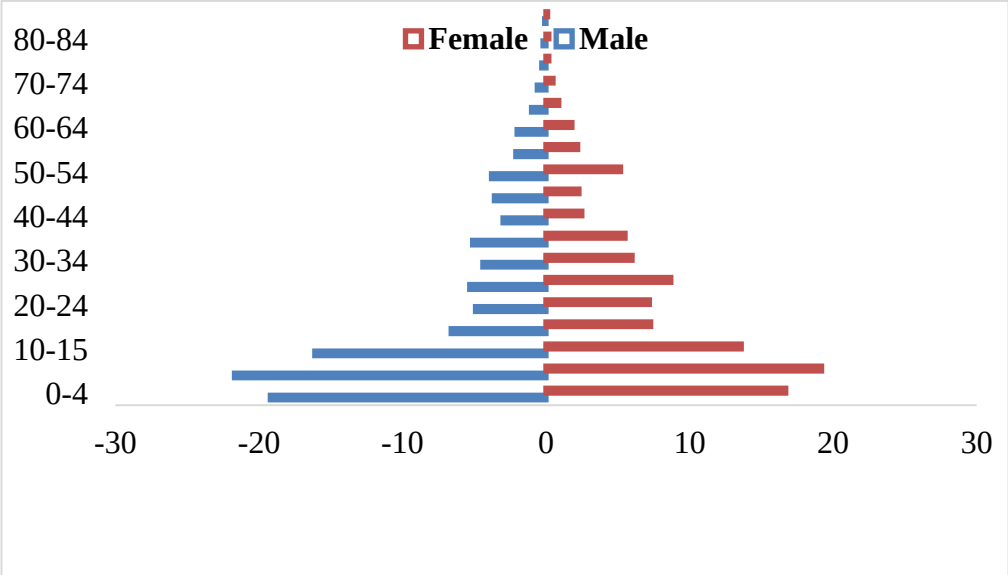


Figure 2-2: **Distribution of population of South Sudan by various age groups** *(Source: South Sudan household survey, 2010)* [9]

South Sudan is administratively divided into ten states, which are further sub-divided into seventy-nine counties. The counties are partitioned into 514 smaller administrative units (districts), referred to as Payams and these are further subdivided into 2,159 Bomas (sub-distract) which consist of a number of villages.[8] The country remains largely rural, with 76 percent of the population

residing in rural areas.[9] Although South Sudan has vast and largely untapped natural resources, it remains relatively undeveloped and it is among the poorest territories in the world. The human development index (HDI) is a measure for assessing three basic dimensions of human development in the country and include: 1) population health reflected on overall mortality level of the population, measured by life expectancy at birth; 2) the ability to acquire knowledge, measured by mean years of schooling and expected years of schooling; and 3) the ability to achieve a decent standard of living, measured by gross national income per capita.[10] South Sudan has an HDI of 0.467, which is below the average of 0.505 for countries in the low human development group, and below the average of 0.518 for countries in Sub-Saharan Africa.[11] This figure puts South Sudan in the low human development category positioning it at 169 out of 188 countries and territories in 2014 as indicated in Table 2.1. [11]

Table 2-1: Trends in South Sudan's human development index from 2010-2014

Year	2010	2011	2012	2013	2014
Life expectancy at birth	53.7	54.2	54.8	55.2	55.7
Expected years of schooling	7.6	7.6	7.6	7.6	7.6
Mean years of schooling	5.4	5.4	5.4	5.4	5.4
GNI per capita (2011 PPP$)	2,993	2,255	2,085	2,156	2,332
HDI value	0.470	0.458	0.457	0.461	0.467

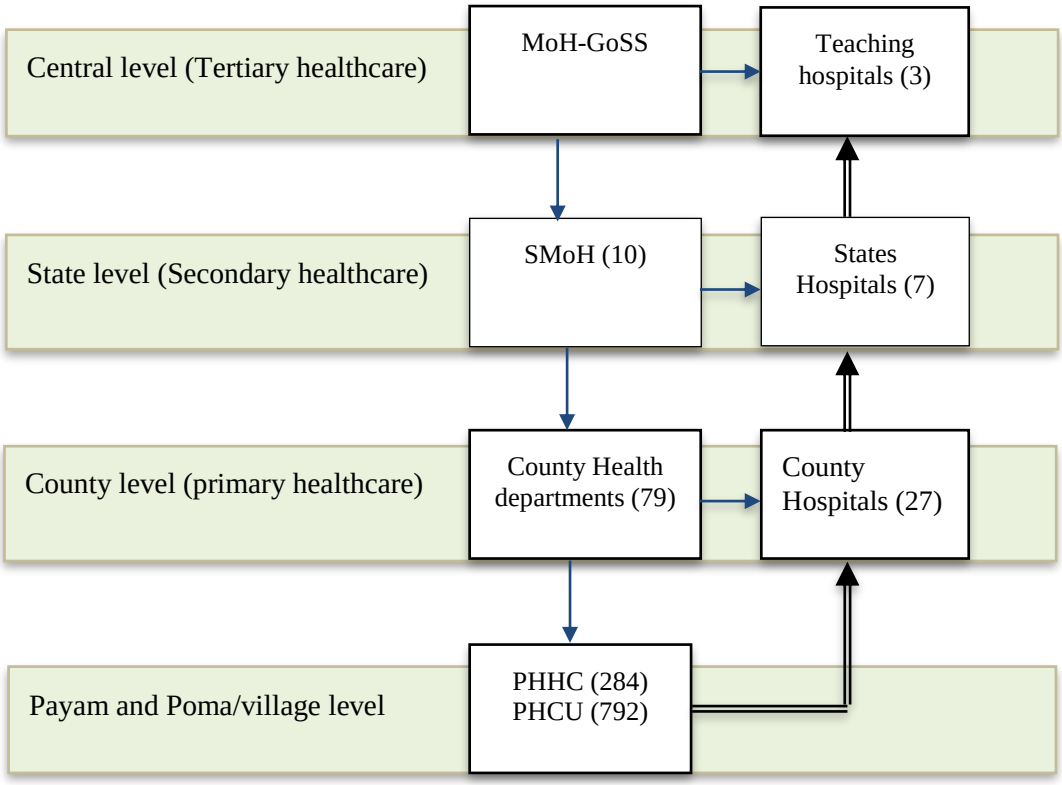
(Source: UNDP, 2015) [11]

2.2 Health system in South Sudan

Decentralized management structure of Ministry of Health

The public health system in South Sudan virtually collapsed during the war. Non-Governmental Organizations (NGOs) and Faith Based Organizations (FBOs) provided approximately 80% of the basic healthcare services during the period of the war.[12] Since the signing of the peace agreement in 2005, the Ministry of Health (MoH) resumed responsibility for rebuilding and transforming the public health system.[8] Currently the healthcare delivery system in South Sudan comprises the public facilities, the NGOs/FBOs, the private and the traditional health systems

In line with the decentralization policy of the interim constitution of South Sudan (2005) and the Local Government Act (2009) the Ministry of Health operates in a decentralized system. [12,13] According to the "Health Sector Development Plan 2011- 2015," the decentralized organizational structure is based on four levels of administrative structure: central, state, county, and community, as shown in Figure 2-2.[12] The Ministry of Health is responsible for delivery of the tertiary healthcare system at the central level, while the state Ministries of Health and the County Health Departments are responsible for secondary and primary health care services at the level of state and county, respectively. Also the County Health Departments manage the delivery of the primary health services at Payam and Poma/village level.[8]



Note:
Blue arrows: *Decentralized management structure of Ministry of Health*
Black arrows: *Hospital referral level.*

Figure 2-3: South Sudan healthcare delivery system along with the structure organization of the MOH *(Source: MOH, 2012)* [8]

The healthcare services delivery in South Sudan

The delivery of public healthcare services within South Sudan is described by the Ministries of Health (MoH & GoSS, 2011) as structured around four key levels starting from primary level of care to and specialized care, linked by a referral system.[8,14] These facilities are to a large extent aligned to the administrative subdivisions of the county in both rural and urban areas.[8]

At sub district/village level PHCUs is the immediate point of contact between communities and the health system. The unit provides basic preventive, promotive, and curative care including maternal and child healthcare services for around 15,000 people. These services are delivered by community health workers, such as village midwife, maternal and child health works, who are residents of the area. PHCCs are the immediate level of referral for the PHCUs and are located at each district and lead by medical assistants. These units aim to provide higher-level services for around 50,000 people. In addition to services offered by primary health care units, it provides basic diagnostic laboratory services inpatient care and maternity and neonatal care, but they are not equipped to assess women with emergency obstetric complications.

At state and county level, the hospitals provide secondary-level of care and serve as the referral site for health centers. These hospitals are located at each of the county and state administrative headquarters of the local government, and provide comprehensive obstetric care, in-patient care, and surgery, for around 300,000 to 500,000 people.[8] At the national level, there are three teaching hospitals that provide tertiary healthcare, and are located in the major cities of Juba, Malakal and Wau. The hospitals aim to target a population of 500,000 people and provide emergency obstetric and newborn care where general medical specialists such as surgeons, obstetricians, physicians and paediatricians provide such care.[8] Currently they are performing basic functions due to lack of equipment, structures and qualified human resources. [8]

In total there are about 1,147 of these functional health facilities in the 10 States of South Sudan. It is estimated that 44% of the population is settled within a 5-kilometre radius of a functional health facility. The per capita outpatient department utilization rate is estimated at 0.2 visits per annum.[8] According to the national baseline survey in 2009 about 70 percent of the population of South Sudan had access to health care facilities. [12]

2.3 Maternal healthcare services in South Sudan

Evidence suggests access to facility care services from skilled healthcare providers during pregnancy, delivery, and post-partum is among the intervention that is associated with improved maternal health outcome.[15-19] Yet access to and use of maternal healthcare services is relatively low in South Sudan as indicated in Figure 2-4.[8] An important way in which the outcomes of pregnancies can be improved in less developed countries is through provision of ANC service for pregnant women that aims to ensure healthy pregnancy outcomes and to improve survival of the newborn.[15]

ANC from skilled health providers is an essential service that assesses women's risk factors at every antenatal visit and provides a range of evidence-based services for pregnant women.[20] It also allows early detection and treatment of complications and existing diseases such as severe anaemia or malnutrition.[21] Furthermore, it enhances healthy behaviours during pregnancy and promote access to skilled health provider at delivery.[16,20]

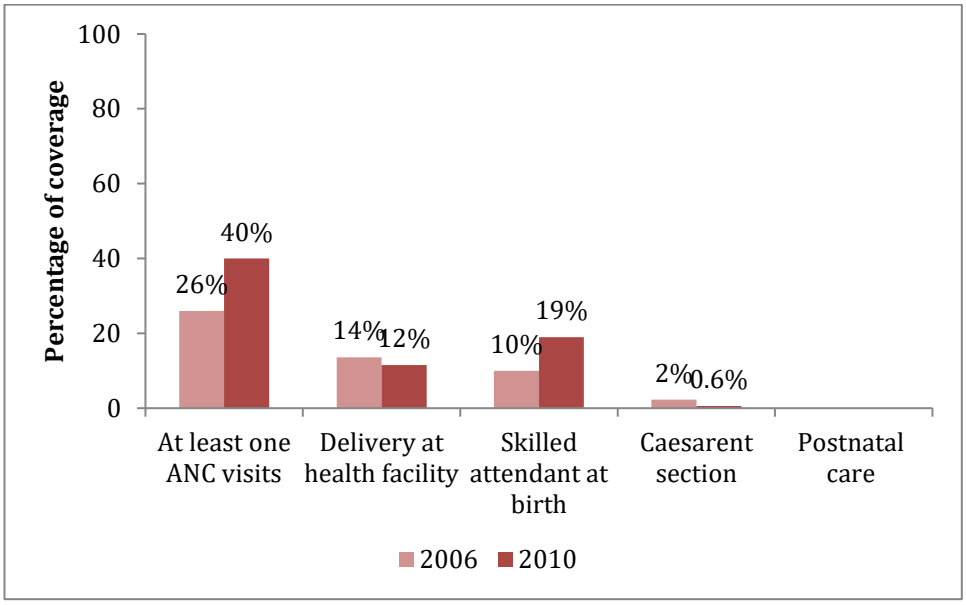


Figure 2-4: **Coverage of maternal healthcare services in South Sudan**
(Source: South Sudan household survey, 2006 and 2010) [9,22]

Since independence in 2011, the Government of South Sudan has adopted a minimum of 4 ANC visits for every pregnancy as recommended by WHO to improve the wellbeing of pregnant women and their infants.[9,15,23] The core services of ANC include routine preventive treatment of malaria, insecticide treated bed nets (given to women twice during pregnancy), tetanus toxoid immunization, iron and folic acid supplements, and syphilis and urine tests.[24] According to the South Sudan Household Health Survey report, the percentage of women receiving at least one antenatal visit from any skilled health provider has increased from 26% in 2006 to 40% in 2010.[9,22,25] However, while this proportion has improved, almost 58% of pregnant women in 2010 had not received any form of ANC services.[9,22,25] Among mothers with no access to ANC visits 53% experienced more than three complications during pregnancy.[26]

At childbirth access to skilled birth attendants during delivery, as well as emergency obstetric care (EmOC) in case of complications is one of the key global strategies in reducing maternal mortality.[15,27,28] Globally in 2014 about 29% of women were not attended by skilled birth attendants at birth. This figure is translated into more than one in four newborns and their mothers had no access to crucial medical care during childbirth.[29] Sub-Saharan Africa and Southern Asia regions have the highest percentage of births (48%) unattended by skilled health professional.[29] It is estimated that about 16% and 33% of maternal mortality globally could be prevented if pregnant women had access to skilled birth attendants at every delivery. [30]The term "skilled attendant" according to the World Health Organization (WHO) standards refers exclusively to people with midwifery skills, such as doctors, midwives, and nurses who have been trained to proficiency in the skills necessary to manage normal (uncomplicated) pregnancies, childbirth, and the immediate postnatal period.[15] These SBAs are also trained in the identification, management and referral of women and/or newborns with complications.[15]

South Sudan is among the Sub-Saharan Africa countries with the lowest percentage of births attended by skilled health personnel.[9] According to the 2010 South Sudan Household Health Survey (SHHSII), it was estimated that trained birth attendants assisted only 19.4% of deliveries.[9] This figure has declined to 17.0% in 2015 based on an estimate developed by the World Health Organisation.[27] Also in South Sudan institutional delivery is among the lowest in the world. It is estimated that the vast majority of births (about 81%) take place

at home with the support of a traditional birth attendant or a relative, and in some cases, there will be no assistance at all.[9] In South Sudan the low access to facility delivery and low use of skilled health providers at delivery may have contributed to high maternal mortality estimated at 789 per 100,000 live births in 2015.[31]

Following the childbirth, access to adequate care for both mother and her newborn child is critically important in reducing the risk of maternal and newborn death.[32] Postnatal care services from skilled health provider within 42 days of birth play an essential role to detect and treat any post-delivery complication.[15,32,33] Lack of access to appropriate care during this period can result in significant ill health and even death for the mother and or her newborn child.[34] In South Sudan the postnatal period is the most neglected time for the provision of quality services for mothers and their infants.[35]

Theoretical framework of factors associated with non-use of maternal healthcare services in South Sudan

The framework by Gabrysch and Campbell was modified to group the risk factors that have a potential impact on access to health care services in developing countries.[36,37] According to the framework the potential risk factors associated with non-use of maternal health services in South Sudan were categorized into four groups as indicated in Figure 2-5.

The first group is socio-cultural factors (referring to the factors that primarily influencing decision making on whether to seek care including socio-demographic factors and women's autonomy).

The second group is perceived needs and benefits (referring to the individuals expectation, believe and values on the benefit and need from accessing healthcare services. This group include health related knowledge and behaviors and access to appropriate types of care at facilities.

The third group is economic accessibility factors (referring to household financial capability to cope with costs associated with access and use of maternal healthcare services including ability to pay for services and or transport).

The fourth group is physical accessibility factor (referring to household location and distance to maternal health services including type of residence and geographical regions).[36,38]

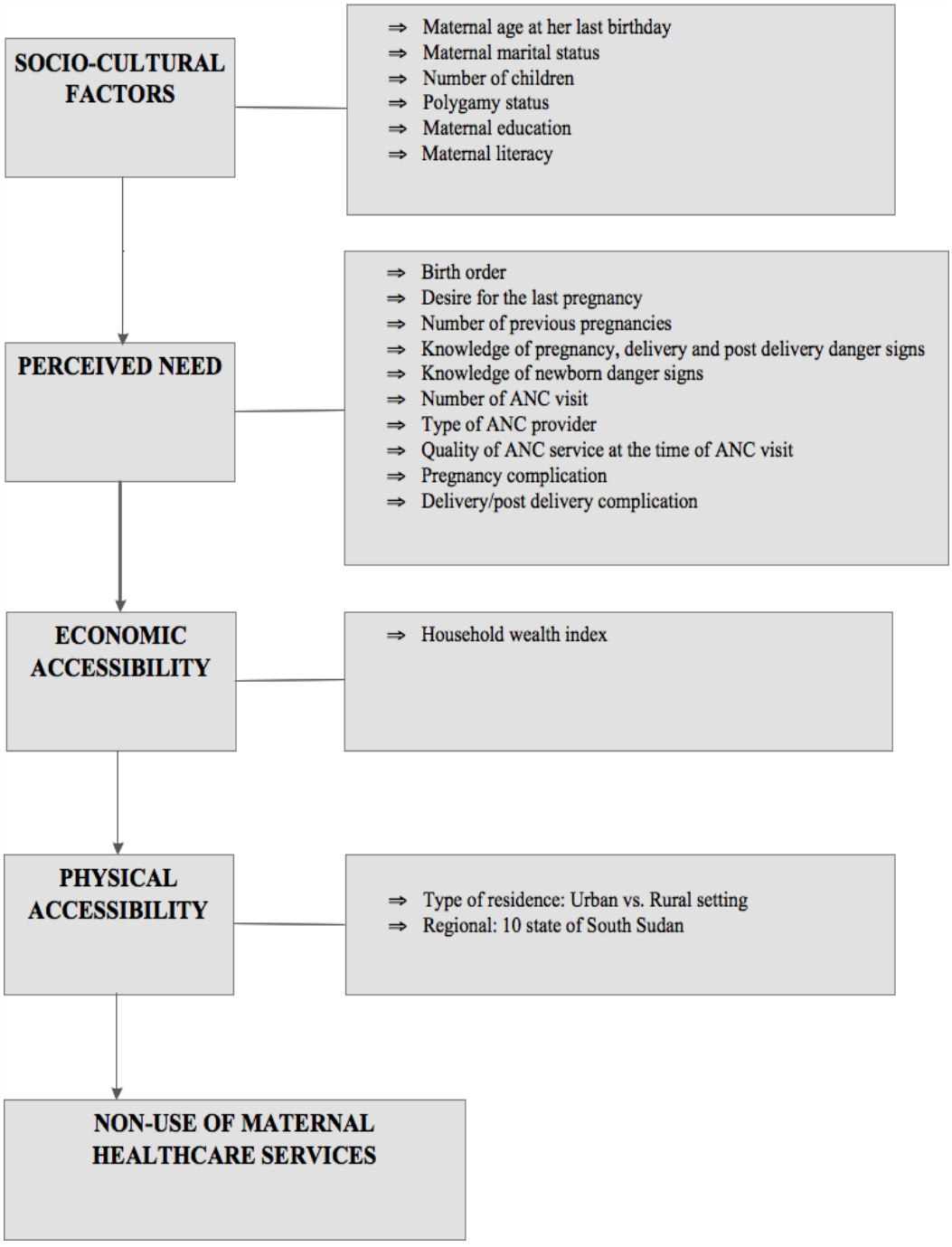


Figure 2-5: **Theoretical framework of the risk factors associated with non-use maternal healthcare services in South Sudan** *(Source: adopted from Gabrysch and Campbell, from the Thaddeus and Maine's three delays model, 2009)*[36]

Previous studies on factors affecting use of maternal healthcare services

Globally access to healthcare services during pregnancy, delivery and post-delivery is determined by several factors such as availability and accessibility of the health services, socio-cultural factors, and economic accessibility.[39-43] Several studies from developing countries have examined various factors affecting use of maternal healthcare services.[44-47] Maternal age at childbirth is among the socio-cultural factors that has been widely examined, and several studies have found a strong association between maternal age and the use of maternal health services.[48-51] An increased risk of non-utilisation of maternal health facilities during pregnancy, delivery and post-delivery is also associated with the level of maternal of education and or maternal literacy.[52-57] Several studies have found that maternal marital status influences the use of skilled care at delivery or facility delivery.[26,58] Maternal knowledge of and previous experience of obstetric complications either during pregnancy, delivery and post-delivery are among the factors associated with an increased uptake of facility delivery.[59-62] Perceived quality of care has also been found to influence health care seeking behaviour.[63-67]

Among the economic accessibility factors, household economic status is strongly associated with the use of health facilities.[68-71] Several studies from developing countries have underlined the importance of household wealth status in influencing maternal health seeking behaviour.[48] Furthermore, studies have also shown that the use of the healthcare services is significantly associated with

availability and or accessibility of the health services.[72] For instance, place of residence (living in an urban or rural area) and regions of residence determine whether or not pregnant women can attend or utilise maternal health services during pregnancy, delivery and post-delivery.[48,73,74]

2.4 Under-five mortality in South Sudan

Reduction of under-five mortality rate of 25 or fewer deaths per 1,000 live births by 2030 is one of the priorities of the Sustainable Development Goals (SDG) and the target for the child survival indicator.[75] Under-five mortality rate is defined as the probability of dying between birth and exactly five years of age expressed per 1,000 live births. During the period of Millennium Development Goals (MDG) era progress was made globally in reducing the under-five child mortality rate from 91 deaths per 1,000 live births in 1990 to 43 in 2015.[76] While the world did not meet the MDG child survival target, every region of the world reduced its under-five deaths by at least a half during the period 1990 to 2015. Yet in 2015 about 5.9 million children died before their fifth birthday. These deaths are heavily concentrated in many fragile settings, such as South Sudan, and low-income countries, such as in Sub-Sahara Africa and Southern Asia, with rates of under-five mortality estimated at 93, 83 and 51 per 1000 live births in 2015 respectively (see Figure 2-6).[76,77]

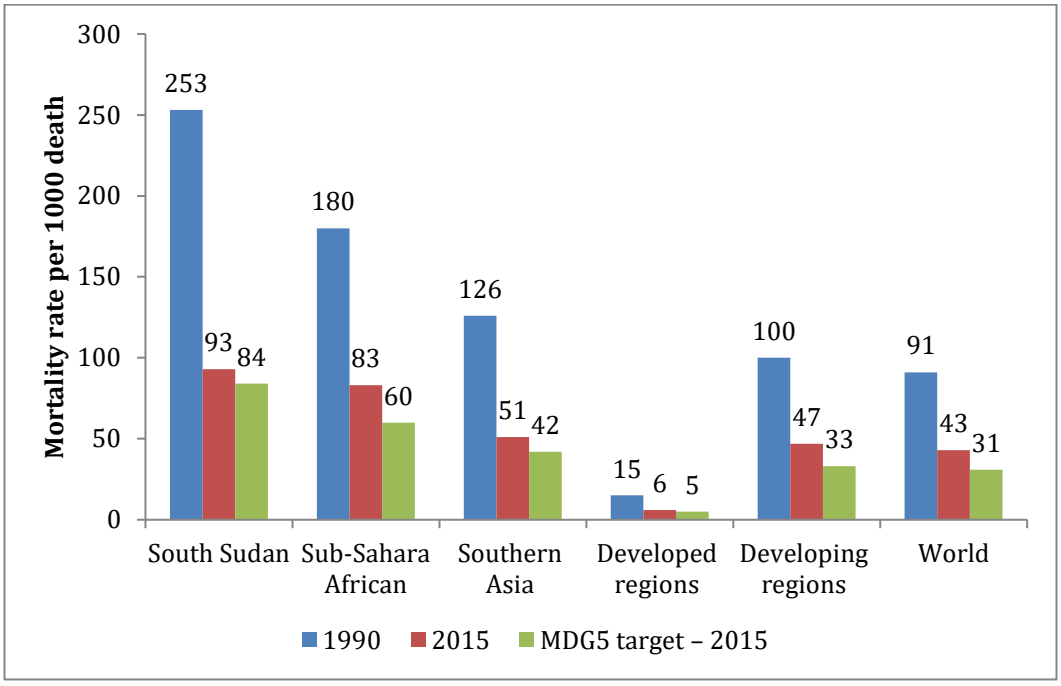
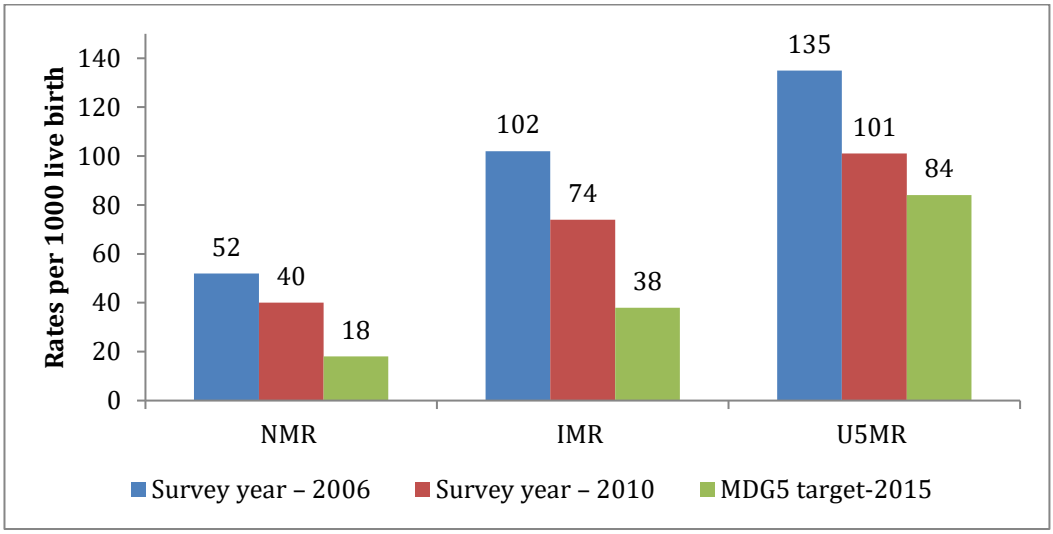


Figure 2-6: **Under-five mortality rates by Millennium Development Goals regions and countries, 1990 and 2015** *(source: UNICEF et all, 2015)*[76]

The newest nation, South Sudan, a post conflict country in Sub Saharan Africa region is faced with a high rate of under-five mortality. According to World Bank, the country is rank number 13 of the top 20 countries in the world with the highest under-five mortality rate, which was estimated to be 93 per 1000 live birth in 2015.[77] Based on the South Sudan household survey estimate, the trends in neonatal, infant and under-five mortality rates remain very high as indicated in Figure 2-7.[9,76] Although, there has been a substantial decline in the under-five mortality rate, the prolonged conflict has hindered progress in reducing under-five mortality rate in the period 1990 to 2015.



Note
***NMR - Neonatal mortality rate**: the probability of dying in the first month of life (0-<28 days)*
***IMR - Infant mortality rate**: the probability of dying between birth and first birthday (0 - < 12 months)*
***Under-five mortality rate (U5MR):** the probability of dying between birth and fifth birthday (0-<60 months)*

Figure 2-7: Trends of neonatal, infant and under-five mortality rates in South Sudan *(source: South Sudan Household survey, 2006, 2010, UNICEF et all, 2015)* [9,22,76]

In addition, the prolonged conflict has also contributed to the country having low coverage of essential live saving intervention for under-five children, such as access to insecticide-treated mosquito nets (34%), improved source of drinking water (69%), improved sanitation facilities (7%), rehydration treatment for diarrhea (49%), antibiotic treatment for pneumonia (33%), and childhood immunizations (6%).[9] As a consequence, these children are at greater risk of premature death and disability than those children with access to established public health interventions.[78,79]

Theoretical framework of factors associated with under-five mortality

In order to address the social determinates of health inequalities that are preventable, avoidable and unfair, we modified and used the conceptual framework developed by World Health Organization[80] as a guide in identifying the key social determinants of health inequalities and their impact on the well-being of under five children. In 2005 the World Health Organization (WHO) established the Commission on Social Determinants of Health (CSDH) as a global strategic mechanism to address the problems associated with health equity.[80] According to the WHO model, the chance of dying in childhood is strongly determined by the living conditions into which the child is born and the systems in place to deal with illness, such as material circumstances, behaviors, biological factors and health services.[80,81] These factors are further shaped by the socioeconomic and political mechanisms, such as macroeconomic policy.[81] The modified framework is presented in Figure 2-8.

Based on this framework we grouped several socio-economic factors from the community and the household level as intermediary determinants that are potentially associated with under-five mortality in South Sudan (see Figure 2-8). Community level factors include type of residence, regions, and healthcare characteristics of the community. Household level factors include household wealth index, education and gender of the household head, maternal education and literacy, maternal marital status and polygamy status. The intermediary factors (the individual's material and social circumstances) were classified into two main groups and consist of maternal behaviours / circumstances and include

mother age, heard about family planning, number of living children less than five, ever had a child who later died, type of fuels used for cooking, cooking location, garbage disposal and women's experience with domestic violence; under-five condition and include child gender, family access to improved drinking water, and family access to improved sanitation toilet.

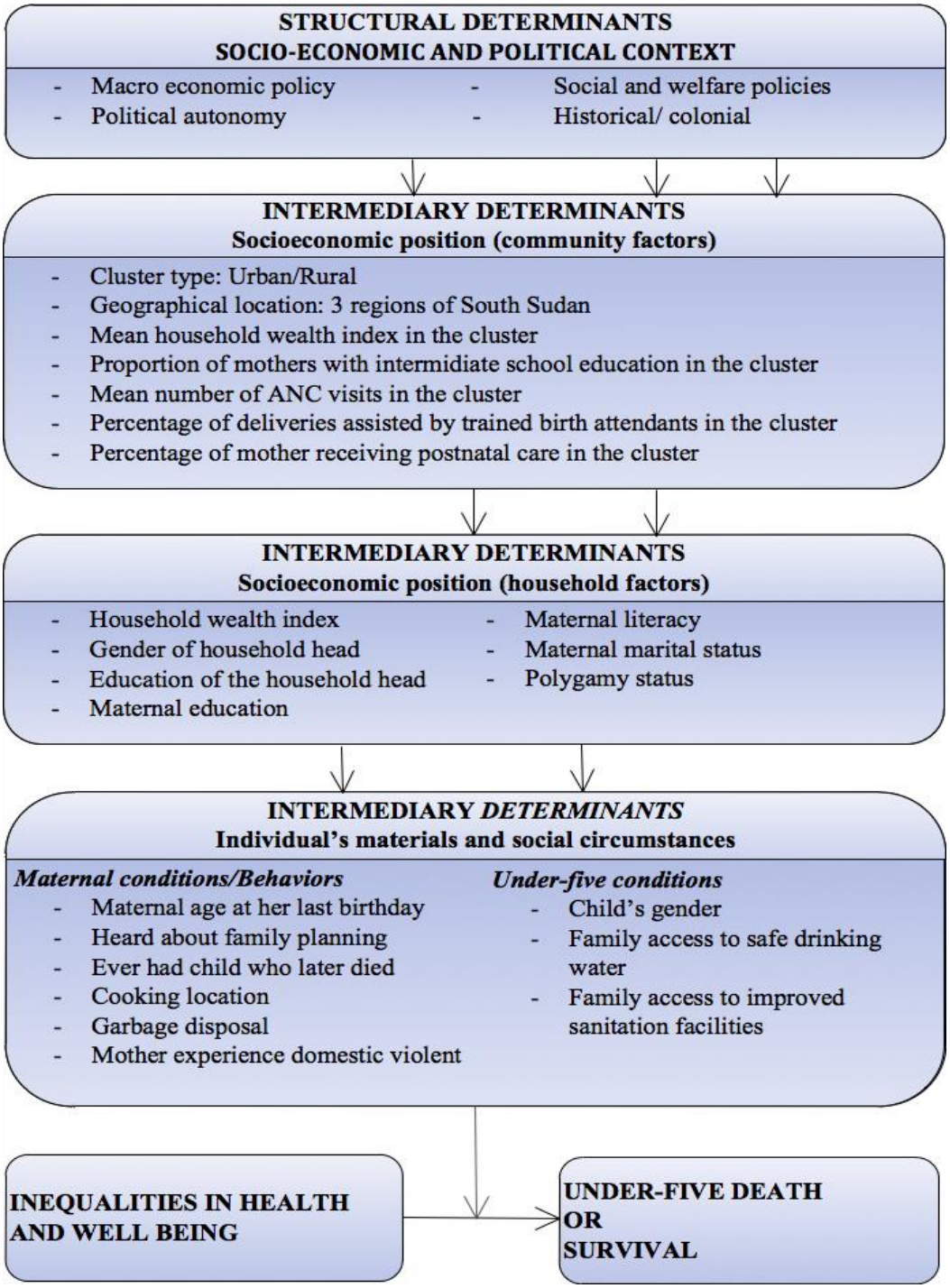


Figure 2-8: **Conceptual framework for factors associated with under-five mortality, adapted from the WHO social determinants of health inequalities** *(source:* Solar O & Irwin A*, 2015)*[80]

Previous studies on determinates of under-five mortality

Evidence indicates that low living standards and social and economic policies have a significant role in health equity and thus mortality.[80,81] Several studies from low-and middle-income countries have reported an association of place of residence, such as dwelling in rural or urban areas, and regions of residence, with higher rates of under-five mortality.[82-88] Access to maternal and child health services such as antenatal care services,[41,83,89] delivery with birth attendant,[41,83] and place of delivery[83,89-91] have been widely reported to be significantly associated with under-five mortality.

Among the household factors socio-economic factors particularly household wealth has been shown to influence child survival.[84,89,92-94] Previous studies from high-and low-income countries have identified maternal education as one of the predictors of under-five health and survival.[88,95,96] Maternal age has also been reported to influence under-five health and wellbeing.[96] Other factors associated with high rate of under-five mortality include maternal literacy,[93] maternal marital status[96,97] and polygamy status.[97]

Maternal material circumstance and environmental factors, such as use of the polluted fuel for cooking,[98,99] have been identified to increase the risk of under-five mortality.[100] Various literature have found an increased risk of death among male children.[101-103] Other factors associated with increased the risk of under-five

mortality include children born to mothers who had had a previous child death, and birth rank.[104]

2.5 Multiple Indicator Cluster Survey (Household Health Surveys)

The Multiple Indicator Cluster Survey (MICS) is an international household survey program developed by UNICEF in the mid-90s to assist countries in filling data gaps for monitoring human development in general, and the situation of children and women in particular.[105] The MICS were originally developed to measure progress towards the globally agreed set of goals that emerged in response to World Summit for Children (WSC) held in 1990.[106] The first round of MICS was conducted around 1995 in more than 60 countries and since then it has been implemented every five years. The methodology of the MICS is standardized/harmonized across the countries using similar questionnaires, manuals and data collection procedures and reporting.[106]

The MICS survey questionnaires are modular tools that can be customized to the needs of a country and consist of three core questionnaires. The household questionnaire, which consists of a list of household members along with their basic socio-demographic characteristics. The women questionnaire is administered to eligible women aged 15-49, and collects information about their socio-demographic, health status and reproductive history. A child questionnaire on the situation of under-five children addressed to the mother or caregiver of the

child. Some surveys might also include an additional questionnaire for eligible married men age 15–49.[105]

The first MICS conducted in Sudan was the National Sudan household survey (SHHS1) carried out in 1995 and collected data for both Sudan and South Sudan.[107] Since then, there have been 3 MICs household surveys conducted in 2000, 2006 and 2010.[9,22,108] The 2010 South Sudan household survey second round was the most recent survey, which was a joint effort between the government of National Unity (GoNU) and the Government of South Sudan in collaboration with the United Nations Children's Fund (UNICEF), which provided financial and technical support.[9]

The SHHSII was a nationally representative survey designed to provide information on the situation of children and women in the country. The survey comprises of four questionnaires: household, women and men aged 15-49 and children under-5 years of age. The household questionnaire lists all household members and collects basic demographic information, such as household assets and conditions. The women's questionnaire collects information from women of reproductive age (15–49 years) and included information on reproductive history, use of family planning, child health and information about child mortality. The men's questionnaire collected information from all men age (15–49 years) and included information about socio-demographic background, reproductive history, family planning, knowledge about AIDS and other health related issues.[9]

The sample of the South Sudan HHSII was designed to provide estimates at the national, sub-national (states) and disaggregation by urban and rural levels.[9] The list produced by 2008 Sudan Population and Housing Census was used for selecting the SSHHS sample.[109] Figure 2-9 shows the sampling frame of the south Sudan household survey.

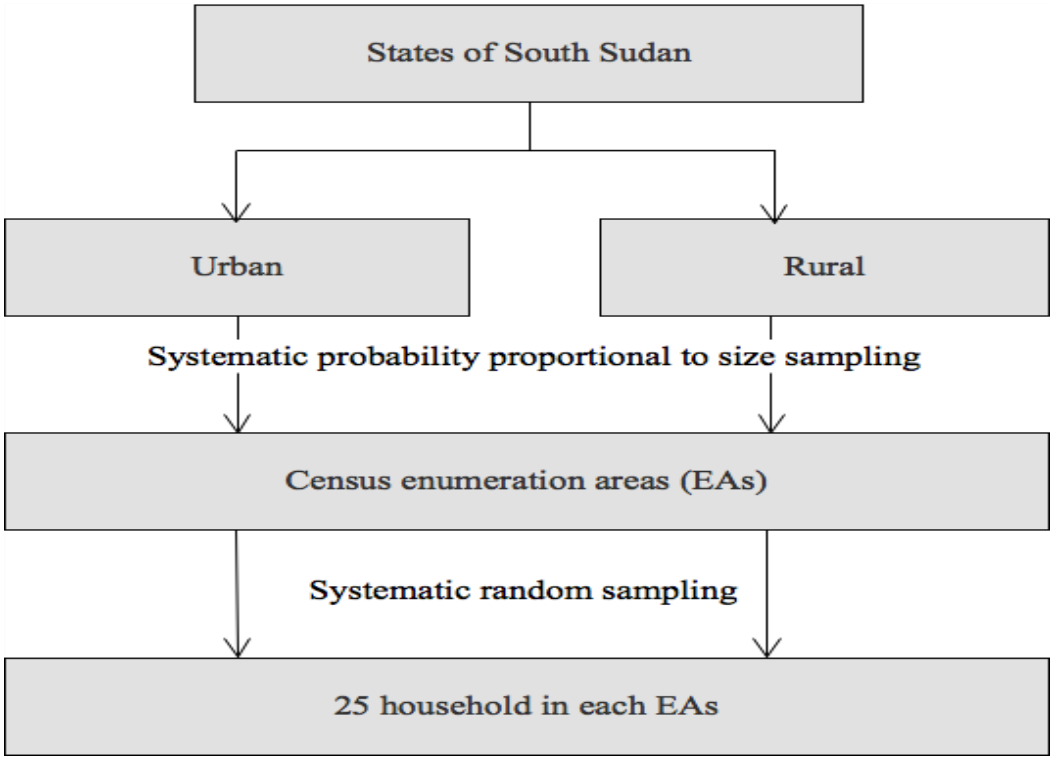


Figure 2-9: South Sudan household Surveys second round sampling frame *(Source: South Sudan household survey, 2013)*[9]

A two-stage cluster sampling design was employed for the selection of the sample in each of the 10 states. The first stage consisted of the selection of the required number of enumeration areas or clusters separately by urban and rural strata. Systematic probability proportional to size sampling procedure was used for selection of 40 enumerations sites in each of the 10 states of South Sudan. Of

the total number of 398 cluster, 66 were base in urban and 134 were base in rural area due to vast majority of clusters across the country were predominantly rural. The second stage was the selection of the total number of household in each cluster using random systematic selection procedures to select on average 25 households in each enumeration area. From the selected households, all ever-married women and men aged 15-49 years were individually interviewed. Table 2–1 show the sample size used in the body of research.

Table 2-2: **Number of households and respondents in the South Sudan household Surveys 2010**

Result	Number (response rate)
Number of household's sample	9950
Number of households occupied	9760
Number of households interviewed	9369 (96)
Number of eligible women	11568
Number of eligible women interviewed	9069 (78)
Number of eligible children under-five	10040
Number of eligible under-five mother/caretakers interviewed	8338 (83)

(Source: South Sudan household survey, 2013)[9]

Potential limitation for South Sudan household survey 2010

The sample population for SSHHSII is assumed to be statistically representative of the total population of South Sudan. However, in some areas may have been inaccessible due to insecurity or remoteness. The major challenge was logistics and access. In 2010, exceptionally high rainfall from May to October led to recurrent flooding in all ten Southern states.[110] The rainy season might have significantly affected access to certain parts of the selected counties, villages or clusters due to the poor road network and many areas might have been inaccessible.

The ongoing insecurity and violence such as armed inter-ethnic clashes during 2009 continued in 2010 may have led to high levels of displacement within South Sudan as well as restricted access to conflict-affected populations.[111] In addition, South Sudan has a low population density spread across an area with one of the world's worst road networks, which, makes sampling especially difficult to conduct. Since South Sudan has a diverse population with over 65 ethnic groups, the sample might not have included all the ethnic and sub-ethnic groups. [110]

The political and economic underpinnings of the conflict in South Sudan

The current crisis reflects underlying tensions and mistrust among South Sudanese leaders and ethnic groups that date back to Sudan's civil war (1983-2005), and to the time after the imperial conquests in the nineteenth century.[112] While the war was described broadly as a north-south conflict. Infighting which

result in the split among leaders of the insurgency, the Sudan People's Liberation Movement/Army (SPLM/SPLA) in the 1990s, damaged their cause by competing for power and mobilizing supporters along ethnic lines.[113] The major factions reconciled in the early 2000s, although several smaller southern militias continued to operate, primarily in the Greater Upper Nile area.[113] In 2005, the Sudanese government and the SPLM signed the Comprehensive Peace Agreement (CPA) to end the war. That deal paved the way for 2010 elections and the southern referendum, after which South Sudan, led by the SPLM, seceded in July 2011. [114]

Just two years after independence from Sudan in 2011, the newest nation of South Sudan was devastated by the internal arm conflict. The armed violence that erupted since 2013 has killed over 50,000 people and displaced about 2.4 million people.[115] It is estimated that since December 2013, nearly 3 million people in South Sudan have been displaced, and among this figure 1.1 million people have sought refuge in neighbouring countries with children comprising 70% of the refugees.[116] Also about 31% of the population are food insecure and over 275,000 children are likely to be affected by severe acute malnutrition. [117] [118]Women and children are at immediate risks of violence, sexual abuse, exploitation, and life-threatening diseases. Several factors have contributed to armed violence in South Sudan as outlined below.

Firstly, the immediate cause of the conflict was a result of an internal power struggle between South Sudanese key political leaders President Salva Kiir and opposition leader Dr. Riek Machar[119] which caused the tensions between different factions of the army, some of which have a stronger sense of loyalty to various tribal leaders and militia groups.[113] Since then the military divided, largely along ethnic lines and the fighting spread to the eastern state of Jonglei and the oil-producing states of Unity and Upper Nile.[114] As a result civilians have been routinely targeted in the conflict, often along ethnic lines.[113]

Secondly competition for access to and the distribution of South Sudanese resources has also contributed to the current crisis, in which civilians from different ethnicities are systematically targeted in asset-stripping raids with intense inter-personal violence.[119] Therefore, government has used violence as a mean to access such resources and this has contributed to forced displacement, looting, cattle theft, crop destruction, and murder, rape and torture of civilians. Furthermore, the violence was used as a way asset stripping by raids, which is evident in most of the states of South Sudan particular in Jonglei, Unity and Upper Nile states. [120]

Thirdly, the 2005 Interim Constitution installed three levels of government in South Sudan: national, state, and local government, with some degree of executive, legislative, and judicial authority at all three levels[121]. Such a system

was thought to be the most appropriate to serve the diverse people of South Sudan, and to address the chronic lack of development in the southern states. However, under the 2011 Transitional Constitution several factors contributed to the current conflict including a lack of decentralization of power and concentration of power in the national government and the ruling party[119]; limited political opportunities for those outside the core SPLM/A; and the misuse of the budget and state resources for factional and personal gain by the national government and the ruling party.[121]

Other underlying factors include, the absence of a professional civil service and concurrent existence of a pervasive military culture, both in government and society more broadly[112]; the fragility of the new country's institutions, which were too weak to constrain individual South Sudanese leaders; and management of oil resources.[120]

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Section II: Factors associated with non-use of maternal healthcare services in South Sudan

In this section the factors that are potentially associated with nonuse of maternal healthcare services such as non-use of antenatal care services and use of un-skilled healthcare providers during delivery are explored in four chapters. The list of the variables with their definitions presented in manuscript 1-4 can be found in the Appendix B.

In this section the first manuscript (publication 1) explores the barriers and challenges of promoting MNCH gains and identifies priorities that will contribute to addressing the Millennium Development Goals and the emerging health priorities for the post-2015 development agenda.

The second manuscript (publication 2) investigates the prevalent of non-use of antenatal care services among pregnant women in South Sudan. The key findings indicate low use of recommended number of antenatal care visits across 10 states of South Sudan.

The third manuscript (publication 3) explores the potential factors associated with nonuse of skilled providers at every delivery. The main finding show that socio-economic status of the household was associated with low use of skilled health care providers during delivery across the 10 states of South Sudan.

In the fourth manuscript (publication 4) investigate the factors associated with mother choice to deliver at home unattended or attended by un-SBAs. The main finding shows that non-use of antenatal care services during pregnancy couple

with low quality of care during antenatal care visits were associated with unassisted home birth or home birth assisted by unskilled healthcare providers.

Chapter 3: Maternal and Child Health in South Sudan: Priorities for the Post-2015 Agenda

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Maternal and Child Health in South Sudan: Priorities for the Post-2015 Agenda

Ngatho Mugo[1,2], Anthony B. Zwi[1], Jessica R. Botfield[1], and Caitlyn Steiner[1]

Abstract

The Republic of South Sudan continues to face considerable challenges in meeting maternal, newborn and child health (MNCH) care needs and improving health outcomes. Ongoing instability and population displacement undermine scope for development, and damaged infrastructure, low coverage of health services, and limited government capacity and a human resource base have resulted in a fragmented health system. Despite considerable attention, effort and support, the issues and challenges facing South Sudan remain deep and sustained, and urban–rural disparities are considerable. There is a need to maintain investments in MNCH care and to support developing systems, institutions, and programs. This review of the literature offers a commentary and appraisal of the current MNCH situation in South Sudan. It explores the barriers and challenges of promoting MNCH gains, and identifies priorities that will contribute to addressing the Millennium Development Goals and the emerging health priorities for the post-2015 development agenda.

Keywords

South Sudan, "post" conflict, maternal, newborn and child health, official development assistance, post-2015, Millennium Development Goals

Introduction

Maternal, newborn and child health (MNCH) has received substantial international attention and is high on global health and development agendas. Investing in MNCH is recognised as contributing to poverty reduction, economic growth and productivity, and more stable societies (Singh, Darroch, Ashford, & Vlassof, 2009). Poor MNCH remains a significant problem in many low- and middle-income countries (LMICs) and poses a significant gap to achieving the Millennium Development Goals (MDGs). This review and commentary on the literature focuses on South Sudan, a country that continues to face considerable challenges in meeting MNCH care needs and improving health outcomes. Drawing on both gray and published literature, it provides an overview of the MNCH situation in late-2014, and seeks to bring together available information on the MNCH-related challenges facing South Sudan's people and systems.

Framing Maternal and Child Health Within the Millennium Development Goals

Of the eight MDGs, set in 2000 with a 2015 end-point, three are specifically focused on health: MDG 4—Reduce Child Mortality, MDG 5—Improve Maternal Health, and MDG 6—Combat HIV/AIDS, Malaria, and other Diseases. Explicit attention to MNCH prompted many global initiatives, including the Partnership for Maternal, Newborn, and Child Health (PMNCH) hosted by the World Health Organization (WHO) and UNICEF and established in 2005 (PMNCH, 2013), and the Countdown to 2015 for Maternal, Newborn, Child Survival. Recognizing the need for a global strategy, United Nations (UN) Secretary General Ban Ki-moon launched "Every Woman, Every Child" in 2010, which set out the key areas requiring action to mobilise financing, strengthen policy, and improve service delivery (PMNCH, 2010).

The MDG 2015 target date has sparked global debate surrounding what should follow. The UN-led global consultation on health from October 2012 to February 2013 led to a report on Health in the post-2015 period. Among a range of proposals that included a focus on universal health coverage,

[1]The University of New South Wales, Australia
[2]The University of Sydney, NSW, Australia

Corresponding Author:
Anthony B. Zwi, The University of New South Wales, Room G25, Morven Brown building, UNSW, Kensington, NSW 2052, Australia.
Email: a.zwi@unsw.edu.au

the determinants of health and the unfinished MDG agenda, was also recognition of the significant challenges posed by conflict to improving health in many countries (The World We Want, 2013).

Discussions around health on the post-2015 agenda identified "the unfinished MDG health agenda; a changing agenda for global health; and health in the context of sustainable development" (UNAIDS, UNICEF, United Nations Population Fund [UNFPA], & WHO, 2012). Schweitzer, Makinen, Wilson, and Heymann (2012) recommend "the current MDGs are likely to have to be included in some form in the post-2015 goals" (p. 9). Critique surrounding the globally set quantifiable metrics and targets associated with the MDGs are balanced with recognition that the ability to have some form of targeting and universally agreed goals is of value.

MDGs 4 and 5 are closely related, and have seen considerable gains in the health status of women and children, with under-five and maternal mortality rates falling by nearly 50% in recent years (Horton, 2012; UN, 2012). Despite this, neither goal will be met for most countries, and where progress has been made, this is often unequally distributed (UN, 2012), with disparities evident in health status and the coverage of health interventions between and within countries (Bhutta et al., 2010).

Accelerating progress requires adopting an integrated package of essential interventions, structured around a continuum of care approach, with services delivered by functioning health systems (PMNCH, 2011). Evidence-based interventions are well-known (PMNCH, 2011) and feasible in resource-poor settings (Lule et al., 2005; You, New, & Wardlaw, 2012). Despite knowledge of effective and appropriate interventions, ensuring universal access to essential health services remains challenging in LMICs.

Maternal and Child Health Millennium Development Goals in Sub-Saharan Africa (SSA)

The SSA region has the highest rates of neonatal, under-five, and maternal mortality. Neonatal mortality sits at 35 deaths per 1,000 live births and has seen the least improvement over the last 20 years. Although the average rate of reduction of under-five deaths doubled from 1.2% per year (1990-2000) to 2.4% per year (2000-2010), the overall mortality rate is still high at 121 deaths per 1,000 live births. The rate of decline is insufficient to meet the target of a two-thirds reduction set through the MDGs. Similarly, although maternal mortality has nearly halved globally since 1990, the global target of reducing the maternal mortality ratio (MMR) by three quarters is unlikely to be achieved by 2015, particularly in SSA, the region with the highest MMR (500 deaths per 100,000 live births) and where 56% of all maternal deaths occur (UN, 2012).

"Post"-Conflict Maternal and Child Health Challenges

Health in fragile and conflict-affected states is handicapped by the legacy of violence on society, systems, and economic development. Such states are often characterised by "economic volatility, political instability, infrastructural collapse and human resource scarcity," all of which contribute to the deterioration of population health and challenges in stabilising systems (Haar & Rubenstein, 2012, p. 289). Haar and Rubenstein (2012) cite evidence of worsened health status and challenges in establishing stable health systems in fragile and conflict-affected states as compared with their geographic neighbors and economic equivalents. Bornemisza and Zwi (2008) highlight the dearth of health systems research in fragile and conflict-affected states, despite the longstanding recognition of the impact of conflict on health systems (Zwi & Ugalde, 1989a, 1989b). By 2012, no fragile or conflict-affected state had achieved a single MDG (Wyeth, 2012).

MNCH often deteriorates during a period of conflict. In addition to poor health outcomes resulting from violent conflict and its effects on the health system, "girls and women are particularly at risk as they are less likely to be able to protect themselves from violence" (Southall, 2011). Infants and children experience heightened risk of communicable diseases, physical and mental trauma, and developmental disorders as compared with their non-conflict-affected counterparts (Bustreo, Genovese, Omobono, Axelsson, & Bannon, 2005). Women and girls are at a greatly increased risk of sexual and other forms of gender-based violence and the associated risks to physical and psychosocial health and well-being (Southall, 2011).

Objectives of the Article

This article focuses on South Sudan and brings together available information on MNCH in late 2014, highlighting the ongoing challenges facing its systems and people. We undertook a narrative review, drawing on a range of databases such as Medline, Embase, and Google Scholar, to identify relevant peer-reviewed and gray literature. We drew on these data and insights to reflect on what is known about the MNCH situation in South Sudan, and its relationship to conflict and health system development. Although admittedly not fully comprehensive, we draw on available evidence to synthesise the issues being faced and contribute to debates around South Sudan development prospects, including the 2015 MDG deadline.

South Sudan Background and Health System

South Sudan general background. The Republic of South Sudan is the world's newest nation, gaining independence in

2011 (Karimi, 2011). Its capital and largest city is Juba, located in the southern state of Central Equatoria (Wakabi, 2006). The population of South Sudan in 2008 was 8.26 million (South Sudan National Bureau of Statistics, 2012). It is a land-locked country, bordered by Ethiopia, Kenya, Uganda, the Democratic Republic of the Congo, the Central African Republic, and Sudan (South Sudan National Bureau of Statistics, 2012).

Although both Sudan and South Sudan are rich in natural resources, South Sudan in particular has an abundance of natural resources and contains the majority of oil reserves. Although this has the potential to contribute to economic growth and poverty reduction, giving South Sudan a major advantage over many "post"-conflict[1] governments (National Population Council, 2010), it is also a source of ongoing conflict and instability—the so-called "resource curse" (Mbaku & Smith, 2012), as witnessed again in 2013 and 2014.

After 21 years of civil war in Sudan, the signing of a Comprehensive Peace Agreement (CPA) between the Government of Sudan and the Sudan People's Liberation Movement/Army (SPLM/SPLA) in January 2005 brought an end to Africa's longest running conflict between the North and South (UNFPA, 2006). Six years later, the Republic of South Sudan declared independence on 9 July 2011 (Embassy of the Republic of South Sudan in Washington, 2011; Karimi, 2011). A timeline of major political developments in South Sudan from 1956 to date highlights ongoing instability (Table 1).

Background to South Sudan health system. Damaged infrastructure, limited human resources, weak stewardship, and a proliferation of non-government organisations (NGOs) characterise health systems in many countries emerging from conflict, and lead to disrupted and fragmented delivery of health services (Roberts, Guy, Sondorp, & Lee-Jones, 2008). In South Sudan, two decades of civil war resulted in a largely dysfunctional health system and contributed to the deteriorating health status of the population during and after the conflict (Neuse, Davis, Masbayi, Harvey, & Rajkotia, 2008), leaving a third of the population without access to adequate health services (Rajkotia, Boulenger, & Pressman, 2007). The health status of the population is marked by high health needs, limited health service provision, and significant urban–rural and regional disparities (Roberts, Damundu, Lomoro, & Sondorp, 2010).

The Ministry of Health (MoH) operates in line with the decentralisation policy of the interim constitution of South Sudan (2005) and the Local Government Act (2009). According to the "Health Sector Development Plan 2011-2015," the decentralised organisational structure should be based on four levels of administrative structure: central, state, county, and community (MoH & Government of South Sudan [GoSS], 2011), as shown in Figure 1 and outlined

Table 1. South Sudan—Timeline and Chronology of Major Political Developments.

Date	Event
1956	Sudan gains independence from joint British Egyptian rule.
1962	Civil war, led by Southern Sudan group, the Anya Nya movement, begins with North.
1969	Sudanese military officers led by Col Jaafar Muhammad Numeiri seize power; policy of autonomy for South outlined.
1972	Government of Sudan, President Jaafar Numeiri concedes measure of autonomy for Southern Sudan—peace agreement signed in Addis Ababa.
1978	Oil discovered in Unity State, Southern Sudan.
1983	Sudanese President Jaafar Numeiri abolishes South Sudan's autonomy.
	Fighting breaks out again between North and South Sudan, involving government forces and the Sudan People's Liberation Movement (SPLM), led by John Garang.
1988	Democratic Unionist Party draft ceasefire agreement with SPLM; not implemented.
1989	Military seizes power in Sudan
2002	Government and SPLA sign agreement providing for 6-month renewable ceasefire in central Nuba Mountains (a key rebel stronghold); Machakos Protocol provides for the South to seek self-determination after 6 years.
2005	January—North/South Comprehensive Peace Agreement (CPA) ends civil war—"permanent ceasefire," autonomy for the South, power-sharing government involving rebels in Khartoum, and a South Sudanese referendum on independence proposed.
	October—Autonomous government formed in South Sudan, in line with peace deal.
2008	Intense fighting between Northern and Southern forces in disputed oil-rich town of Abyei.
2009	Leaders of North and South reach deal on terms of referendum on independence due in South by 2011.
2011	The people of South Sudan vote in favor of full independence from Sudan.
2012-13	Simmering tensions over oil field control with flare-ups between Sudan and South Sudan
2013	March—Sudan and South Sudan agree to resume pumping oil.
	December—Civil war erupts as President Salva Kiir accuses ex-vice-president of plotting to overthrow him; rebel factions seize control of several regional towns.
2014	January—Ceasefire signed but broken several times over subsequent weeks.
	August—Peace talks begin in Addis Ababa, but drag on for months as fighting continues.

Source. (BBC *News, 2015*).

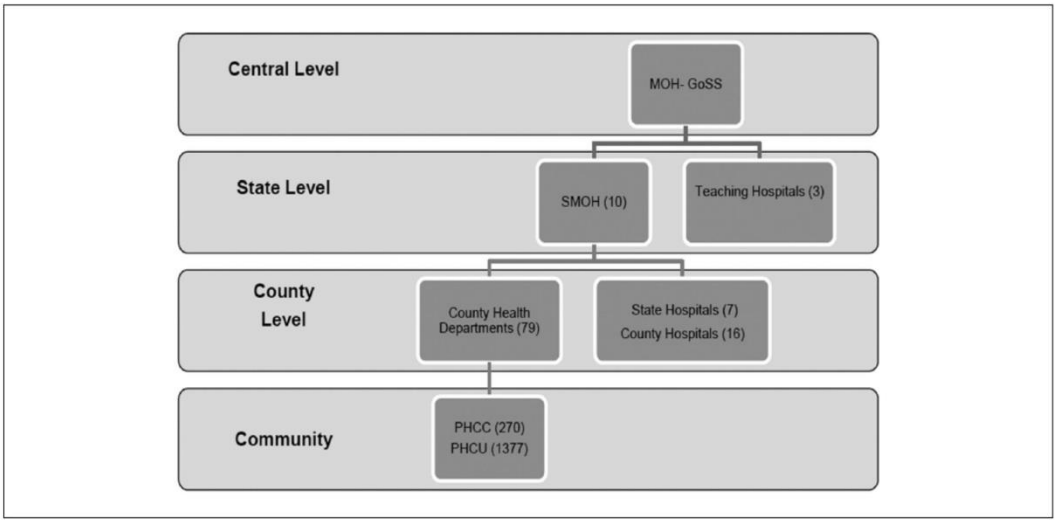

Figure 1. Ministry of Health organisational structure.
Source. Ministry of Health and Government of South Sudan (2011).

below. However, the reality on the ground shows many functions underdeveloped, particularly at the lower levels.

It is envisaged that the Central MoH will provide policy guidance, leadership, and funds for services, and is responsible for monitoring and evaluation. The State MoH, located in each state capital, is responsible for annual management work plans, joint assessments, planning, monitoring and evaluation, the referral system, and implementation of government health care and services. The County MoH should oversee monthly management work plans, joint strategic planning based on local needs, assessment and analysis of local health and managerial needs, supervision, guidance and monitoring, the referral system, and implementation of health care and services. The Community MoH (Primary Health Care Units and Centers) should ensure implementation of the Basic Package of Health Services (BPHS), weekly work plans, outreach activities, the referral system, and community participation (Rajkotia et al., 2007).

The BPHS outlines a package of health care services that should be affordable and accessible to the majority of the population, at the primary and secondary health care levels. It covers curative, promotive, preventive, and managerial activities (MoH & GoSS, 2011). Combined contributions from the GoSS and the Multi-Donor Trust Fund (MDTF) initially allowed for the provision of the BPHS (Health Systems for Outcomes, 2009); however, according to the Health Sector Development Plan 2011-2015, NGOs are often the primary providers (MoH & GoSS, 2011).

The functioning of health care services within South Sudan is described by the MoH (MoH & GoSS, 2011) as structured around four key levels: community, primary, secondary, and specialised care, linked by a referral system. Community health care should be provided by community health workers, maternal and child health workers, and home health promoters. Primary health care units are meant to be the first point of contact between communities and the health system and should provide basic preventive, promotive, and curative care for around 15,000 people. These units aim to provide higher-level services for around 50,000 people and, in addition to services offered by primary health care units, provide basic diagnostic laboratory services and maternity care. County hospitals and state hospitals should provide secondary-level care, including comprehensive obstetric care, in-patient care, and surgery, for around 300,000 and 500,000 people, respectively. Numerous gaps and challenges are encountered at each of these levels, however, particularly in equipping and strengthening them to reach even minimum standards (MoH & GoSS, 2011).

Health indicators. More than 50% of the South Sudanese population lives below the poverty line, with particularly high levels of poverty in rural areas (South Sudan National Bureau of Statistics, 2012). This is comparable with the SSA average of 47% of people living on less than $1.25 a day (UN, 2012). The adult literacy rate in South Sudan is also low at just 27% (53% urban areas and 22% rural areas) with the rate among females half that of males (South Sudan National Bureau of Statistics, 2012). Minimal progress has been made toward meeting the MDG targets (Mustafa & Alsiddiq, 2007; WHO, 2009). The GoSS is working toward achieving these goals, but has argued it will require time beyond 2015 (GoSS, 2011). Maternal, newborn, and child mortality indicators used for monitoring progress toward the achievement of MDGs 4 and 5 remain high (Table 2).

Table 2. South Sudan—Key Indicators/Trends in Maternal, Newborn, and Child Health (2000-2010).

	2000[a,b]	2006	2010
Maternal mortality ratio (per 100,000 live births)	763[a]	2,054	Not included
Infant mortality rate (per 1,000 live births)	82[a]	102	75
Under-five mortality rate (per 1,000 live births)	132[a]	135	105
Children below 5 moderately or severely underweight	Not included	32.8%	27.6%
Children below 5 severely underweight	Not included	14.1%	12.2%
Contraception usage by women married or in union	Not included	3.5%	4%
Use of improved drinking water sources	5.4%-91.3%[a]	48.3%	68.7%
Use of sanitary means of excreta disposal	48%[a]	6.4%	7.4%
GPI (primary school)	Not included	0.85 GPI	0.79 GPI
	(Federal Ministry of Health, Central Bureau of Statistics, & UNICEF, 2000)	*(Government of Southern Sudan Ministry of Health & Southern Sudan Commission for Census, 2007)*	*(Ministry of Health & National Bureau of Statistics, 2013)*

Note. GPI = gender parity index.
[a]Only three "safe" urban areas were included in surveys in Southern Sudan.
[b]A Demographic and Health Survey (DHS) was conducted in Sudan in 1989/1990; however, it was limited to Northern Sudan due to civil unrest in the south (Department of Statistics & the Institute for Resource Development/Macro International, 1991).

Mortality rates and other indicators are also presented below. Data vary considerably by place of residence, mother's education, gender, and wealth index, although data classified according to these determinants are not always available.

In South Sudan, nearly 7% of women aged 15 to 49 marry before their 15th birthday, a substantial reduction from 16.7% in 2006. However, 45% still married before the age of 18 in 2010, which is an increase from the 2006 average of 41% (MoH & National Bureau of Statistics, 2013). Young women experience exacerbated problems during pregnancy and delivery due to incomplete body growth (Bearinger, Sieving, Ferguson, & Sharma, 2007), and are particularly at risk of obstetric fistulae and obstructed labor.

In 2010, the average rate of contraception use for women married or in union in South Sudan was 4%, only 0.5% higher than in 2006 (MoH & National Bureau of Statistics, 2013). This can be compared with 8% in Sudan as a whole (including Southern Sudan at that time; GoSS MoH & Southern Sudan Commission for Census, 2007) and 25% in SSA (UN, 2012). Access to family planning is strongly linked to gender equity, empowerment of women, education, and employment, and is a vital component to saving lives and preserving health through preventing untimely and unwanted pregnancies (Cleland et al., 2006; Grown, Gupta, & Pande, 2005; Prata, Sreenivas, Greig, Walsh, & Potts, 2010; United Nations Children's Fund, 2012). Polygamy and polygyny are common in South Sudan, with 41% of all unions in 2010 being polygynous. Fewer than 10% of those in polygamous unions use safe sex practices (MoH & National Bureau of Statistics, 2013).

In Sudan (including Southern Sudan) in 2006, 36.4% of women received antenatal care (ANC) from a medical doctor, 12.7% from a nurse or midwife, and 14.5% from a traditional birth attendant. This contrasted with Southern Sudan at the same time, where only 9.8% of women received ANC from a medical doctor, 16.4% from a nurse or midwife, and 28.6% from a traditional birth attendant (GoSS MoH & Southern Sudan Commission for Census, 2007). Thus, only 26.2% of women in Southern Sudan received ANC by skilled health personnel in 2006; this increased to 40.3% in 2010; however, only 17% of women had the recommended 4 or more ANC visits (MoH & National Bureau of Statistics, 2013). Pregnancy outcomes in LMICs can be greatly improved through ANC (WHO, 2005).

The majority of maternal deaths occur during labor, delivery, and the immediate post-partum period, and as most are preventable, it is essential that a skilled health professional be available during childbirth. In Sudan as a whole, 49% of births were delivered by skilled personnel in 2006: doctors (6%), nurses or midwives (17%), and auxiliary midwives (26%). These figures are substantially lower in the states of Southern Sudan, with only 4% of deliveries being delivered by a doctor and 7% by nurses and midwives. In both Northern and Southern states, in 2006, traditional birth attendants assisted with 20% of births (GoSS MoH & Southern Sudan Commission for Census, 2007), which increased to 34% in South Sudan in 2010 (MoH & National Bureau of Statistics, 2013). In 2006, friends and family assisted in 16% of births in the North and 36% in the South (GoSS MoH & Southern Sudan Commission for Census, 2007).

The postnatal period is critical for mothers and newborns as they are at the highest risk of death during delivery and in the first hours and days following childbirth. Newborn survival is inextricably linked to the health and survival of the mother; thus, the early postnatal period is an important period for delivering integrated interventions to both. Postnatal care services from a skilled health care provider following delivery optimise mother and newborn health, promote healthy behaviors and healthy household practices, and strengthen linkages between maternal health and child health programs (Sines, Syed, Wall, & Worley, 2007). Data on the postnatal period in South Sudan appear to be scarce.

A child born in South Sudan has a 25% chance of dying before age five(WHO, 2009); high mortality in under-fives is associated with pneumonia, malaria, and diarrheal diseases. Malnutrition is common: 27.6% of children below five are moderately or severely underweight and 12.2% severely underweight (MoH & National Bureau of Statistics, 2013). South Sudan has one of the lowest levels of immunisation in the world (UNICEF, 2011), with some sources suggesting this has deteriorated over the past five years, whereas others suggest this results from variations in data collection and sampling. In 2010, only 4.3% of children aged 12 to 23 months had vaccination cards available, compared with around 13% in Southern Sudan in 2006. Measles vaccination coverage differed little between 2006 and 2010 (27.7% vs. 26.3%, respectively), as did the proportion of children who received all recommended vaccinations (2.7% in 2006 vs. 2.6% in 2010; MoH & National Bureau of Statistics, 2013).

Health System Influences and Challenges in South Sudan

The line between acute humanitarian intervention and longer-term health development in South Sudan is blurred (Cometto, Fritsche, & Sondorp, 2010; Downie, 2012), as in many "post"-conflict and fragile states (see, for example, Macrae, Zwi, & Gilson, 1996). Recurring bouts of violence and political instability make transitioning from humanitarian service provision into national development challenging for government officials, development partners, and citizens. Decades of humanitarian assistance "fragmented horizontally a variety of actors (at least 76 NGOs and six UN agencies) and vertically across multiple disease-specific control programmes" coupled with costly, short-term and inefficient operations, severely impeded the development of institutions, systems, policies, and personnel to contribute to longer-term development in Southern Sudan (Cometto et al., 2010). Post-independence optimism was shattered by the government's decision to halt oil production in January 2012, hindering both planned health system development and damaging relationships with external donors (Green, 2012).

A broad set of issues have an impact on effective development and are briefly described below.

Governance. Throughout the period of conflict and immediately following the referendum, governance in Southern Sudan was absent or constrained by the low capacity of government and lack of personnel. Initiatives aimed at improving governance following the referendum had mixed results (Bennett et al., 2010), although the launch of the Health Sector Development Plan in early 2012 provided an opportunity to facilitate improvement. Governance and implementation arrangements are coordinated by development partners, usually in collaboration with South Sudan's MoH. Despite the MoH demanding greater ownership, some concern around the level of "fiduciary and governance risks" remains (Australian Agency for International Development [AusAID], 2012). The lack of personnel skilled in policy, planning, and oversight presents a serious challenge for governance (Downie, 2012).

Security. Localised conflicts remain in South Sudan, due in part to disputes over border areas and oil-revenue sharing (the British Broadcasting Corporation [BBC] News, 2014; GoSS, 2011; Maxwell, Gelsdorf, & Santschi, 2012; United Nations High Commissioner for Refugees [UNHCR], 2013; UNICEF, 2011). Widespread conflict broke out in South Sudan in December 2013, leading to thousands of deaths and the displacement of more than half a million people before a ceasefire was signed between the government and rebels on January 23, 2014 (Whiting & Migiro, 2014). By late 2014, tensions remained high, and over 1.9 million people were reported to be displaced since December 2013, of whom 1.4 million were displaced internally (Office for the Coordination of Humanitarian Affairs, 2014).

South Sudan also continues to experience other ongoing conflicts and security challenges, including intertribal conflicts, widespread landmines and unexploded ordnance, influx of returnees, and natural disasters. Years of conflict contributed to the disintegration of social fabric, leading to decreased protection and conditions exposing people to high levels of violence and exploitation (UNICEF, 2011).

Landmines and unexploded ordnance (UXO) pose a continued threat to communities in South Sudan, despite growing awareness and control efforts (GoSS, 2011). The National Mine Action Authority, which oversees relevant activities in South Sudan, and other associated organizations have increased the awareness of nearly two million people concerning mine risks and have removed more than 50,000 landmines and UXOs (UN Mission in South Sudan, 2013).

South Sudan also faces a degree of internal insecurity resulting from the return of refugees from camps in other countries of Africa, refugees fleeing to South Sudan from conflicts elsewhere in Africa, and growing numbers of internally displaced people (IDP) due to ongoing instability. The number of IDPs remained high in 2013 (UNHCR, 2013).

In addition to experiencing prolonged conflict, South Sudan is also prone to natural disasters; a National Baseline

Household Survey conducted in 2009 found that 56% of the population suffered from drought or floods (GoSS, 2011).

Funding/international aid environment. In the presence of recurrent violence and instability in South Sudan, several key funding programs were ended simultaneously and replaced by less generous programs (Downie, 2012). The MDTF, which had covered several key health initiatives in South Sudan, was operationally closed on December 31, 2012, and financially closed at the end of June 2013 (Independent Evaluation of the Multi-Donor Trust Fund for South Sudan [MDTF-SS], 2013). The MDTF marshalled the financial resources of several external donors, but concerns regarding ongoing funding remain. The MDTF contributed to establishing and strengthening state institutions and expanded public services and delivery. One identified problem was the transition from the Rapid Impact Emergency Project (RIEP) to more sustainable services and systems (Independent Evaluation of the MDTF-SS, 2013).

South Sudan was due to receive a US$130 million credit from the World Bank Group's Fund for the poorest countries, the International Development Association (IDA; World Bank, 2013), as well as funding and support from several other sources including United States Agency for International Development (USAID) and Department for International Development, UK (DFID; MoH, n.d.). It was hoped that some oil revenues would also be directed to MNCH, given its focus within the National Health Plan (Downie, 2012; Rai, Ramadhan, & Tulchinsky, 2012). Adequate levels of sustained funding are vital to improving health outcomes (Zwi, 2011).

To better coordinate health service delivery between the ranges of stakeholders in South Sudan, a "division of labour" has been implemented, based on geographical coverage among three key health development partners: USAID, DFID, and the World Bank. Stakeholders involved in the financing and provision of health services in South Sudan include health development partners, international NGOs, national NGOs, faith-based organisations, and the private sector (MoH, n.d.).

Coordination, fragmentation, and aid effectiveness. Before independence, health assistance to South Sudan was characterised as being "supply driven" (Downie, 2012, p. 11). Like many conflict-affected states, development partners and NGOs provided fragmented services suited to their own interests, covering selected regions. Fox and Manu (2012) suggest that coordination by the major development partners in South Sudan improved following a geographic division of responsibility for health assistance among development partners.

Promoting aid effectiveness is a significant issue given prior history of fragmentation and poor coordination. Global attention to development effectiveness has led to attention being focused on issues such as national ownership, mutual accountability, transparency, and coordination—all relevant to more effective aid. Debates concerning this broader aid and development context simultaneously offer guidance and place pressure on both the South Sudanese government and its development partners to promote better practice.

South Sudan is a founding member of the g7+, an intergovernmental organization of "fragile" and "post"-conflict states. It draws on the New Deal for engagement in fragile states, a declaration concerning how best to progress development in the least developed states with the support of the international community (Dyori, n.d.). The New Deal (g7+, 2011) offers guidance on engagement between fragile states and their development partners, and specifically sets out objectives concerning the achievement of five peace- and state-building goals as the foundation for progressing the MDG targets. These include promoting "legitimate politics," security, justice, economic foundations, and revenues and services. South Sudan is piloting the New Deal and completed its first fragility assessment in late 2012, the first element of the "pathway out of fragility" (Ministry of Finance and Economic Planning, 2012).

Maternal and Child Health Service-Related Challenges

Access. Delays in seeking medical care are a significant factor contributing to maternal deaths (Geller, Cox, Callaghan, & Berg, 2006; Mathai, 2008), and women with obstetric complications in LMIC, such as South Sudan, face numerous barriers to access (Barkat, Rahman, Bose, Com, & Akhter, 1997; Mbaruku, van Roosmalen, Kimondo, Bilango, & Bergström, 2009), as outlined below.

Geographical

Pregnant women in South Sudan often experience considerable time delays when trying to reach a health facility for treatment (Karoshi & Keith, 2009; Sivaganesh & Senarath, 2009). Geographic barriers impede women with obstetric complications from accessing emergency obstetric care (Borghi, Ensor, Somanathan, Lissner, & Mills, 2006). Access is generally worse in rural than urban areas, and 83% of the population in South Sudan is rural (South Sudan National Bureau of Statistics, 2012). Women in South Sudan may travel long distances by foot to reach health centers (Murphy, 2007), as many villages do not have road access and families do not have access to vehicles or public transportation. It may take literally days for women with life-threatening conditions to reach a health care facility; many women die from treatable complications.

Financial

The cost of receiving health care is another major constraint in South Sudan, due to the need for transportation, physician

and facility fees, and the cost of medications and other medical supplies (Borghi et al., 2006). Pregnant women may be seen by community members as a "burden" due to the high costs, often unaffordable by families, associated with childbirth. The government has committed to free services in the public sector (GoSS, 2011); however, under-the-counter payments have been reported, which will require ongoing monitoring (Rajkotia et al., 2007), and, as in other settings, time lost seeking money to pay for care may delay access to crucial services and lead to loss of life (Lewis, 2003; Prata et al., 2010).

Cultural and Social

At a global level, achieving the MDG targets relies heavily on women's empowerment and equal access to education, work, health care, and decision making, yet MDG 3, concerning the promotion of gender equality and empowerment of women, remains largely unfulfilled (UN, 2012). Women in rural areas often do not have the power to seek, receive, or communicate around health issues, including information that can help prevent maternal mortality such as safe abortion, family planning, and antenatal care (Lewis, 2003). Girls continue to be discriminated against with respect to education at all levels, yet education enables women to gain the knowledge, confidence, skills, and opportunities to increase their social and economic status in their household and in society (Gill, Pande, & Malhotra, 2007). Educated women have better health outcomes; for each additional year of education achieved by 1,000 women, two maternal deaths will be prevented (World Bank, 2002).

Gender inequalities and discrimination lie at the root of child marriage, common in South Sudan. The most recent Household Health Survey indicated that 7.3% of girls are married before 15 years of age, and 45.2% before 18 (MoH & National Bureau of Statistics, 2013). Early marriage has harmful consequences associated with risks of pregnancy, sexual violence, and sexually transmitted infections including HIV. Pregnancy and delivery are particularly dangerous for adolescents, who have a five times greater risk of dying in childbirth than women in their 20s (WHO &UNFPA, 2006).

The contraceptive prevalence rate among married women or those in other unions is particularly low in South Sudan, reflecting the high levels of illiteracy and lack of education about reproductive health and family planning (Rajkotia et al., 2007; WHO, 2009). Even with education opportunities, women, and especially adolescents, often lack access to consistently and appropriately stocked family planning services and distribution points (Aquilina et al., 2006). South Sudan has high fertility rates, estimated at 6.7 births per woman (MoH, 2011), which exacerbate the high risk of maternal death (MoH & National Bureau of Statistics, 2013; New Sudan Center for Statistics and Evaluation & UNICEF, 2004).

Gender inequality is also high in South Sudan, and gender-based violence widespread (Learning on Gender and Conflict in Africa, 2012; World Bank, 2013). The Independent Evaluation of the MDTF-SS (2013) found that gender inequality was not a Task Force priority during initial implementation phases, and it was not until 2009 that it received proper attention. Addressing gender inequalities has now been identified as a key priority in South Sudan (GoSS, 2011; MoH & GoSS, 2011).

There are many forms of traditional practice in South Sudan, and much health-seeking behavior relates to traditional medicine. Traditional healers are often sought due to personal beliefs, or because no other means of health care is available or accessible (MoH, 2009). According to the National Baseline Household Survey 2009, 47% of the household population in South Sudan that does not have access to a health care facility seeks help from traditional healers (South Sudan National Bureau of Statistics, 2012). South Sudan is home to more than 60 ethnic groups (Jok, 2011; Kimenyi, 2012), held together primarily by their shared struggle and collective opposition to the north (Jok, 2011). Health-seeking behavior in general, and for these varied groups, remains inadequately understood (MoH & GoSS, 2011; National Population Council, 2010), and a key objective of the 2011-2015 Health Sector Development Plan is to improve access to, and the delivery of, quality primary health services through, among other things, mobilising the community around appropriate health care seeking (MoH & GoSS, 2011).

Applying multi-faceted concepts of access to primary health care, as elaborated by Levesque, Harris, and Russell (2013), will be helpful in identifying enablers that should be supported and barriers that need to be addressed.

Health facilities and human resources for health. Human resources for health (HRH) play a pivotal role in the availability, accessibility, and equity of health services. The availability of skilled birth attendants able to detect, prevent, and manage obstetric complications as well as to provide drugs, equipment, and other supplies is the single most important factor in preventing maternal deaths (Rosenfield & Schwartz, 2005). South Sudan's health worker density is far lower than the minimum threshold recommended by the WHO (Gupta et al., 2011). In 2009-2010, there were a reported total of 189 physicians across 8 states (a doctor/population ratio of 1:65,574) and 309 midwives (a midwife/population ratio of 1:39,088; MoH, 2010). Figures vary however, with other sources suggesting 1 midwife for every 125,000 women (Kolok, 2013).

South Sudan has experienced a critical shortage of skilled human resources in all sectors, including health (MoH & GoSS, 2011). Development of institutional and human resource capacity is a stated government priority (MoH, 2010), and although innovative training of frontline health workers has commenced, considerable constraints remain (Fehling et al., 2013).

Even when women do have the means of reaching a health service, inadequate numbers of high quality services and facilities (and insufficient numbers of qualified personnel to staff the services) can increase delays and raise the risk of maternal mortality. Delays can occur when facilities do not have the capacity to perform basic services, which can put women with emergency complications at heightened risk of maternal mortality (Karoshi & Keith, 2009). Poor maternal health outcomes in South Sudan are strongly connected to poor prenatal, delivery, and postnatal care services in health facilities (Rai et al., 2012), and inadequate links between the community and the first level of the referral system significantly increase the risk of maternal death for women. Health facilities in South Sudan often also face chronic shortages of medicines and other necessary supplies. Medicines are supplied through the MoH, however transportation to facilities, and storage within these facilities, remains a significant challenge (Ministry of Health & Government of South Sudan, 2011).

Health service providers in "post"-conflict settings need to understand and be sensitive to the differing community perspectives around health and health care, and of the importance of building trust in health services (Zwi, Bunde-Birouste, Grove, Waller, & Ritchie, 2006). They must also be sensitive to historical inequalities, socio-cultural and economic developments, and eroded trust that might be present (Schweitzer et al., 2012).

Discussion

This review has reflected on the widespread MNCH needs and challenges in South Sudan. The civil war fractured social structures, displaced millions of people, destroyed much of the physical infrastructure, and led to the collapse of the public health system, resulting in high morbidity and mortality (GoSS, 2011). Despite efforts by the GoSS and the international community, South Sudan remains far from achieving the MDGs, a major challenge in all "fragile" and conflict-affected states. A broad and comprehensive approach to addressing population-based MNCH is required, along with ongoing support to developing institutions and systems.

Priority Areas

Three priority areas emerge from this narrative review: (a) addressing the macro-political and "post"-conflict security and development context, (b) focusing on the key determinants of health, and (c) building the health system, its capacity, and its capabilities, with the support of the international community. These priorities are interrelated and should be simultaneously considered in addressing MNCH needs, though are discussed separately below.

Macro-political and "post"-conflict security and development context. South Sudan and other "fragile" and "post"-conflict states have shown least progress toward meeting MDG targets and exhibit the most pressing health and development needs. The conflict-to-peace transition and the challenges of nation building are fundamental, requiring deep and sustained commitment by both government and development partners. These are mutually reinforcing—charting a vision for the country's development and establishing a sense of security and stability along with effective governance are central to securing international community support and engagement.

The debate around the MDG targets and the development goals being formulated for the post-2015 period highlight the search for solutions to some of the most complex development needs. This debate, however, also provides some opportunity and space, in part in association with the g7+ and other "fragile" and "post"-conflict states, to highlight the specificity of their needs alongside their commitment to addressing the development deficit present within their countries. Nascent local civil society, along with engaged global civil society, will play an important part in keeping this debate alive and accountability in focus (The World We Want, 2013).

Key determinants that influence health outcomes. This narrative review highlights the poor health status and MNCH outcomes in South Sudan, and draws attention to the need to address the determinants of health if improved outcomes are to be achieved. Despite the many obstacles and challenges in South Sudan, peace and security, and addressing basic needs of nutrition, shelter, employment, and water and sanitation, among others, require attention. Gender equality, and the education of girls and women, is vital and requires high levels of government commitment and leadership, as "low rates of primary school completion and high gender disparities pose enormous challenges to the development of South Sudan" (UNICEF, 2011). The South Sudan Household Health Surveys of 2006 and 2010 demonstrate that women with more years of schooling have both higher levels of knowledge about health and better health outcomes, as do their families.

The UN-led Consultation on Health in the Post-2015 Agenda emphasised that the most disadvantaged, marginalised, stigmatised, and hard-to-reach populations in all countries must be prioritised, and equity must be made explicit in the post-2015 goals (The World We Want, 2013). This echoes broader calls for the more central role of rights within this agenda and the focus on reducing disparities and inequalities. That report also recognised that the goal of achieving universal health access must improve governance and access to decision making, as well as reduce those barriers that relate to gender, income level, and geography (The World We Want, 2013). Improving upstream interventions must complement those operating through health systems and services.

Improved health system and services. This article brings together an extensive range of insights into health system functioning, performance, and challenges in South Sudan. Ongoing conflict has a detrimental impact on health status and health system development, although considerable efforts are now underway to try and move beyond the "post"-conflict challenges and to consolidate nation building. A major element of this agenda is establishing and maintaining effective services operating within a broader health and development policy with long-term objectives. We have highlighted the key challenges present, with an emphasis on applying what is already known to be effective in improving and securing MNCH outcomes for populations in LMICs. Informing policy with evidence (Bowen & Zwi, 2005) requires acute sensitivity to local context. Applying well-established guidance and policies, building and working with trustworthy and committed development partners, is likely to be an essential component of this long-term effort.

The literature highlights the lack of skilled MNCH service providers as the greatest obstacle to achieving improved MNCH in South Sudan (Nelson et al., 2011), with the majority of births still attended by family or friends rather than a trained provider, and delays in seeking medical care contributing to maternal deaths. Human resources for health are critically low in South Sudan and require ongoing investment and commitment to building institutions. Fujita et al. (2013) examined the role of midwives in addressing high maternal mortality in "post"-conflict Cambodia, and highlighted the importance of political commitment, high level leadership, capable mid-level managers, and supportive development partners, if systems and institutions are to be built on an effective and sustainable basis. These all apply to South Sudan.

The health and humanitarian situation in South Sudan, with particular reference to MNCH, requires substantial financial and technical assistance from the international community (Rai et al., 2012). Rai et al. (2012) indicate that technical support should include establishing good governance practices, creating a conducive environment for pooled funding and programs, and establishing an accountability framework. Zwi (2011) argues that the seven "sins" associated with "aid" funding should be carefully avoided in relation to development assistance for health; these include being patient, being more generous, and committing to longer-term building of institutions. Health systems and services should also take into account general lessons learned; according to the Independent Evaluation of the MDTF-SS (2013), recommendations for successful projects included the following:

a. strong national leadership;
b. careful preparation, with realistic development objectives and implementation schedules;
c. recognition of capacity constraints of national implementing institutions;
d. avoiding top-down approaches;
e. integrating risk assessment and mitigation measures into the design; and
f. establishing a robust field implementation presence, with management oversight, and regular engagement with national counterparts.

The South Sudan health sector development plan (MoH & GoSS, 2011) notes the importance of monitoring, evaluation, and operational research. Enhancing our understanding of context—historical, cultural, political, economic, and developmental—and of current capacity and its constraints will be important to assuring appropriate support and capability strengthening.

Post-2015 Agenda

Several issues reflected in the Thematic Consultations for the post-2015 development agenda are acutely relevant to South Sudan: the need to focus on health and related inequalities and disparities, the importance of recognising specific contexts such as conflict and fragility, the centrality of universal health coverage, and the associated right to health. Innovations on the ground and the role of civil society and responsiveness to the community also receive attention.

The Thematic Consultation highlighted the importance of gender equality, accountability, and sustainability as guiding principles for the new development agenda. It argued that MDG health priorities would continue to feature in the post-2015 agenda given the importance of women's and children's health, HIV, and other infectious diseases especially in SSA (The World We Want, 2013). A DFID evaluation of the Basic Services Fund in South Sudan (Johnson, Ockelford, & Power, 2013) found that gender equity had not been sufficiently highlighted; addressing this gap will be core to enhancing health and development. The post-2015 development framework should be more "people-centred and rights-based . . . " with goals and indicators with "universal relevance . . .", while highlighting the importance of country context (The World We Want, 2013).

Conclusion

This narrative review has sought to contextualise the MNCH challenges in "post"-conflict South Sudan. We have highlighted ongoing constraints, barriers, and impediments to improving health outcomes across the MNCH continuum. We draw attention to these within the broad context of international community support to "post"-conflict states and have highlighted opportunities arising as a result of South Sudanese independence, commitment to the MDGs, debates around the post-2015 development agenda, and the emergence of the g7+, which allows South Sudan to engage with its peers and develop shared objectives and frameworks for nation building.

We emphasise a number of core challenges that remain—securing the peace and building macro-economic and political stability; addressing the determinants of health; and building services and systems that are attuned to the realities on the ground. Much remains to be done, however, and sustained, multi-layered, and dependable support are required if advances for MNCH are to be achieved in South Sudan.

Authors' Note

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Note

1. We use the term "post"-conflict in recognition that many countries, including South Sudan, often experience ongoing instability and conflict despite achieving independence or signing a peace treaty.

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Author Biographies

Ngatho Mugo is an Australian Sudanese born in rural South Sudan. She completed both a bachelor of medical sciences and master of international public health at the University of New South Wales (UNSW). Currently, she is enrolled as a PhD research student, in the School of Public Health, University of Sydney. Her interest is to find ways to improve maternal and child health in South Sudan.

Anthony B. Zwi is a professor of global health and development at the UNSW. He heads the Health, Rights and Development group (HEARD@UNSW) and teaches and researches around global health and health systems, international development policy, and human rights. He has extensive research experience in conflict-affected and post-conflict countries and seeks to develop links between practitioners and academics.

Jessica R. Botfield has strong interests in sexual and reproductive health, and global health and development, with experience of these in both Australia and low- and middle-income country contexts, notably Somalia, Kenya, Vietnam, and Timor-Leste. She has been involved in several related research projects as a research associate at the School of Social Sciences, UNSW Australia, and also works as a registered nurse at Marie Stopes International in Sydney, Australia.

Caitlyn Steiner is a graduate from the Master of Public Health program at UNSW and now works in Seattle on the Global Burden of Disease study at the Institute for Health Metrics and Evaluation. She is committed to robust health metrics research, and works specifically on morbidity and maternal mortality estimation for the Global Burden of Disease study.

Chapter 4: Prevalence and risk factors for non-use of antenatal care visits: analysis of the 2010 South Sudan household survey

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Prevalence and risk factors for non-use of antenatal care visits: analysis of the 2010 South Sudan household survey

Ngatho S Mugo[1*], Michael J Dibley[1] and Kingsley E Agho[2]

Abstract

Background: Antenatal care (ANC) is a preventive public health intervention to ensure healthy pregnancy outcomes and improve survival and health of newborns. In South Sudan, about 40% of pregnant women use ANC, however, the frequency of the ANC checks falls short of the recommended four visits. Hence, this study examined potential risk factors associated with non-use of ANC in South Sudan.

Method: Data for this analysis was from the 2010 South Sudan Household Survey second round, which was a nationally representative stratified cluster sample survey. The study included information from 3504 women aged 15–49 years who had given birth within two years preceding the survey. Non-use of ANC was examined against sixteen potential risk factors, using simple and multiple logistic regression analyses adjusted for cluster sampling survey design.

Results: The prevalence of non-use of ANC was 58% [95% confidence interval (CI): (55.7, 59.8)], the prevalence of 1–3 ANC visits was 24% [95% CI: (22.7, 26.7)] and that for 4 or more visits was 18% [95% CI: (16.3, 19.3)]. After adjusting for potential confounding factors, geographic regions, polygamy status [adjusted odds ratio (AOR) = 1.23; 95% CI: (1.00, 1.51), p = 0.047 for a husband with more than one wife], mother's literacy [AOR = 1.79; 95% CI: (1.31, 2.45), p = 0.001 for illiterate mothers], and knowledge on a newborns' danger signs [AOR = 1.77; 95% CI (1.03, 3.05), p = 0.040 for mothers who had limited knowledge of a newborns' danger signs] were significantly associated with non-use of ANC.

Conclusions: Overall improvement of women's access to the recommended number of ANC visits is needed in South Sudan. Strategies to encourage Southern Sudanese women to pursue education as well as to raise awareness about the importance of ANC services are essential. It is also important to prioritize strategies to increase access to health care services in rural areas as well as developing strategies to reduce the financial burden associated with maternal health services.

Keywords: Antenatal care, Pregnancy complications, Socioeconomic factors, Mortality, South Sudan

Background

Underutilization of ANC services among pregnant women in many low and middle-income counties has been a major public health issues with only 51% attending four or more ANC visits [1]. However, the rate of progress has been slowest in sub-Saharan Africa with about 44% women receiving at least four or more ANC visits [1]. ANC from a medically trained provider is an essential service for pregnant women aimed at ensuring healthy pregnancy outcomes and improving survival rates of the newborn [2]. Effective ANC links the pregnant woman and her family to formal health systems, enhances the chance of using skilled birth attendants at delivery and contributes to good health throughout pregnancy [3]. Timely access to ANC is one of the most effective methods to improve pregnancy outcomes in less-developed countries [4,5].

* Correspondence: n.mugo@hotmail.com
[1]School of Public Health, Edward Ford Building (A27), University of Sydney, Sydney, NSW 2006, Australia
Full list of author information is available at the end of the article

Pregnant woman in South Sudan have poor health status with significant urban–rural and regional disparities [6-8]. The Ministry of Health of South Sudan has adopted a minimum of four ANC visits as recommended by the WHO to improve the wellbeing of women and their infants [4,9]. However, the proportion of women receiving at least one ANC examination from any skilled health provider was only 26% in 2006, leaving about 74% of pregnant women without any ANC [10]. WHO recently reported the maternal mortality ratio in South Sudan as 2,054 per 100,000 [11]. These high levels of maternal mortality in Southern Sudan are associated with poor access to quality reproductive health services, including ANC services, trained health personnel at delivery and family planning services [9,12].

In South Sudan the prolonged conflict, which has lasted over two decades, has destroyed much of the health services with currently over 40% of health facilities not operative [13,14]. As a result, pregnant women in South Sudan have limited access to, and availability of maternal health services [9].

Several studies have examined risk factors affecting utilization of ANC services [15-19]. In South Sudan the factors affecting ANC utilization, the social dynamics, barriers and use of maternal health care services are not adequately understood. Therefore, this analysis examined the prevalence of non-use of ANC services, and the associated risk factors. The results from this study will help public health and policy makers to develop interventions aimed at improving access to maternal and neonatal health services to reduce maternal and child mortality in South Sudan.

Methods

Data sources

The data set used in this research was collected during the 2010 South Sudan Household Health Survey second round (SSHHSII). The SSHHSII is a nationally representative, stratified, cluster sample survey, covering the entire population of South Sudan. It aimed to collect health and related indicators essential for identifying the health needs of women and children and for establishing priorities for evidence-based planning, decision-making and reporting. The survey was largely based on the UNICEF's Multiple Indicator Cluster Survey (MICS) methodology [9]. The MICS is a five to three -year periodic survey programme developed by UNICEF to assist countries to fill data gaps in monitoring the situation of women and children. The survey comprises of four questionnaires: household, women and men aged 15–49 years and children younger than 5 years. The women's questionnaire includes questions about the women's demographic characteristics, reproductive history, pregnancy, antenatal care, as well as immunization. Details of the SHHSII sampling methods have been reported elsewhere [9].

Sample size

The sample size for the SSHHSII was calculated as 10,000 households using the prevalence of under-five child diarrhea as the key indicator assuming a prevalence of 20%, a design effect of 1.5, 16% of the total population to be under-five children, and a participation rate of 90%. The results reported in this paper were based on data from 3,504 women with the primary outcome non-use of antenatal care. We estimate that this sample has 80% power to detect an odds ratio of at least 1.24, or a difference of prevalence of 5.7%, assuming an alpha level of 5%, prevalence of non-use of ANC of 60%, a design effect of 1.25 (based on other surveys) [20], and a total sample of 2800, which was obtained by dividing 3500 by the value for the design effect. We consider this sufficient statistical power to examine differences in non-use of ANC that would be of public health significance.

Study population

The study population for this analysis was limited to women aged 15–49 who gave birth in the last two years preceding the survey. Figure 1 shows the selection process of the women at the household level. Among 11,568 of eligible woman there were 9,069 who were interviewed with a response rate of 78.4%. Information on the ANC visits was collected for the last birth from women, who had more than one birth in the last two years preceding the survey. A total of 3,504 women had at least one birth in the two years preceding the survey.

Variables

Non-use of ANC services was the primary outcome variable used in the analysis of the SSHHSII. It was categorized into three groups consisting of: 1) those women who had ANC checks by non-skilled providers, and those who had no ANC, 2) those who had between 1 to 3 ANC checks by skilled providers, and 3) those who attended 4 or more ANC checks by skilled providers. The World Health Organization defines ANC as "care before birth", and includes education, counseling, screening and treatment to monitor and to promote the well being of both mother and baby [21]. For the purpose of this analysis, ANC service refers to any pregnancy-related services provided by skilled health personnel, such as doctors, nurse-midwives, midwives and health visitors [9] whereas non-skilled ANC services refers to women receiving no ANC services at all or woman receiving any pregnancy-related services provided by non-SBAs, such as, traditional birth attendants, community health workers, relatives or friends.

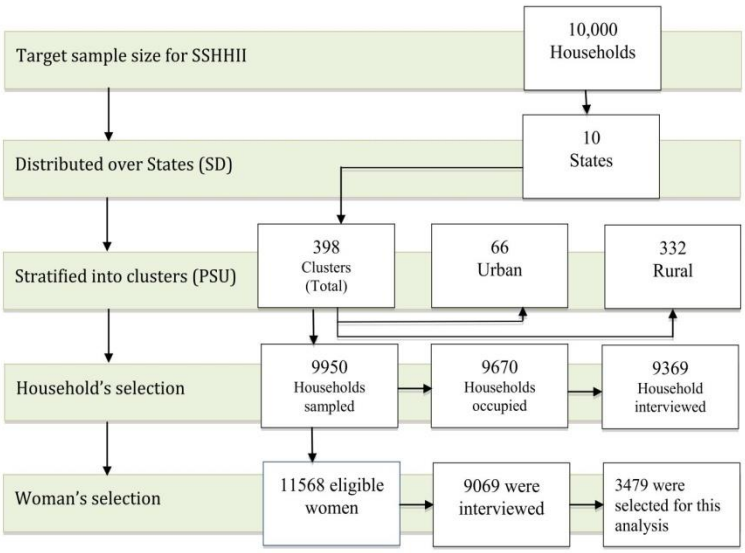

Figure 1 A multiple stage methodology process for selection of woman at the household level, 2010-SSHHSII. State: is the sampling domain. Cluster: is the primary sampling unit (PSU).

We modified the Andersen behavioural model framework for health services utilization to understand the factors that determine pregnant women's use of health care services [22]. Figure 2 shows the modified Andersen behavioural model conceptual framework and all the variables included in this analysis. The possible risk factors associated with non-use of ANC services were categorized into four main groups; namely (1) external environment including health services characteristics of the regions and living in rural/ urban, (2) predisposing factors such as maternal characteristics that existed before the onset of the need for ANC services, (3) enabling factors that facilitate the pregnant women to receive ANC services, and (4) need factors that indicate the potential for adverse ANC outcomes. Using the Andersen model, sixteen potential risk factors associated with non-use of ANC services were identified and categorized into external environment, predisposing, enabling and need factors.

Statistical analysis

Descriptive analyses were performed using the STATA/MP version 12 (StataCorp, College Station, TX, USA); 'Svy' commands were used to allow for adjustments for the cluster sampling design, sampling weights and the calculation of standard errors. The Taylor series linearization method was used in the analysis when calculating confidence intervals around prevalence estimates. Cross tabulations were generated to describe the frequencies and confidence intervals of ANC services across independent variables, and the statistical significance was tested using chi-squared tests.

To determine the risk factors for non-use of ANC services, the outcome variable was expressed in a binary form, that is, category 0 for 1 to 4+ ANC visits and category 1 for no ANC visits. In the univariate and bivariate logistic regression, which was adjusted for the effects of the sampling design and weighted, the odds ratios with 95% confidence intervals were calculated to determine the unadjusted risk of independent variables on non-use of ANC services. Multiple logistic regression was used in a backwards elimination model in order to identify the factors significantly associated with the study outcome. At the start, all variables were included in the model and backward elimination process was employed to remove non-significant variables. Only variables with statistical significance of $p < 0.05$ were retained in the final model. In the final model, we tested and reported any co-linearity, and calculated the odds ratios with 95% confidence intervals in order to assess the adjusted risk of the independent variables.

Ethical approval

The ethics committee of the Ministry of Health, Government of South Sudan, reviewed and approved this research study. All respondents to the survey provided verbal informed consent; consent for children was obtained through the parents, caregivers or guardians. The dataset of SSHHII is not available as a public domain survey dataset. The first author requested the access to

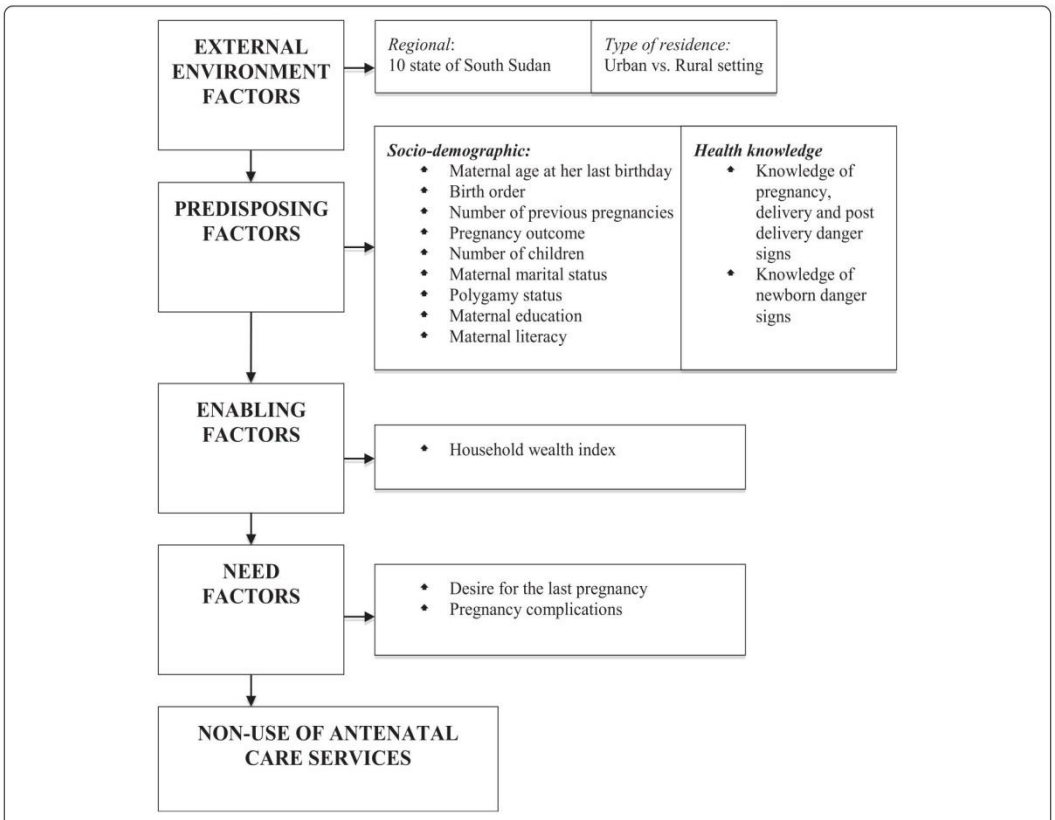

Figure 2 Theoretical framework of a range of risk factors associated with non-use of antenatal care in South Sudan. This framework adopted from Anderson behavioural model.

the data from Director of Health Social and Demographic Statistics and from the Ministry of Health of South Sudan, and access was granted to use the data for research.

Results

Our study population consisted of 3,504 (weighted total) women aged between 15–49 years who had given birth in the two years preceding the survey distributed across the 10 regions of South Sudan. The prevalence of women who did not use any form of ANC services was found to be 58% [95% CI: (55.7, 59.8)]. The prevalence of women who made less than four ANC visits was 24% [95% CI: (22.7, 26.7)] and that of women who made the recommended number of ANC visits was about 18% [95% CI: (16.3, 19.3)] (see Figure 3).

Characteristics of the study sample

Table 1 describes the baseline characteristics of the risk factors. More than three-quarters (77%) of the women interviewed resided in rural areas and the majority of them (72%) were aged between 20–34 years. About 87% of them had a first birth order child. Nearly all of the women (90%) were illiterate and 78% had no formal education. Few women showed good knowledge on newborn danger signs (4.0%) and knowledge on the obstetric danger signs and symptoms associated with pregnancy, delivery and post-delivery complications (4.2%). Slightly more than one third of the women experienced at least one complication during the course of pregnancy. Only 18% of the women attend the recommended 4 or more ANC visits during pregnancy. About 57% of the women received ANC services from unskilled health personnel. Almost 58% of the women had not attended any form of ANC during the course of their pregnancy. More than four-fifths (85%) of the woman wanted their last pregnancy and about 77% were currently married.

Factors associated with non-use of the recommended number of ANC visits

Table 2 shows the external environment, predisposing, enabling and need factors were significantly associated

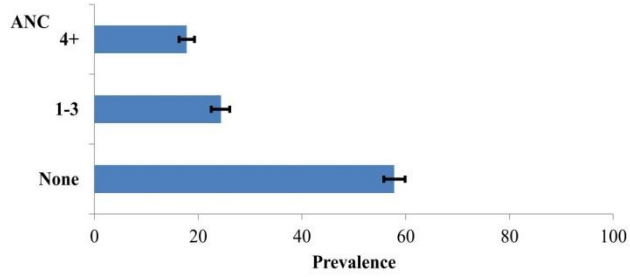

Figure 3 The prevalence of maternal use of antenatal care by number of visits, in South Sudan.

with use of ANC visits in South Sudan. The analysis shows that the residence of pregnant women in Warab, Junglei and Unity regions was strongly associated with maternal non-use of ANC visits compared to their counterparts from the remaining regions. The table also shows that pregnant women from rural areas were more likely to underutilize ANC services compared to their counterparts from urban areas. The non-use of ANC services was also significantly higher among illiterate women, women who had no formal education, those whose husbands had more than one wife, and among never married (single) women. Among the other socio-demographic factors, maternal age was negatively associated with the outcome variable. For instance, older women (aged 35–49 years) tend not to utilise ANC visits during the course of their pregnancy compared to younger women (aged 15–19 years). The pregnancy outcomes of having stillbirths or miscarriages were significantly higher among mothers who did not utilise ANC services. Knowledge of obstetric danger signs during pregnancy, delivery and post-delivery, as well as knowledge on newborn danger signs were other significant factors that were strongly associated with non-use of ANC services. Enabling resources, such as the household wealth index, were significantly associated with non-use of ANC services. For instance women from the top two household wealth quintiles had an increased utilization of the recommended number of four or more ANC visits compared to their counterparts from the lowest two quintiles. Women who never experienced pregnancy complications were strongly associated with non-use of ANC services compared to their counterparts who experienced more than one complication. Utilization of unskilled health personnel was highly significant among non-users of ANC with a prevalence of 94%.

Table 3 presents the adjusted and unadjusted odds ratios for the factors associated with maternal non-use of ANC visits. The analysis shows that socio-demographic factors including maternal level of education, maternal age, number of children and their birth order, number of previous pregnancies and the outcomes, and marital status were associated with the use of ANC services in South Sudan. Geographical region was significantly associated with women's non-use of ANC services. For instance, women who resided in Jounglei [AOR = 1.76; 95% CI: (1.19, 2.60), P = 0.005], Warab [AOR = 1.66; 95% CI: (1.16, 2.23), P = 0.127] and Unity [AOR = 1.42; 95% CI: (0.90, 2.23), P = 0.127] regions were more likely not to utilize ANC services compared to other regions of South Sudan. Among the socio-demographic factors, the odds of non-use of ANC services increased significantly for women whose husbands had more than one wife and among illiterate women (woman who were unable to read). Knowledge on newborn danger signs was another significant variable associated with non-use of ANC.

Discussion

In South Sudan, the main factors that pose risks to non-use of ANC services were: geographical region, the husband's polygamy status, woman's literacy and place of residence. The odds of non-use of ANC services were higher in some regions of South Sudan such as Jounglei, Warab and Unity. The risk of not using ANC services was higher among women with no formal education and those from poor households and among older women. The risk of non-use of ANC services was also higher among women who desired to become pregnant, and those who did not experience any pregnancy complications.

This paper is one of the first articles to describe the risk factors for non-use of ANC services in South Sudan. The paper reports potential risk factors that were correlated with non-use of ANC services. The sampling method, appropriate adjustment for sampling design in the analysis including sampling weights, and an adequate response rate (78%) to the survey interviews are important strengths of this survey. This analysis was based on a nationally representative survey SSHHSII 2010, covering the total population of South Sudan. To minimize the potential recall bias, data on the most recent births were obtained from the women who had given birth only during the two years preceding the survey. Also, due to the

Table 1 Baseline characteristics of factors associated with maternal utilization of ANC health services, categorized by the external environment, predisposing, enabling and need factors in South Sudan, SSHHSII 2010 (n = 3504)

VARIABLES	n	%
1. EXTERNAL ENVIRONMENTAL FACTORS		
Geographical Region (state)		
Upper Nile	464	13.3
Jounglei	452	12.9
Unity	205	5.8
Warap	480	13.7
Northern Bahr el Ghazal	280	8.0
Western Bahr el Ghazal	138	3.9
Lakes	280	8.0
Western Equatoria	313	8.9
Central Equatoria	500	14.3
Eastern Equatoria	392	11.2
Type of residence (total)		
Urban	808	23.0
Rural	2697	77.0
2. PREDISPOSING FACTORS		
Socio-demographic characteristic		
Maternal age at her last birthday (years)		
15-19	272	7.8
20-34	2520	71.9
35-49	713	20.3
Birth order		
1st birth	2794	86.5
2nd birth	368	11.4
3rd + birth	68	2.1
Number of previous pregnancies		
1 pregnancy	3113	95.1
2+ pregnancy	161	4.9
Pregnancy outcome		
Live birth	3062	96.7
Other (Still birth, Miscarriage, Currently pregnant)	105	3.3
Number of children		
1-2 children	1211	34.6
3-4 children	1157	33.0
5 children and more	1136	32.4
Maternal marital status		
Currently married	2702	77.1
Formerly married	582	16.6
Never married (Single)	220	6.3
Polygamy status		
Husband have one wife	1889	59.0
Husband have more than one wife	1313	41.0
Maternal education		
No education	2745	78.4
Primary education	615	17.6
Secondary + education	143	4.1
Maternal literacy		
Able to read	334	10.0
Unable to read	3018	90.0
Health knowledge		
Knowledge of obstetric danger signs during pregnancy, delivery and post delivery		
Good for (correct answer 8 or more)	147	4.2
Fair for (correct answer between 5–7)	170	4.8
Bad for (correct answer less than 5)	3188	91.0
Knowledge on newborn danger signs		
Good for (correct answer 8 or more)	140	4.0
Fair for (correct answer between 5–7)	180	5.1
Bad for (correct answer less than 5)	3184	90.9
3. ENABLING FACTORS		
Household wealth index		
Poorest	671	19.2
Poorer	704	20.1
Middle	654	18.7
Richer	747	21.3
Richest	728	20.8
4. NEED FACTORS		
Desire for last pregnancy		
Wanted to get pregnant then	2995	85.5
Wanted to get pregnant later	314	9.0
Never wanted to get pregnant	106	3.0
Pregnancy complications		
Yes with 1–2 complications	1240	35.4
Yes with 3 and more complications	1140	32.5
No without complications	1124	32.1

large size of the survey, we were able to examine a variety of risk factors associated with non-use of ANC services among women in South Sudan, across the external environment, predisposing, enabling and need factors. There were some limitations to the analysis of the data and these should be noted when interpreting the results. The cross-sectional study design restricted the interpretation of the causality of the risk factors associated with non-use of ANC services. Even though the data were collected within 2 years of the preceding survey, it is still

Table 2 Number of Antenatal care visits according to external environment, predisposing, enabling and need factors in South Sudan, SSHHSII 2010 (n = 3504)

VARIABLE	Number of antenatal care visits						
	None		1-3 visits		4+ visits		P
	%	[95% CI]	%	[95% CI]	%	[95% CI]	
1. EXTERNAL ENVIRONMENTAL FACTORS							
Geographical Region (state)							
Upper Nile	57.7	(52.1, 63.1)	22.3	(18.7, 26.3)	20.1	(15.9, 25.1)	
Jounglei	72.5	(66.0, 78.2)	18.7	(14.2, 24.2)	8.8	(5.6, 13.6)	
Unity	68.3	(61.0, 74.8)	18.9	(14.1, 24.8)	12.8	(8.9, 18.1)	
Warap	78.8	(73.8, 83.1)	15.7	(11.9, 20.6)	5.5	(3.2, 9.1)	
Northern Bahr el Ghazal	58.2	(51.0, 65.0)	29.5	(22.7, 37.3)	12.3	(9.0, 16.7)	
Western Bahr el Ghazal	51.3	(46.2, 56.5)	20.9	(16.7, 25.9)	27.7	(23.8, 32.1)	
Lakes	53.7	(47.8, 59.5)	30.3	(25.9, 35.1)	16.0	(11.5, 21.7)	
Western Equatoria	41.9	(33.6, 50.7)	31.2	(23.1, 40.5)	26.9	(19.6, 35.8)	
Central Equatoria	33.5	(28.6, 38.8)	33.9	(28.3, 40.0)	32.6	(27.7, 37.9)	
Eastern Equatoria	58.5	(52.1, 64.6)	23.2	(18.6, 28.4)	18.4	(13.2, 25.1)	<0.001
Type of resident (total)							
Urban	40.8	(36.5, 45.2)	28.4	(23.1, 34.3)	30.9	(26.3, 35.9)	
Rural	62.9	(60.6, 65.2)	23.3	(21.7,25.0)	13.8	(12.6, 15.2)	<0.001
2. PREDIPOSING FACTORS							
Scio-Demographic characteristic							
Maternal age at her last birthday (years)							
15-19 years	52.3	(44.2, 60.3)	22.6	(17.7, 28.3)	25.1	(19.3, 32.1)	
20-34 years	57.0	(54.4, 59.6)	25.3	(23.2, 27.5)	17.7	(15.9, 19.7)	
35-49 years	62.7	(58.8, 66.5)	22.1	(18.6, 26.2)	15.1	(12.3, 18.5)	0.0156
Birth order							
1st birth	59.4	(57.2, 61.6)	24.0	(22.1, 25.9)	15.6	(15.3, 18.0)	
2nd birth	47.8	(41.6, 54.2)	27.9	(22.2, 34.5)	24.2	(18.8, 30.6)	
3rd + birth	26.0	(15.4, 40.5)	34.0	(20.9, 50.0)	40.0	(25.7, 56.3)	<0.001
Number of previous pregnancies							
1 pregnancy	55.3	(53.2, 57.3)	26.0	(24.1, 27.9)	18.8	(17.3, 20.3)	
2+ pregnancy	46.7	(38.3, 55.3)	29.8	(23.7, 36.7)	23.5	(17.0, 31.6)	<0.001
Pregnancy outcome							
Live birth	54.9	(52.9, 56.9)	26.1	(24.2, 28.1)	19.0	(17.6, 20.6)	
Other (Still birth, Miscarriage, Currently pregnant)	62.8	(51.9, 72.4)	17.8	(11.0, 27.6]	19.4	(11.6, 30.6)	<0.001
Number of children							
1-2 children	55.3	(51.6, 56.0)	25.3	(22.3, 28.6)	19.4	(16.7, 22.4)	
3-4 children	61.6	(58.2, 64.9)	22.8	(19.9, 25.9)	15.6	(13.3, 18.4)	
5 children and more	56.6	(53.5, 59.7)	25.2	(22.2, 28.5)	18.2	(15.8, 20.9)	0.1245
Maternal marital status							
Currently married	55.6	(53.2, 58.0)	25.3	(23.3, 27.4)	19.1	(17.4, 21.0)	
Formerly married	66.0	(60.9, 70.8)	21.2	(17.2, 25.8)	12.8	(10.0, 16.3)	
Never married (Single)	63.4	(55.6, 70.5)	22.5	(16.2, 30.5)	14.1	(9.4, 20.6)	0.0022
Polygamy status							
Husband have one wife	54.5	(52.0, 57.0)	25.3	(22.9, 27.9)	20.2	(17.9, 22,7)	

Table 2 Number of Antenatal care visits according to external environment, predisposing, enabling and need factors in South Sudan, SSHHSII 2010 (n = 3504) *(Continued)*

Husband have more than one wife	61.2	(58.1, 64.0)	23.8	(21.4, 26.5)	15.0	(13.0, 17.3)	0.0033
Maternal education							
No education	64.8	(62.6, 67.0)	22.4	(20.7, 24.2)	12.8	(11.5, 14.3)	
Primary education	33.0	(28.8, 37.5)	33.2	(28.6, 38.2)	33.8	(29.1, 38.8)	
Secondary + education	29.8	(19.8, 42.1)	26.1	(18.6, 35.2)	44.2	(34.4, 54.5)	<0.001
Maternal literacy							
Able to read	36.5	(30.8, 42.6)	34.1	(27.7, 41.2)	29.4	(23.9, 35.6)	
Unable to read	61.4	(59.2, 63.6)	23.3	(21.5, 25.2)	15.3	(13.9, 16.7)	<0.001
Health knowledge							
Knowledge of obstetric danger signs during pregnancy, delivery and post delivery							
Good for (correct answer 8 or more)	42.6	(33.9, 51.7)	30.7	(23.1, 39.4)	26.8	(19.2, 36.0)	
Fair for (correct answer between 5–7)	52.1	(42.9, 61.2)	28.6	(21.0, 37.7)	19.3	(11.6, 30.4)	
Bad for (correct answer less than 5)	58.8	(56.6, 61.0)	23.9	(22.0, 25.9)	17.3	(15.9, 18.7)	0.0247
Knowledge on newborn danger signs							
Good for (correct answer 8 or more)	45.3	(33.8, 57.3)	25.6	(17.0, 36.7)	29.1	(19.6, 40.9)	
Fair for (correct answer between 5–7)	37.8	(29.9, 46.3)	42.1	(32.7, 52.0)	20.2	(13.8, 28.6)	
Bad for (correct answer less than 5)	59.5	(57.3, 61.6)	23.4	(21.6, 25.2)	17.1	(15.6, 18.7)	<0.001
3. ENABLING FACTORS							
Household wealth index							
Poorest	74.5	(70.3, 78.3)	20.3	(17.3, 23.7)	5.2	(3.3, 8.2)	
Poorer	66.8	(62.8, 70.6)	20.7	(17.6, 24.2)	12.5	(10.3, 15.0)	
Middle	62.6	(59.3, 65.9)	23.9	(20.7, 27.5)	13.4	(10.8, 16.7)	
Richer	52.5	(48.0, 56.9)	26.5	(23.2, 30.2)	21.0	(17.9, 24.6)	
Richest	34.8	(29.6, 40.4)	30.2	(25.0, 36.0)	35.0	(30.3, 40.0)	<0.001
4. NEED FACTORS							
Desire for last pregnancy							
Wanted to get pregnant then	59.1	(57.1, 61.2)	23.7	(21.9, 25.7)	17.1	(15.6, 18.7)	
Wanted to get pregnant later	47.9	(40.0, 55.8)	29.0	(22.9, 35.8)	23.2	(17.8, 29.6)	
Never wanted to get pregnant	42.9	(33.6, 52.8)	34.5	(25.7, 44.5)	22.6	(15.3, 32.0)	0.007
Pregnancy complications							
Yes with 1–2 complications	49.5	(46.6, 52.5)	28.6	(25.6, 31.8)	21.9	(19.5, 24.4)	
Yes with 3 and more complications	52.6	(49.7, 55.4)	27.1	(24.3, 30.0)	20.4	(18.1, 22.9)	
No without complications	72.3	(68.8, 75.5)	17.2	(14.9, 19.7)	10.6	(8.7, 12.7)	<0.001

subject to recall biases. The recall bias may have occurred because the information collected relied on the woman's recall ability about her pregnancy. The potential risk factor variables included in this analysis were based on the availability of the information that was found in SSHHSII. As a result, this analysis did not cover many possible risk factors from the Andersen behavioural model framework such as the availability and accessibility of ANC services, content of ANC services and the users' satisfaction with services. However, we believe these limitations should not have a significant impact on the validity of the study.

Recent studies in other countries have found regional differentials in the under-utilization of ANC services [23,24]. We found that women who resided in Jounglei, Warab and Unity remained highly disadvantaged with increased odds of under-utilising ANC services compared to their counterparts in other regions of South Sudan. The non-use of ANC services could be attributed to the lack of these services or lack of easy access to them in these geographic locations. For instance in Jonglei the long history of inter-ethnic violence among the cattle raiding groups from Lou Nuer, Murle, and Dinka

Table 3 Unadjusted and Adjusted odds ratios for factors associated with maternal non-use of ANC services, in South Sudan, SSHHSII 2010 (n = 3504)

VARIABLE	Unadjusted odds ratio			Adjusted odds ratio (AOR)*#		
	OR	[95% CI]	P value	AOR	[95% CI]	P value
1. EXTERNAL ENVIRONMENTAL FACTORS						
Geographical Region (state)						
Upper Nile	1.00			1.00		
Jounglei	1.94	(1.37, 2.74)	<0.001	1.76	(1.19, 2.60)	0.005
Unity	1.58	(1.01, 2.47)	0.044	1.42	(0.90, 2.23)	0.127
Warap	2.73	(1.95, 3.82)	<0.001	1.66	(1.16, 2.38)	0.006
Northern Bahr el Ghazal	1.02	(0.69, 1.52)	0.913	0.81	(0.52, 1.27)	0.354
Western Bahr el Ghazal	0.77	(0.60, 1.01)	0.055	0.73	(0.54, 0.98)	0.037
Lakes	0.85	(0.60, 1.20)	0.349	0.63	(0.41, 0.97)	0.036
Western Equatoria	0.53	(0.34, 0.83)	0.006	0.43	(0.26, 0.69)	0.001
Central Equatoria	0.37	(0.27, 0.83)	<0.001	0.42	(0.29, 0.62)	<0.001
Eastern Equatoria	1.03	(0.74, 1.45)	0.849	0.93	(0.66,1.32)	0.698
Type of resident (total)						
Urban	1.00					
Rural	2.46	(2.01, 3.03)	<0.001			
2. PREDISPOSING FACTORS						
Socio-demographic characteristic						
Maternal age at her last birthday (years)						
15-19 years	1.00					
20-34 years	1.21	(0.85, 1.71)	0.278			
35-49 years	1.53	(1.08, 2.17)	0.017			
Birth order						
1st birth	1.00					
2nd birth	0.67	(0.52, 0.86)	0.003			
3rd + birth	0.52	(0.26, 1.04)	0.063			
Number of previous pregnancies						
1 pregnancy	1.00					
2+ pregnancy	0.71	(0.49, 1.02)	0.064			
Pregnancy outcome						
Live birth	1.00					
Other (Still birth, Miscarriage, Currently pregnant)	1.38	(0.86, 2.22)	0.172			
Number of children						
1-2 children	1.00					
3-4 children	1.29	(1.04, 1.61)	0.021			
5 children and more	1.05	(0.84, 1.32)	0.642			
Maternal marital status						
Currently married	1.00					
Formerly married	1.55	(1.20, 2.01)	0.001			
Never married (Single)	1.38	(1.02, 1.88)	0.040			
Polygamy status						
Husband have one wife	1.00			1.00		
Husband have more than one wife	1.31	(1.12, 1.54)	0.001	1.23	(1.00, 1.51)	0.047

Table 3 Unadjusted and Adjusted odds ratios for factors associated with maternal non-use of ANC services, in South Sudan, SSHHSII 2010 (n = 3504) *(Continued)*

Maternal education						
No education	1.00					
Primary education	0.27	(0.22, 0.33)	<0.001			
Secondary + education	0.23	(0.13, 0.39)	<0.001			
Maternal literacy						
Able to read	1.00			1.00		
Unable to read	2.77	(2.09, 3.67)	<0.001	1.79	(1.31, 2.45)	0.001
Health knowledge						
Knowledge of obstetric danger signs during pregnancy, delivery and post delivery						
Good for (correct answer 8 or more)	1.00					
Fair for (correct answer between 5–7)	1.47	(0.89, 2.43)	0.132			
Bad for (correct answer less than 5)	1.93	(1.34, 2.78)	0.001			
Knowledge on newborn danger signs						
Good for (correct answer 8 or more)	1.00			1.00		
Fair for (correct answer between 5–7)	0.73	(0.41, 1.31)	0.288	0.81	(0.40, 1.63)	0.545
Bad for (correct answer less than 5)	1.77	(1.11, 2.84)	0.018	1.77	(1.03, 3.05)	0.040
3. ENABLING FACTORS						
Household wealth index						
Poorest	1.00					
Poorer	0.69	(0.51, 0.93)	0.015			
Middle	0.57	(0.44, 0.74)	<0.001			
Richer	0.38	(0.29, 0.50)	<0.001			
Richest	0.18	(0.13, 0.25)	<0.001			
4. NEED FACTORS						
Desire for last pregnancy						
Wanted to get pregnant then	1.00					
Wanted to get pregnant later	0.63	(0.46, 0.88)	0.008			
Never wanted to get pregnant	0.52	(0.36, 0.75)	0.001			
Pregnancy complications						
Yes with 1–2 complications	1.00					
Yes with 3 and more complications	1.13	(0.95, 1.34)	0.16			
No without complications	2.65	(2.20, 3.19)	<0.001			

*632 (18%) missing information was not included in the multivariate analysis.
Independent variables adjusted for are: geographical region (state); type of residence (total); maternal age at her last birthday (years); birth order; number of previous pregnancy; pregnancy outcome; number of children; maternal marital status; polygamy status; maternal education; maternal literacy; knowledge of obstetric danger signs during pregnancy, delivery and post delivery; knowledge on newborn danger signs; household wealth index; desire for last pregnancy; pregnancy complications.

has contributed to overall poor health development, infrastructure and a lack of security [25]. These groups are often illiterate, poor and with low socio economic status. In Unity, Jonglei and Warab regions, most mothers, seeking health services spend two days travelling to health centers [26]. Hence the Government of South Sudan and stakeholders needs to implement mobile clinical services in these remote and rural areas in order to improve ANC services.

One of the key findings of our study was the high risk of non-use of ANC services among woman whose husbands had more than one wife. This finding is similar to that reported in a study conducted in Uganda [27]. Women need support from their husbands to utilize ANC. For women in a polygamous relationship, her husband's attention is divided between his wives, and therefore he would have less time to pay attention to the needs of each of his wives. In order to understand the

barriers on the use of ANC services among women living in polygamous marriages, qualitative research study is needed to understand such barriers. Furthermore, husbands should be educated on the importance of ANC services during pregnancy, and should support and encourage their wives to utilize such services. The Government of South Sudan should also promote educational campaigns targeting both men and women of reproductive age about the importance of ANC services.

Our study found that illiterate mothers had the worst maternal health outcomes compared to their literate counterparts in terms of access and utilization of recommended number of ANC visits. It is also unlikely that illiterate women would seek out quality ANC services; they also lack the essential knowledge that might help them use health care inputs that offer better maternal health care services [28].

The women's level of education was found to be a risk factor for the non-utilization of ANC services in our study with greater use of services as levels of education increased among women. Previous studies have also found maternal education essential not only for ANC attendance in general, but also in influencing the utilization of antenatal care content [27,29-32]. Several other studies have found a positive and significant association between maternal education and utilization of maternal health services [33-36]. Lack of education has hindered South Sudan women from receiving, seeking and communicating information concerning their health that could help prevent maternal and newborn deaths [37]. These findings show that maternal education can be instrumental in enabling women to gain the knowledge, confidence, skills, and capability to make decisions about their own health and the health of their unborn babies. Therefore the government of South Sudan and other stakeholders should focus on enhancing female education beyond secondary level in order to attain favourable maternal health outcomes in the future. Interventions aimed at mitigating the conditions that lead girls to drop out of school early should be intensified.

We also performed additional analysis to investigate the association between maternal education and literacy. Of those women who were illiterate, 82% of them had no education. Also our analysis indicated that most of the illiterate women (70%) lived in rural areas. Similar findings in developing countries indicate that women who underutilize maternity care are often poor, illiterate, and unmarried, with limited knowledge of maternity care services [38].

In this study, we found that women living in rural areas were less likely to use ANC services, compared to their counterparts in urban areas. This finding is similar to studies conducted by other investigators [39-41], which have reported that non-use of antenatal services was significantly higher among rural women compared to their urban counterparts. Other factors such as higher quality of care, shorter walk-time to health facilities and the woman's education were significant determinants of routine use of ANC [41]. A study from Ghana [17] found that about a third of the rural population travel long distances (more than 5 km) to reach ANC services. Thus, distance to maternal health services and transportation problems may greatly reduce access to ANC services in rural areas of South Sudan.

The findings from this study could be attributed to the lack of most of the services items of ANC in the rural areas. This may also be brought about by a low demand for ANC in the rural areas. The low demand for the ANC services by these rural women may be due to poverty; and the low demand would explain why health centres would not stock the appropriate items for ANC. Since the majority (80%) of the population of South Sudan reside in rural areas [12], the government and other stakeholders should make efforts to improve facilities and infrastructure (such as better access to paved roads as well as adequate number of maternal health services) in these deprived areas [42].

Our findings also underscore the significance of socioeconomic level in influencing the use of ANC services in South Sudan. We found that women in the highest household wealth quintile were more likely to use ANC services, compared to those in the poorest. Other investigators have also underlined the importance of household wealth status in influencing maternal health-seeking behaviour [31,32,40,43]. In our final model, when we replaced literacy with household wealth, it was significant, which suggested there was co-linearity between literacy and household wealth. We believe that household wealth is highly associated with maternal non-use of ANC services in South Sudan since the use of services is associated with financial costs of transportation, physician and facility fees, and the cost of medications. The financial cost of receiving care is a major constraint in South Sudan as over 50% of the population lives below the poverty line, with the majority living in rural settings [12]. In our analysis, women from the wealthy households were those who were literate, had secondary education or higher education, and resided in urban areas. Several other studies have shown that household wealth is positively associated with maternal utilization of health services for delivery [39,44]. The South Sudan government should implement policies that would ensure that all women, irrespective of their ability to pay, have access to the appropriate free ANC services for pregnant women.

There is evidence in the literature indicating that women who were less likely to practice family planning and those who did not seek care from a health professional were more likely not to use ANC services [27].

This is consistent with our finding that women who desired to get pregnant were more likely not to use ANC services.

Our findings may not represent the current situation of women in South Sudan and their need for access to reproductive care including ANC. As the result of the recent armed violence that broke out in the capital Juba on 15 December 2013, and which subsequently spread to several states in South Sudan, there has been further destruction of the health system. Since 15 December 2013, over 908,000 people have been displaced by violence, including 705,800 people within South Sudan and 202,500 into neighbouring countries [45]. The dead and the wounded are estimated to be in the tens of thousands [45,46]. As a result of this internal armed conflict the people of South Sudan have experienced severe health consequences exacerbated by population displacement, food insufficiency, and the collapse of the existing basic health services. For example the conflict has caused the collapse in the health system in Upper Nile state in the city of Malakal where, the hospitals that had survived two decades of civil war, have now been completely destroyed and looted. There is a similar situation in Jounglei, Upper Nile and Unity states that have all been severely affected by the conflict and created regional disparities within the country [47]. A drop in the number of women accessing reproductive health services as a result of this recent conflict was also reported [47]. Also lack of access to basic reproductive health services and the closure or destruction of health care facilities due to the violence has put the lives of women and their newborns at risk [48]. Further complicating the situation is the reduced access of these populations to life-saving health care from seasonal flooding. Nonetheless our findings remain important for future health care assessments once the conflict has ceased.

Conclusion

Many underlying external environment, predisposing, need and enabling factors influence women's non-use of maternal health services in South Sudan. This study found that the number of years of schooling influenced the women's attitudes towards the use of ANC services. This is because the choice of the recommended number of ANC visits is influenced by education. Therefore the Ministry of Health and policy makers in South Sudan need to implement outreach programmes to raise the awareness about women's education and to encourage South Sudanese women to pursue higher levels of education. It is also crucial for these programmes to target women from poor households and those from rural areas about the importance of ANC services, to increase their awareness as well to increase their use of these services. Strategies to increase access to health care services in rural areas should be a priority in South Sudan. Also implementing strategies that would reduce the financial burden associated with using maternal health services, such as, medical and transportation costs, would enable women from poor households to use maternal health services.

Competing interests
The authors declare that they have no competing interests.

Authors' contributions
NSM and MJD contributed in the study design. KA and NSM performed the analysis and NSM prepared the manuscript. Revision of the manuscript and advice on analysis of data were provided by MJD and KA. All authors read and approved the final manuscript.

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Author details
[1]School of Public Health, Edward Ford Building (A27), University of Sydney, Sydney, NSW 2006, Australia. [2]School of Science and Health, Building (24), University of Western Sydney, Locked Bag 1797, Penrith, NSW 2751, Australia.

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Erratum:

Typological	Correction
Knowledge of newborn danger signs was another significant variable associated with non-use of ANC	Knowledge of newborn danger signs was another significant variable associated with use of ANC

Chapter 5: Risk Factors for Non-use of Skilled Birth Attendants: Analysis of South Sudan Household Survey, 2010

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Risk Factors for Non-use of Skilled Birth Attendants: Analysis of South Sudan Household Survey, 2010

Ngatho Samuel Mugo[1] · **Kingsley E. Agho**[2] · **Michael J. Dibley**[1]

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Abstract *Objectives* South Sudan has the lowest percentage of births attended by skilled health personnel in the world. This paper aims to identify potential risk factors associated with non-use of skilled birth attendants at delivery in South Sudan. *Methods* Secondary data analyses of the 2010 South Sudan Household Health Survey second round were conducted with data for 3504 women aged 15–49 years who gave birth in the 2 years prior to the survey. The risk of non-use of skilled birth attendants was examined using simple and multiple logistic regression analyses. *Results* The prevalence rates for skilled, unskilled and no birth attendants at delivery were 41 [95 % confidence interval (CI) 38.2, 43.0], 36 [95 % CI 33.9, 38.8], and 23 % [95 % CI 20.6, 24.9] respectively. Multivariable analyses indicated that educated mothers [adjusted odds ratio (AOR) 0.70; 95 % CI 0.57, 0.86], mothers who had three and more complications during pregnancy [AOR 0.77; 95 % CI 0.65, 0.90], mothers who had at least 1–3 ANC visits [AOR 0.38; 95 % CI 0.30, 0.49] and mothers from rich households [AOR 0.52; 95 % CI 0.42, 0.65] were significantly more likely to use skilled birth attendants (SBAs) at delivery. Mothers who lived in rural areas [AOR 1.44; 95 % CI 1.06, 1.96] were less likely to deliver with SBAs. *Conclusion* Intensive investments to recruit and train more skilled birth attendants' on appropriate delivery care are needed, as well as building a community-based skilled birth attendants' program to reduce avoidable maternal mortality in South Sudan.

Keywords Skilled birth attendants · Maternal health services · Socioeconomic factors · South Sudan

Significance

What is already known on this subject? Very limited published data on type of delivery attendants in South Sudan. The use of skilled birth attendants is known to be very low in South Sudan.

What this study adds? Factors associated with unskilled birth attendance at delivery include low levels of maternal education, non-use of ANC services, living in rural areas and mothers from poor households.

Introduction

The burden of high rates of maternal morbidity and mortality remains a significant challenge in developing countries [1, 2]. Many of these deliveries are still taking place at home without assistance from SBAs [2]. It is estimated that 13–33 % of maternal mortality could have been prevented if pregnant women had access to SBAs at every delivery [3, 4]. The high level of the maternal mortality ratio in South Sudan (2054 per 100,000 live births) is associated with poor access to quality health

✉ Ngatho Samuel Mugo
n.mugo@hotmail.com

Kingsley E. Agho
k.agho@uws.edu.au

Michael J. Dibley
michael.dibley@sydney.edu.au

[1] School of Public Health, Edward Ford Building (A27), University of Sydney, Sydney, NSW 2006, Australia

[2] School of Science and Health, Building (24), University of Western Sydney, Locked Bag 1797, Penrith, NSW 2751, Australia

services, including antenatal care (ANC) services, trained health personnel at delivery and family planning services [5, 6]. In addition, remoteness, poverty and early marriage are among the other challenges facing women in South Sudan which contribute to maternal morbidity and mortality.

The international health community's primary strategy to reduce maternal mortality has been to ensure that every woman has access to SBAs during delivery, as well as emergency obstetric care (EmOC) in case of complications [7]. However, this strategy is not working in South Sudan, probably due to the prolonged civil war, which has contributed to the country having the world's lowest percentage of births attended by skilled health personnel [5]. It was reported in 2009–2010 a total of 189 physicians and 309 midwives were operating across the 10 states of South Sudan [8]. These numbers are lower than the minimum health workers density recommended by WHO [9]. The war has also contributed to the destruction of health services with now over 40 % of health facilities not operating, limited human resources and disrupted delivery of health services to vulnerable communities of women and children [5, 10]. As a result pregnant women in South Sudan have limited access and availability of maternal health services. Details on the delivery of health services, the structure of the service, management, coverage and utilization of services in South Sudan has been reported elsewhere [10, 11].

According to the 2006 South Sudan Household Health Survey, on average a very low percentage of deliveries were assisted by doctors (3 %), and by nurses and midwives (7 %) [12]. Approximately 20 % of deliveries were assisted by a traditional birth attendant, 36 % by a relative or friend, but for many women there was no delivery assistance at all (30 %). In south Sudan the majority of births (81 %) take place at home with far fewer deliveries at health facilities (14 %) [12, 13].

Evidence suggests that access to SBAs at all births, as well as EmOC in case of complications, are the most critical interventions to ensure safe motherhood [14, 15]. Many socio-cultural factors have been identified as stumbling blocks to a women's access to maternal health services in many developing countries [16, 17]. Several studies have examined risk factors affecting utilization of SBAs at delivery [3, 18–20]. However, to date there is no study that has examined the social dynamics, barriers and use of maternal health care services in South Sudan. This analysis aimed to assess the associations between a range of risk factors and non-use of SBAs at delivery in South Sudan. The results from this study will help public health managers and policy makers to develop interventions aimed at improving access to maternal and neonatal health services in South Sudan and for future health care assessments once the conflict ceases.

Methods

Data Sources

The dataset for our analysis was obtained from the 2010 South Sudan Household Health Survey second round (SSHHSII), which employed the UNICEF Multiple Indicator Cluster Survey (MICS) methodology. The survey collected information from 8338 under-five children, 9069 women and 4345 men aged 15–49 years, and included information on demographic characteristics of the household members, such as reproductive history, pregnancy-related information, use of ANC services, knowledge and practices of family planning methods, information on the child health indicators, and other determinants of maternal health in South Sudan. Details of SSHHSII sampling methods have been reported elsewhere [5].

Study Sample Size

The results reported in this paper were based on data from 3504 women with the primary outcome non-use of SBAs at birth. We estimate that this sample has 80 % power to detect an odds ratio of at least 1.24 or a difference of prevalence of 5.7 %, assuming an alpha level of 5 %, prevalence of non-use of SBAs of 60 %, a design effect of 1.25 (based on other surveys) [21], and a total sample of 2800, which was obtained by dividing 3500 by the value for the design effect. We consider this sufficient statistical power to examine differences in non-use of SBAs at birth that would be of public health significance.

Study Population

The dataset for this analysis was limited to the study population of women aged 15–49 years, who gave birth 2 years prior to the survey. Figure 1 indicates the selection process of the women at the household level. A total of 9069 women were interviewed out of 11,568 eligible women, yielding a response rate of 78.4 %. We included 3504 women who gave birth within 2 years prior to the survey. Information on the delivery assistance was collected from the mother's most recent birth.

Variables

Non-use of SBAs at delivery was the dependent variable for this analysis. According to WHO standards the term "skilled attendant" refers exclusively to people with midwifery skills, such as doctors, midwives, and nurses, who have been trained to proficiency in the skills necessary to manage normal (uncomplicated) pregnancies and

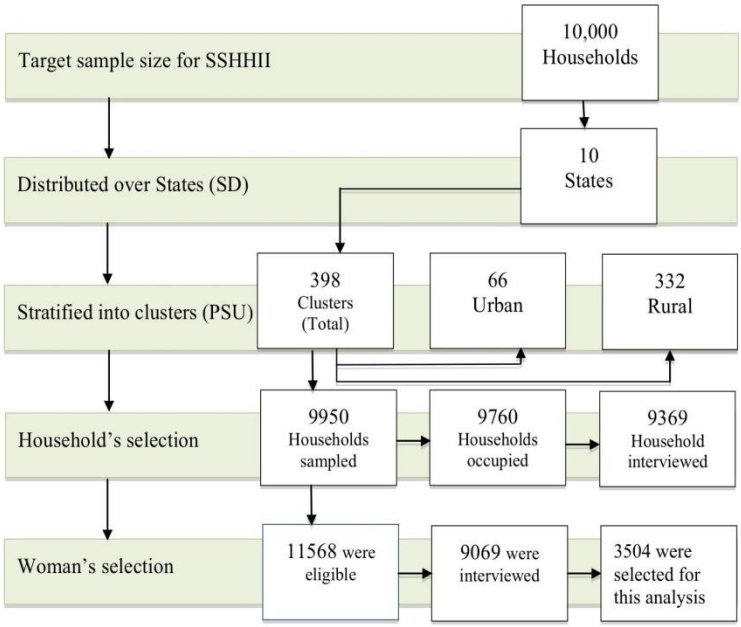

Fig. 1 A multiple stage methodology process for selection of woman at the household level, 2010-SHHSII

childbirth during the immediate postnatal period. These SBAs are also trained in the identification, management and referral of women and/or newborns with complications [22]. Based on WHO definition, SBAs refers to any assistance provided to a pregnant woman by a doctor, nurse-midwife, village midwife, as well as other trained SBAs working in public and private facilities who have had extensive training in midwifery skills, such as medical assistants and health visitors. Whereas, non-SBAs refers to any assistance provided to a pregnant woman by traditional birth attendants (TBAs), community health workers, relative/friend, or no assistance at delivery. The type of delivery assistance has been categorized into: (1) delivery with any SBAs, (2) delivery with non-SBAs and (3) delivery with no assistance. TBAs in this context are often older illiterate women who acquired their skills by delivering babies or by working with other TBAs. These providers are recognized as a link between communities and health facilities and UNICEF and NGOs provide them with training.

The independent variables for this analysis were selected based on the adapted Andersen behavioural model framework for health services utilization [23], to understand the factors that determined pregnant women's use of health care services. Figure 2 illustrates the modified Andersen behavioural model conceptual framework and presents all the variables included in this analysis. Twenty potential risk factors for non-use of SBAs at delivery were identified and categorized into four main groups. The first are external environment factors, which include health services characteristics of the regions and type of residency such as living in rural/urban. The second are predisposing factors such as maternal characteristic that existed before the onset of the need for SBAs at delivery. The third are enabling factors that include factors that enable the pregnant women to receive health services such as ANC services. And the fourth groups are need factors such as factors associated with adverse antenatal outcomes.

Household wealth index variable was constructed from an inventory of 20 household facilities and assets using principal components analysis to weight the contribution of the items to the index [24]. This index was divided into three categories; the bottom 1/3rd of households that was arbitrarily referred to as poor households, the next 1/3rd as the middle level households, and the top 1/3rd as rich households.

We also generated a variable referred to as quality of ANC services from a combination of a set of ANC services a woman received during the course of her pregnancy. These services included measuring blood pressure, examining urine and blood samples, administering tetanus toxoid injections, use of iron/folic acid supplements, received any preventive treatment for malaria, and received information on the mode and place of delivery. A woman was considered to have had a good quality of ANC services when she had received four or more of the above ANC

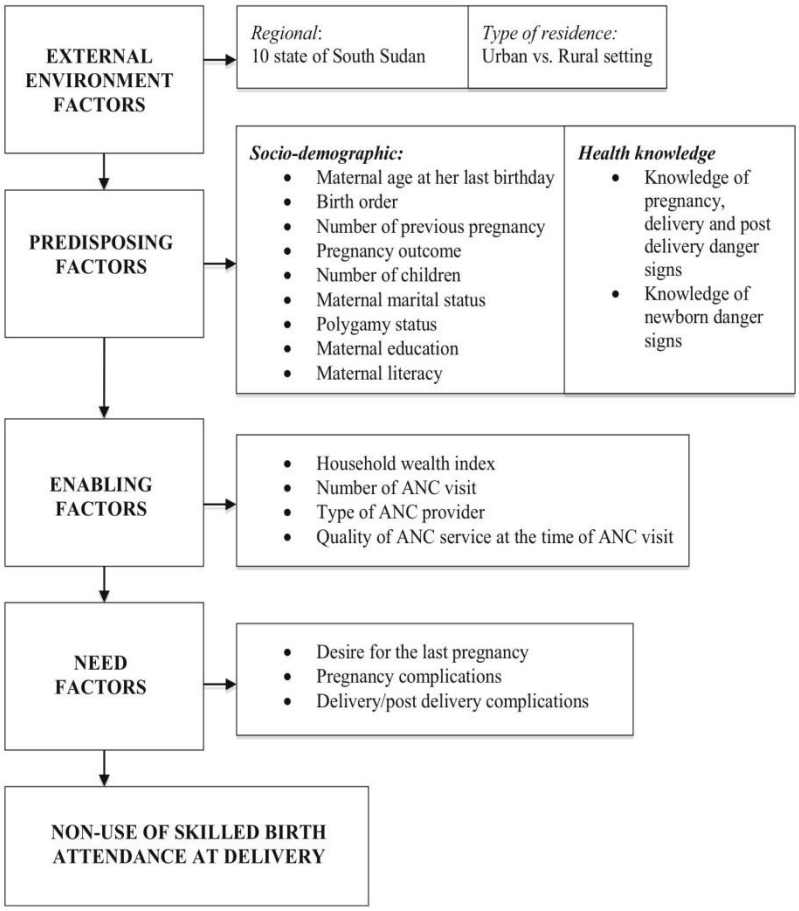

Fig. 2 Theoretical framework of a range of risk factors associated with non-use of trained birth attendants at deliveries in South Sudan

services, and to have had a lower quality of ANC services when she had received <4 ANC services.

Ethical Approval

The ethics committee of the Ministry of Health, Government of South Sudan, reviewed and approved this research study. All respondents to the survey provided verbal informed consent; consent for children was obtained through parents, caregivers or guardians. The dataset of SSHHII is not available as a public domain survey dataset. The first author requested the access to the data from Director of Health Social and Demographic Statistics and from the Ministry of Health of South Sudan, and access was granted to use the data for research.

Statistical Analysis

Descriptive analyses were performed using the STAT/MP version 12 (Stata Corp, College Station, TX, USA). 'Svy' commands were used to allow for adjustments for the cluster sampling design, sampling weights and the calculation of standard errors using the Taylor series linearization method. Cross tabulations were generated to describe the frequencies and confidence intervals of delivery assistance across independent variables, and the statistical significance was tested using Chi squared tests.

To determine the risk factors for non-use of SBAs at delivery, the dependent variable was expressed in a binary form (0 for use of SBAs and 1 for non-use of SBAs including no assistant at delivery). In the univariate and bivariate logistic regression, which was adjusted for the effects of the sampling design and weighted, the odds ratios with 95 % confidence intervals were calculated to determine the unadjusted risk of independent variables. Multiple logistic regression models were used starting with all the variables in the model and using manual backward elimination to remove non-significant variables. Only variables with statistical significance of $p < 0.05$ were retained in the final model. We tested and reported any co-linearity, and the odds ratios

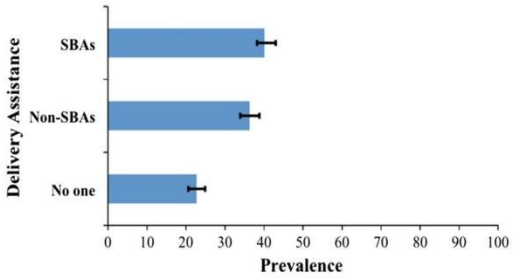

Fig. 3 The prevalence and 95 % confidence intervals of maternal use of different types of birth attendants at delivery in South Sudan (2010 SSHHSII). *Birth attendance*: refer to mothers seeking assistance during delivery from: skilled birth attendances (SBAs) such as doctor, nurse-midwife, village midwife, medical assistant and health visitor; non-skilled birth attendance (non-SBAs) such as traditional birth attendants, community health workers or relative/friend) and with no assistance at all. *SSHHSII*: South Sudan Household Health Survey second round

with 95 % confidence intervals were calculated in order to assess the adjusted risk of independent variables.

Results

The study population for this analysis consisted of a weighted total of 3504 of women aged 15–49 years, who gave birth 2 years prior to the survey. We found 36 % [95 % CI (33.9, 38.8)] of mothers were delivered by non-SBAs, 23 % [95 % CI (20.6, 24.9)] had no delivery assistance at all, and 41 % [95 % CI (38.2, 43.0)] were delivered by SBAs (see Fig. 3).

Characteristics of the Study Sample

Table 1 shows the baseline characteristics of mothers according to external environment, predisposing, enabling and need factors. The distribution of the study population varied across the regions of South Sudan with, 4 % residing in Western Bahr el Ghazal, in comparison to 14 % in central Equatoria state. The sample examined was mainly young, rural, married women having their first birth. These women were mostly uneducated and lacked knowledge about newborn and obstetric danger signs and symptoms. About 1 in 5 of these women experienced delivery/post-delivery complications and 1/3rd of them had had 1–2 pregnancy complications. Over four-fifths of the study population had desired the last birth. Over 80 % of these women delivered their babies at home and only 1 % of deliveries were by caesarian section (Data not shown).

Factors Associated with Non-use of the SBAs at Delivery

Table 2 shows the prevalence of assistance at delivery and the associations with external environment, predisposing, enabling and need factors. In this analysis, place and type of residence were associated with a mother's choice of utilizing SBAs. Mothers from Unity, Warab, Eastern Equatoria and Upper Nile states were less likely to use SBAs compared to others states. Also, mothers from rural areas had a lower prevalence of being assisted by SBAs. Many socio-demographic factors such as, maternal level of education and literacy, were strongly associated with non-use of SBAs. Furthermore, non-use of SBAs was also significant among never married (single) women, mothers with first order children, new mothers, and mothers from poor households. Mothers who had the recommended number of ANC visits as well as those who received ANC services from skilled personnel had a significantly higher prevalence of using SBAs. Mothers who received at least four or more ANC services, such as blood pressure and blood and urine sample tests, had a significantly higher prevalence of use of SBAs. Mothers who experienced more than one complication during pregnancy as well as delivery/post delivery complications had a significantly higher prevalence of using SBAs. Mothers who were not expecting to get pregnant had a higher prevalence of utilising SBAs compared to women who desired to get pregnant (Fig. 3).

Table 3 presents the adjusted and unadjusted odds ratios for factors associated with non-use of SBAs. Multivariable analyses indicated that mothers who reside in rural areas, as well as mothers who had no education had significantly higher odds of not using SBAs. Other significant factors for non-use of SBAs at birth were the number of ANC visits, household poverty and women without pregnancy complications.

It was evident in the univariate analyses that geographical region was strongly associated with a mother's non-use of SBAs at birth. However the AORs for seven of the regions (Unity, Warab, Eastern Equatoria Upper Nile, Lakes, Northern Bahr el Ghazal, and Jounglei) changed direction in the final model from being a risk factor in the univariate analysis to being protective factor, relative to Central Equatoria where the capital city is located. When household wealth, education and number of ANC visits were removed from the model, the AORs for the above seven regions were similar to the univariate findings. Geographic regions were highly correlated with household wealth, education and number of ANC visits therefore this variable was removed from the final model.

Discussion

Access to skilled care at every birth is one of the indicators for monitoring progress towards the maternal health Millennium Development Goal [22]. Our findings indicate that South Sudan is unlikely to improve access to SBAs for all births by the year 2015, given the current need for access to maternal and child health services, and the shortage of

Table 1 Baseline characteristic of factors associated with maternal use of health services in South Sudan, SHHSII 2010 (n = 3504)

Variable	n	%
1. External environmental factors		
Geographical region (state)		
Central Equatoria	500	14.3
Western Equatoria	313	8.9
Eastern Equatoria	392	11.2
Lakes	280	8.0
Western Bahr el Ghazal	138	83.9
Northern Bahr el Ghazal	280	8.0
Warap	480	13.7
Unity	205	5.8
Jounglei	452	12.9
Upper Nile	464	13.3
Type of resident (total)		
Urban	808	23.0
Rural	2697	77.0
2. Prediposing factors		
Socio-demographic characteristics		
Maternal age at her last birthday (years)		
15–19	272	7.8
20–34	2520	71.9
35–49	713	20.3
Birth order		
1st birth	2796	86.5
2nd birth	364	11.3
3rd + birth	72	2.2
Number of previous pregnancies		
1 Pregnancy	3113	95.1
2+ Pregnancy	161	4.9
Pregnancy outcome		
Live birth	3062	96.7
Other (still birth, miscarriage, currently pregnant)	105	3.3
Number of children		
1–2 Children	1211	34.6
3–4 Children	1157	33.0
5+ Children	1136	32.4
Maternal marital status		
Currently married	2702	77.1
Formerly married	582	16.6
Never married (single)	220	6.3
Polygamy status		
Husband has one wife	1889	59.0
Husband has more than one wife	1313	41.0
Maternal education		
No education	2745	78.4
Primary education	615	17.6
Secondary + education	143	4.1
Maternal literacy		
Able to read	334	10.0
Unable to read	3018	90.0

Table 1 continued

Variable	n	%
Health knowledge		
Knowledge of obstetric danger signs during pregnancy, delivery and post delivery		
Good (correct answer 8 or more)	147	4.2
Adequate (correct answer between 5 and 7)	170	4.8
Inadequate (correct answer <5)	3188	91.0
Knowledge on newborn danger signs		
Good (correct answer 8 or more)	140	4.0
Adequate (correct answer between 5 and 7)	180	5.1
Inadequate (correct answer <5)	3184	90.9
3. Enabling factors		
House hold wealth index		
Poorest	671	19.2
Poorer	704	20.1
Middle	654	18.7
Richer	747	21.3
Richest	728	20.8
Number of ANC visits		
No visit	2026	57.8
1–3 visits	856	24.4
4+ visits	623	17.8
Type of ANC provider		
Skilled health personnel	1496	42.7
Non-skilled health personnel/no ANC visits[a]	2008	57.3
Quality of ANC service at the time of ANC visits		
Good quality ANC (receiving ≥ 4 ANC services)	1696	52.0
Lower quality ANC (receiving < 4 ANC services)	1563	48.0
4. Need factors		
Desire for last pregnancy (n = 3416)		
Wanted to get pregnant then	2995	85.5
Wanted to get pregnant later	314	9.0
Never wanted to get pregnant	106	3.0
Pregnancy complications		
Yes with 1–2 complications	1240	35.4
Yes with 3 or more complications	1140	32.5
No without complications	1124	32.1
Delivery/post delivery complications		
Yes with 1–2 complications	1008	28.8
Yes with 3 or more complications	1037	29.6
No without complications	1459	41.6

[a] Referred to any ANC services provided by: traditional birth attendance, community health workers and relative/Friend and those who had no ANC visits

SBAs. Type of residence, maternal education, household wealth, pregnancy complications and number of ANC visits were the main factors associated with non-use of SBAs at delivery. Other factors such as maternal age, birth order, geographical regions, type of ANC providers and quality of ANC services were also associated with non-use of SBAs at delivery.

In South Sudan rural residence was identified as a barrier for access to maternal health services. This finding is consistent with previous studies conducted in Ethiopia, India and Nigeria, which reported greater use of services in urban than rural areas [25–27]. In South Sudan many factors might hinder rural mothers from accessing maternal health services, for example, remoteness, poor road conditions, lack of

Table 2 The prevalence of assistance at delivery according to external environment, predisposing, enabling and need factors South Sudan Household Survey, 2010 (n = 3504)

Variable	Delivery assistance						
	Skilled		Non-skilled		No one		*P*
	%	[95 % CI]	%	[95 % CI]	%	% [95% CI]	
1. External environmental factors							
Geographical region (state)							
Central Equatoria	53.5	(47.6, 59.3)	18.8	(15.0, 23.3)	27.2	(22.1, 32.9)	
Western Equatoria	52.1	(43.6, 60.4)	36.7	(28.9, 45.3)	11.2	(6.8, 18.0)	
Eastern Equatoria	36.7	(30.8, 43.0)	35.0	(29.3, 41.0)	27.6	(23.0, 32.8)	
Lakes	38.3	(33.6, 43.3)	31.2	(25.9, 37.1)	29.9	(25.2, 35.1)	
Western Bahr el Ghazal	53.0	(47.9, 58.1)	32.1	(27.5, 37.8)	14.3	(11.6, 17.5)	
Northern Bahr el Ghazal	43.5	(38.4, 48.7)	42.1	(36.7, 47.7)	14.1	(10.4, 18.9)	
Warap	26.9	(22.6, 31.7)	42.0	(36.7, 47.6)	30.5	25.5, 36.0)	
Unity	27.7	(21.8, 34.4)	49.3	(43.8, 54.8)	22.7	(18.0, 28.2)	
Jounglei	39.7	(32.7, 47.2)	45.6	(39.1, 52.3)	14.6	(10.3, 20.3)	
Upper Nile	38.9	(34.0, 44.1)	35.8	(31.0, 40.9)	24.5	(19.6, 30.2)	<0.001
Type of resident (total)							
Urban	59.0	(53.5, 64.4)	26.9	(22.6, 31.6)	13.4	(10.0, 17.7)	
Rural	35.1	(32.5, 37.8)	39.1	(36.3, 42.0)	25.5	(23.0, 28.1)	<0.001
2. Prediposing factors							
Socio-demographic characteristic							
Maternal age at her last birthday (years)							
15–19	46.0	(37.4, 54.9)	35.0	(27.7, 43.0)	18.6	(12.8, 26.3)	
20–34	41.3	(38.7, 44.0)	35.5	(33.2, 37.9)	22.7	(20.3, 25.3)	
35–49	35.9	(32.0, 40.0)	39.5	(34.6, 44.7)	24.2	(19.9, 29.1)	0.2613
Birth order							
1st born child	39.1	(36.5, 41.8)	38.5	(35.8, 41.3)	22.0	(19.9, 24.3)	
2nd birth	48.8	(43.6, 54.0)	29.9	(24.1, 36.6)	20.5	(16.2, 25.5)	
3rd + birth	70.2	(57.1, 80.7)	16.3	(9.6, 26.2)	13.5	(5.8, 28.5)	<0.001
Number of previous pregnancies							
1 Pregnancy	42.9	(40.5, 45.4)	39.7	(37.2, 42.2)	17.0	(15.5, 18.7)	
2+ Pregnancy	53.9	(43.9, 63.7)	22.7	(16.5, 30.4)	22.1	(15.0, 31.2)	<0.001
Pregnancy outcome							
Live birth	43.3	(40.9, 45.9)	39.7	(37.2, 42.2)	16.5	(15.0, 18.2)	
Other (still birth, miscarriage, currently pregnant)	41.4	(31.7, 51.9)	27.9	(18.1, 40.5)	29.7	(20.3, 41.2)	<0.001
Number of children							
1–2 Children	43.7	(40.0, 47.5)	34.7	(31.3, 38.2)	21.1	(18.0, 24.7)	
3–4 Children	39.0	(35.6, 42.5)	36.8	(33.5, 40.2)	23.8	(20.8, 27.0)	
5+ Children	38.9	(35.7, 42.3)	37.5	(33.7, 41.4)	23.2	(20.6, 26.1)	0.3105
Maternal marital status							
Currently married	42.1	(39.4, 44.8)	34.7	(32.3, 37.2)	22.8	(20.6, 25.2)	
Formerly married	36.2	(30.8, 42.1)	39.2	(34.2, 44.5)	23.9	(19.8, 28.7)	
Never married (single)	34.0	(34.0, 42.1)	47.9	(39.6, 56.5)	17.6	(11.4, 26.2)	0.0297
Polygamy status							
Husband has one wife	41.9	(39.0, 44.8)	35.7	(32.8, 38.7)	22.0	(20.1, 24.1)	
Husband has more than one wife	39.1	(35.9, 42.3]	35.7	(32.0, 39.5)	24.9	(21.6, 28.5)	0.1413
Maternal education							
No education	34.7	(32.3, 37.3)	39.6	(36.9, 42.3)	25.3	(22.9, 27.9)	
Primary education	59.8	(55.1, 64.2)	26.0	(21.9, 30.5)	13.6	(10.4, 17.7)	

Table 2 continued

Variable	Delivery assistance						
	Skilled		Non-skilled		No one		*P*
	%	[95 % CI]	%	[95 % CI]	%	% [95% CI]	
Secondary + education	70.4	(58.4, 80.1)	17.6	(10.3, 28.2)	11.6	(5.8, 21.8)	<0.001
Maternal literacy							
Able to read	58.0	(51.9, 63.8)	27.6	(22.2, 33.7)	13.7	(9.8, 18.9)	
Unable to read	37.3	(34.7, 39.9)	38.1	(35.5, 40.8)	24.2	(21.9, 26.7]	<0.001
Health knowledge							
Knowledge of obstetric danger signs during pregnancy, delivery and post delivery							
Good (correct answer 8 or more)	54.5	(43.4, 65.3)	31.2	(21.7, 42.5)	14.3	(9.8, 20.4)	
Adequate (correct answer between 5 and 7)	48.6	(39.3, 57.9)	34.8	(26.4, 44.3)	16.6	(10.6, 25.1)	
Inadequate (correct answer <5)	39.5	(37.1, 42.0)	36.6	(34.2, 39.1)	23.4	(21.2, 25.8)	0.0301
Knowledge on newborn danger signs							
Good (correct answer 8 or more)	57.8	(46.8, 68.1)	27.3	(17.4, 40.1)	14.1	(8.5, 22.4)	
Adequate (correct answer between 5 and 7)	57.3	(49.4, 64.9)	26.8	(19.0, 36.3)	15.9	(10.6, 23.1)	
Inadequate (correct answer <5)	38.9	(36.5, 41.3)	37.2	(34.7, 39.8)	23.5	(21.3, 25.8)	0.0001
3. Enabling factors							
Household wealth index							
Poorest	28.0	(23.0, 32.5)	45.2	(40.5, 49.9)	26.5	(22.6, 30.7)	
Poorer	28.0	(24.1, 32.3)	44.5	(38.9, 50.3)	27.1	(22.6, 32.1)	
Middle	35.9	(31.5, 40.6)	37.4	(33.0, 42.0)	26.5	(22.4, 31.2)	
Richer	44.1	(39.8, 48.5)	37.3	(33.0, 41.9)	18.1	(15.3, 21.2)	
Richest	65.0	(60.2, 69.6)	18	(14.8, 21.7)	16.2	(12.6, 20.5)	<0.001
Number of ANC visits							
No visit	24.9	(22.6, 27.5)	42.6	(39.2, 46.1)	31.8	(29.0, 34.8)	
1–3 visits	56.8	(52.4, 61.0)	30.9	(27.2, 35.0)	12.0	(9.7, 14.8)	
4+ visits	69.3	(64.9, 73.4)	22.9	(19.0, 27.5)	7.6	(5.3, 10.7)	<0.001
Type of ANC provider							
Skilled health personnel	64.8	(61.9, 67.6)	24.5	(21.7, 27.4)	10.6	(9.0, 12.4)	
Non-skilled health personnel/no ANC visit[a]	22.6	(20.3, 25.1)	45.1	(41.6, 48.6)	31.7	(28.9, 34.6)	<0.001
Quality of ANC service at the time of ANC visits							
Good quality ANC (receiving ≥4 ANC services)	57.3	(54.6, 59.9)	31.3	(28.5, 34.4)	11.2	(9.3, 13.3)	
Lower quality ANC (receiving < 4 ANC services)	19.1	(16.8, 21.7)	43.5	(40.2, 47.0)	36.7	(33.7, 39.7)	<0.001
4. Need factors							
Desire for last pregnancy							
Wanted to get pregnant then	39.2	(36.6, 41.9)	38.0	(35.3, 40.8)	22.4	(20.2, 24.7)	
Wanted to get pregnant later	48.6	(41.1, 56.2)	29.5	(23.6, 36.2)	21.4	(15.6, 28.7)	
Never wanted to get pregnant	58.0	(45.5, 69.5)	20.3	(11.8, 32.7)	21.7	(13.6, 32.9)	0.0024
Pregnancy complications							
Yes with 1–2 complications	45.1	(42.1, 48.2)	36.6	(32.9, 40.5)	17.9	(15.0, 21.2)	
Yes with 3 or more complications	48.2	(43.9, 52.5)	37.9	(34.0, 42.0)	13.6	(11.3, 16.3)	
No without complications	27.9	(25.1, 30.8)	34.2	(31.0, 37.6)	37.2	(33.1, 41.5)	<0.001
Delivery/post delivery complications							
Yes with 1–2 complications	48.9	(45.2, 52.6)	36.9	(33.1, 40.9)	14.1	(11.8, 16.8)	
Yes with 3 or more complications	45.5	(42.0, 49.0)	38.7	(35.1, 42.4)	15.6	(12.8, 19.0)	
No without complications	31.4	(28.0, 35.0)	34.1	(30.8, 37.6)	33.6	(30.2, 37.2)	<0.001

[a] Referred to any ANC provider such as: traditional birth attendance, community health workers and relative/Friend and those who had no ANC visits

transport, lack of local health services, or cost of reaching and using the services [28, 29]. These problems have been exacerbated by over two decades of war that has destroyed the basic health system. As a result over two-fifths of health facilities are not operative mainly due to a lack of human resources or because of inadequate and dilapidated infrastructure, lack of equipment and supplies [10]. Also our analyses indicated that urban–rural and regional differences in non-use of SBAs can be attributed to poverty, low levels of education and the low number of mothers attending ANC visits. Since the majority (80 %) of the population of South Sudan reside in rural areas [28, 29], the government and other stakeholders should make greater efforts to improve rural health services with better facilities and better training for the staff, as well developing other infrastructure such as roads, and public transport.

In South Sudan, mothers' education (years of school) was found to be negatively associated with use of SBAs at delivery, which is consistent with other studies that have found that educated women better utilize maternal health services [30, 31]. Previous studies have also found that maternal education is essential not only for use of ANC services but also for the mother's choice to deliver with SBAs [32, 33]. Therefore the government of South Sudan should focus on enhancing female education in order to attain favorable maternal health outcomes in the future. Community-based interventions aimed at mitigating the conditions that lead to girls dropping out of school early should be intensified.

Household poverty was found to be strongly associated with non-use of SBAs at delivery in South Sudan, which is consistent with previous studies in Ghana and Turkey [34, 35]. This may be the result of the financial burden associated with the cost of accessing services, such as the cost of transportation, physician and facility fees, and the cost of medications, as over half of the population of South Sudan lives below the poverty line [29]. In order to increase access to SBAs at birth, the South Sudan government should ensure that all women, irrespective of their ability to pay, have access to appropriate free ANC, delivery and newborn care services. Women in rural and remote areas should be offered conditional cash transfers to encourage them to deliver in health facilities or at home with SBAs.

Our study revealed that mothers without pregnancy complications were at an increased risk of non-use of SBAs at delivery, perhaps because they felt comfortable about their childbirth thus leading to fewer deliveries by SBAs. Also, mothers might lack the essential information about the unexpected risks that childbirth may pose to their health and the health of their newborn. It is essential to inform pregnant women and their families about the need for a birth plan and the actions required in case of an emergency arising during childbirth [36, 37]. In South Sudan this might be lacking, as over half (58 %) of pregnant women have no access to ANC visits [38]. Findings from Vietnam and other Asian populations have revealed that the main reason for unpreparedness for delivery was the perception that childbirth was a normal process [39–41]. In order to improve women's knowledge about childbirth, implementing strategies for access to affordable prenatal, ANC and postnatal care services and access to SBAs at every home delivery is essential. Training and improving the skills of health staff, who have remained through the continued conflicts in South Sudan, is essential to address the current priority health problems of mothers and their unborn babies.

Our findings may not represent the current situation of women in South Sudan and their needs for access to reproductive care, because of the recent further destruction of the health system due to armed violence that broke out in the capital, Juba on December 15 2013, and which subsequently spread to several states [42]. As a result of this internal armed conflict, the people of South Sudan have experienced severe health consequences exacerbated by population displacement, food insufficiency, and the collapse of the existing basic health services. Jounglei, Upper Nile and Unity states have all been severely affected by the conflict, which will have exaggerated regional disparities within the country [43]. A drop in the number of women accessing reproductive health services as a result of this recent conflict has also been reported [43]. Also lack of access to basic reproductive health services and the closure or destruction of health care facilities due to the violence has put the lives of women and their newborns at risk. Further complicating the situation is the reduced access of these populations to life-saving health care from seasonal flooding. Nonetheless our findings remain important for future health care assessments once the conflict ceases.

Strengths and Limitations

This paper is the first analysis that describes the potential risk factors associated with mothers' non-use of SBAs at delivery in South Sudan. The important strengths of this study include a high response rate (78 %) and an appropriate adjustment in the analysis for the sampling design. Due to the large sample size, we were able to identify a variety of risk factors associated with non-use of SBAs. Also data on the most recent birth within 2 years of the survey was collected to minimize potential maternal recall bias. The limitations in our study include the use of cross-sectional survey data that restricted the interpretation of the causality of risk factors associated with non-use of SBAs. The potential risk factors included in this analysis were restricted to those factors available in SSHHSII data. The

Table 3 Unadjusted and adjusted odd ratios for factors associated with maternal non-use of SBA at delivery, South Sudan Household Survey, 2010 (n = 3504)

Variable	Unadjusted odd ratio			Adjusted odd ratio (AOR)[b]		
	OR	[95 % CI]	*P* value	AOR	[95 % CI]	*P* value
1. External environmental factors						
Geographical region (state)						
Central Equatoria	1.00					
Western Equatoria	1.03	(0.64, 1.66)	0.906			
Eastern Equatoria	1.75	(1.15, 2.67)	0.010			
Lakes	1.42	(1.01, 1.99)	0.044			
Western Bahr el Ghazal	0.89	(0.62, 1.27)	0.515			
Northern Bahr el Ghazal	1.36	(0.96, 1.92)	0.083			
Warap	2.09	(1.46, 2.99)	<0.001			
Unity	2.79	(1.86, 4.20)	<0.001			
Jounglei	1.48	(0.98, 2.24)	0.059			
Upper Nile	1.85	(1.29, 2.66)	0.001			
Type of resident (total)						
Urban	1.00			1.00		
Rural	2.69	(2.08, 3.49)	<0.001	1.44	(1.06, 1.96)	0.022
2. Prediposing factors						
Socio-demographic characteristic						
Maternal age at her last birthday (years)						
15–19	1.00					
20–34	1.21	(0.84, 1.75)	0.304			
35–49	1.52	(1.05, 2.22)	0.029			
Birth order						
1st birth	1.00					
2nd birth	0.67	(0.53, 0.85)	0.001			
3rd + birth	0.27	(0.16, 0.48)	<0.001			
Number of previous pregnancies						
1 Pregnancy	1.00					
2+ Pregnancy	0.63	(0.42, 0.95)	0.029			
Pregnancy outcome						
Live birth	1.00					
Other (still birth, miscarriage, currently pregnant)	1.07	(0.69-1.66)	0.749			
Number of children						
1–2 Children	1.00					
3–4 Children	1.23	(1.01, 1.47)	0.040			
5+ Children	1.22	(1.02, 1.46)	0.026			
Maternal marital status						
Currently married	1.00					
Formerly married	1.28	(0.97, 1.67)	0.076			
Never married (single)	1.41	(0.98, 2.04)	0.066			
Polygamy status						
Husband has one wife	1.00					
Husband has more than one wife	1.12	(0.97, 1.30)	0.113			
Maternal education						
No education	1.00			1.00		
Primary + education[c]	0.38	(0.32, 0.46)	<0.001	0.70	(0.57, 0.86)	0.001

Table 3 continued

Variable	Unadjusted odd ratio			Adjusted odd ratio (AOR)[b]		
	OR	[95 % CI]	*P* value	AOR	[95 % CI]	*P* value
Maternal literacy						
Able to read	1.00					
Unable to read	2.35	(1.81, 3.03)	<0.001			
Health knowledge						
Knowledge of obstetric danger signs during pregnancy, delivery and post delivery						
Good (correct answer 8 or more)	1.00					
Adequate (correct answer between 5 and 7)	1.27	(0.68, 2.37)	0.444			
Inadequate (correct answer <5)	1.82	(1.15, 2.88)	0.012			
Knowledge on newborn danger signs						
Good (correct answer 8 or more)	1.00					
Adequate (correct answer between 5 and 7)	1.04	(0.60, 1.79)	0.886			
Inadequate (correct answer <5)	2.18	(1.43, 3.33)	0.001			
3. Enabling factors						
Household wealth index[d]						
Poor	1.00			1.00		
Middle	0.63	(0.51, 0.78)	<0.001	0.74	(0.59, 0.92)	0.009
Rich	0.29	(0.24, 0.37)	<0.001	0.52	(0.42, 0.65)	0.001
Number of ANC visits						
No visit	1.00			1.00		
1–3 visits	0.25	(0.23, 0.31)	<0.001	0.37	(0.29, 0.48)	<0.001
4+ visits	0.15	(0.12, 0.18)	<0.001	0.26	(0.20, 0.33)	<0.001
Type of ANC provider						
Skilled health personnel	1.00					
Non-skilled health personnel[a]	6.28	(5.36, 7.34)	<0.001			
Quality of ANC service at the time of ANC visits						
Good quality ANC (receiving ≥ 4 ANC services)	1.00					
Lower quality ANC (receiving < 4 ANC services)	5.65	(4.88, 6.55)	<0.001			
4. Need factors						
Desire for last pregnancy						
Wanted to get pregnant then	1.00					
Wanted to get pregnant later	0.68	(0.48, 0.96)	0.029			
Never wanted to get pregnant	0.47	(0.29, 0.77)	0.004			
Pregnancy complications						
Yes with 1–2 complications	1.00			1.00		
Yes with 3 or more complications	0.89	(0.75, 1.05)	0.150	0.77	(0.65, 0.90)	0.001
No without complication	2.12	(1.77, 2.54)	<0.001	1.23	(1.00, 1.52)	0.051
Delivery/post delivery complications						
Yes with complications	1.00					
Yes with 3 or more complications	1.14	(0.97, 1.35)	0.099			
No without complications	2.07	(1.67, 2.57)	<0.001			

[a] Referred to any ANC services provided by: traditional birth attendance, community health workers and relative/Friend and those who had no ANC visits

[b] 366 missing information was not include in the multivariate analysis; Independent variables adjusted for all the above variables

[c] Secondary + education was merge with primary + education due to small number of mothers who have attended secondary + education

[d] Household wealth was divided into 3 categorizes the bottom 1/3rd of household that was arbitrarily referred as poor household, the next 1/3 rd as middle level household and the top 1/3rd as rich households

survey data used relied on a mother's ability to remember details about her previous pregnancy and childbirth.

Conclusion

Several environment, predisposing, enabling and need factors were associated with non-use of SBAs at delivery. Among the independent variables, low levels of maternal education, poverty and rural dwelling appeared to influence a mother's choice of non-use of SBAs at birth. There is a need to prioritize strategies to improve facilities and infrastructure in these deprived rural areas. Provision of free reproductive services would enable mothers from poor households to utilize maternal health services. Improving female education should be a priority in South Sudan as well as training and improving the skills of health staff.

Author's Contributions NSM and MJD contributed in the study design. NSM and KA performed the analysis and NSM prepared the manuscript. Revision of the manuscript and data analysis advice was provided by MJD and KA. All authors read and approved the final manuscript.

Compliance with Ethical Standards

Conflict of interest The authors declare no conflict of interest.

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Chapter 6: Factors associated with different types of birth attendants for home deliveries: an analysis of the cross-sectional 2010 South Sudan Household survey

Global Health Action

ORIGINAL ARTICLE

Factors associated with different types of birth attendants for home deliveries: an analysis of the cross-sectional 2010 South Sudan household survey

Ngatho S. Mugo[1]*, Kingsley E. Agho[2], Anthony B. Zwi[3] and Michael J. Dibley[1]

[1]Sydney School of Public Health, The University of Sydney, Sydney, Australia; [2]School of Science and Health, Western Sydney University, Penrith, Australia; [3]School of Social Sciences, University of New South Wales, Kensington, Australia

Background: In South Sudan, birth deliveries attended by unskilled birth attendants put the mothers and their newborns at increased risk of perinatal morbidity and mortality. The aim of this study was to identify factors associated with delivery by unskilled birth attendants or by unassisted delivery.

Design: We examined data for 2,767 (weighted total) women aged 15–49 years who delivered at home 2 years prior to the South Sudan Household Health Survey 2010. Multinomial logistic regression analyses were used to identify factors associated with delivery by unskilled birth attendants or by unassisted delivery.

Results: The prevalence of delivery by unskilled birth attendants was 19% [95% confidence interval (CI) 17.0, 20.5], by skilled birth attendants (SBAs) was 45% (95% CI 42.4, 47.0), and by unassisted delivery was 36% (95% CI 34.2, 38.6). After adjusting for potential confounders, the following factors were associated with the increased odds for unassisted delivery or delivery by an unskilled birth attendant: mothers with no schooling, who did not attend antenatal care (ANC) during pregnancy, who had lower quality of ANC services, from poor households, or who had no prior knowledge about obstetric danger signs.

Conclusions: We found that non-utilization of maternal health care services, such as ANC, was significantly associated with unattended birth delivery or delivery by unskilled health providers. The increased uptake of SBAs at delivery will require easier access to ANC services, health promotion on the importance and benefits of SBAs for delivery, targeting both mothers and their families, and the training and deployment of more SBAs across the country.

Keywords: *skilled birth attendants*; *maternal health services*; *home birth*; *socio-economic factors*; *South Sudan*

Responsible Editor: Maria Emmelin, Lund University, Sweden.

*Correspondence to: Ngatho S. Mugo, University of Sydney, Room 125, Edward Ford Building (A27), NSW, 2006, Sydney, Australia, Email: n.mugo@hotmail.com

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Introduction

Globally, unassisted delivery or delivery assisted by unskilled birth attendance is a public health concern associated with high maternal mortality and morbidity. According to 2013 estimates, the Sub-Saharan Africa region accounted for 62% (179,000) of global maternal deaths (1). Most of these deaths could have been prevented if mothers had access antenatal care (ANC) during pregnancy, were attended by a skilled birth attendant (SBA) who was able to deal with complications during delivery, and had appropriate care and support in the early postpartum period (2–7). In low and middle-income countries, a significant proportion of women still deliver at home either without or with support from unskilled health providers (8–10).

The dangers of home deliveries include an unhygienic setting, the failure to recognize maternal and fetal distress or complications, the failure to detect maternal and newborn complications during delivery or post-delivery, and inadequate supervision by health care workers (10). Unfortunately, in South Sudan, pregnant women often deliver under such conditions, thus increasing their risks of maternal morbidity and mortality (11).

Access to and use of maternal and child healthcare related services in South Sudan is relatively low. Pregnant women often deliver at home unattended by an SBA due to various socio-economic and physical barriers, such as the costs of health service user fees, lack of transport, inadequate number of skilled health workers, coupled

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with the insecurity in most of states and the impact of the prolonged civil war, which has led to an almost total destruction of functioning health facilities (11).

In the 2007 South Sudan household survey report, the majority of births (81%) occurred at home with only 11.5% of deliveries at a health facility (12, 13). Of mothers who delivered at home, 30% delivered without assistance, 36% were assisted by relatives or friends, 20% were assisted by traditional birth attendants, and only 10% were assisted by an SBA (12).

In response to Millennium Development Goals (MDGs 5), the government has made efforts to reduce maternal deaths during pregnancy and childbirth and deaths in the first year of life as outlined in the national reproductive health plan (14, 15). The government has also made a recent commitment to the UN Secretary General's Every Woman Every Child initiative with the provision of free reproductive health services and increased access to good quality emergency obstetric care services (16). However, maternal mortality was estimated at 2,054 per 100,000 live births in 2006 and is amongst the highest in the world, highlighting the critical need for developing quality health care during pregnancy, childbirth, and the postpartum period (17).

Several studies have explored the associations between socio-cultural, economic, and other determinants of health that influence women's decisions to deliver at home rather than in a health facility (18–20). However, no study has investigated the factors that influence women choices to deliver at home with unskilled health care providers in South Sudan. Therefore, the aim of this study was to investigate the risk factors associated with delivery in the absence of any assistance and delivery by unskilled birth attendants compared to deliveries attended by an SBA. Our findings will enable policy makers and public health researchers to develop interventions that target vulnerable populations of women and improve access to facility delivery and maternal health services.

Methods

Data source

Our dataset was obtained from the South Sudan Household Health Survey second round (SSHHSII) carried out in 2010 that used the Multiple Indicator Cluster Survey (MICS) methodology developed by UNICEF. The SSHHSII is a nationally representative, stratified, cluster sample survey covering the population of South Sudan (13). The aim of the study was to collect health and related indicators to identify the health needs of women and children and to establish priorities for evidence-based planning, decision-making, and reporting. The survey comprised a general questionnaire to collect information on all household members, with three individual questionnaires addressed to specific target groups: women and men aged 15–49 and under-five children. The household and individual questionnaires were used to collect information on demographic characteristics and reproductive history, pregnancy-related information, knowledge and practices concerning family planning, information on child health indicators, and other determinants of maternal health. The dataset comprised information on 9,069 ever-married women, 4,345 men aged 15–49 years and 8,338 under-five children. Details of the SSHHSII sampling methods have been reported (13, 21).

Sample size determination

The sample size for the SSHHSII was calculated as 10,000 households using the prevalence of under-five child diarrhea as the key indicator assuming a prevalence of 20%, a design effect of 1.5, 16% of the total population to be under-five children, and a participation rate of 90%. The results reported in this paper were based on data from 2,767 women for which the primary outcome was unassisted delivery or delivery by unskilled birth attendants. We estimated that the sample had a 80% power to detect an odds ratio of at least 1.3 or a difference in prevalence of 6.0%, assuming an alpha level of 5%, a prevalence of delivery by unskilled birth attendants or unassisted delivery of 60%, a design effect of 1.25 (based on other surveys) (22), and a total sample of 2,214, which was obtained by dividing 2,767 by the design effect. This provided sufficient statistical power to examine risk factors for the non-use of SBAs that would be of public health significance.

Study population

A total of 2,767 of mothers out of 3,504 aged 15–49 years who gave birth within 2 years prior to the survey and delivered their babies at home were included in the analyses. Figure 1 illustrates the selection process for the mother at the household level. Information on delivery assistance was collected from the mothers' most recent birth. We excluded 457 (14%) of mothers who delivered at health facilities.

Conceptual framework and study variables

We modified the framework by Gabrysch and Campbell (23) to group risk factors that have a potential impact on the access to health care services in developing countries (23, 24). Figure 2 presents the variables included in the analyses. These were selected based on the framework to understand how they were linked to the likelihood of delivery unattended or attended by an unskilled birth attendant. A total of 16 potential risk factors associated with delivery were categorized into 1) socio-cultural factors primarily influencing decisions whether to seek care including maternal age at last birthday, maternal marital status, number of living children, maternal education, and polygamy status; 2) perceived needs and benefits (factors that influence perception of the benefit and need for facility delivery by SBAs including birth order, desire of

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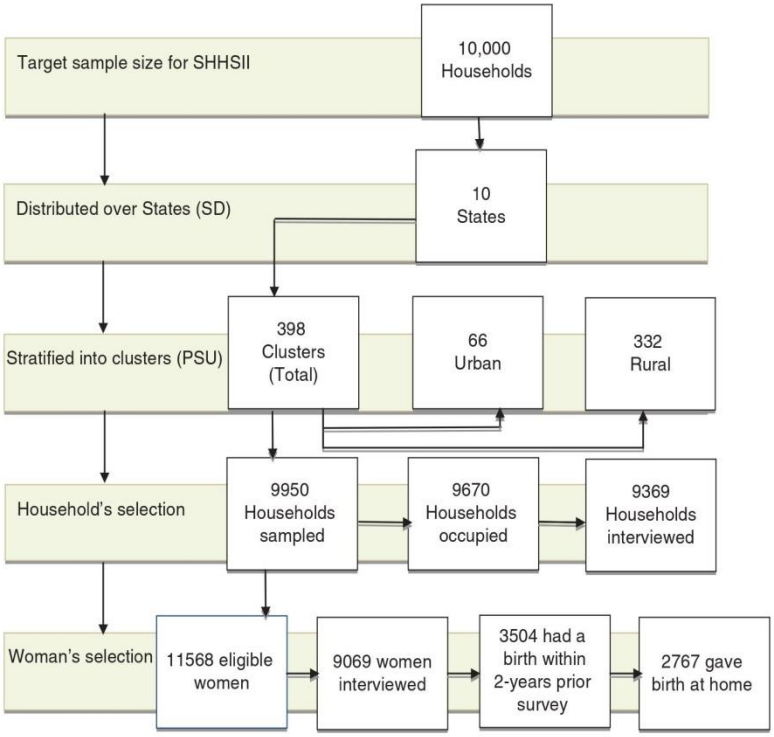

Fig. 1. A multiple-stage methodology process for selection of woman at the household level, 2010-SHHSII. SSHHSII: South Sudan Household survey second round. State: is the sampling domain (SD). Cluster: is the primary sampling unit (PSU).

the last pregnancy, number of previous pregnancy, knowledge of danger signs of pregnancy, delivery and post-delivery, knowledge of newborn danger signs, number of ANC visits, and quality of ANC visits and pregnancy complication); 3) economic accessibility (capacity to cope with costs associated with maternal healthcare including household wealth); and 4) physical accessibility (distance and transport to maternal health services including type of residence and geographical location) (23, 25).

The outcome variable used in analyses was home delivery defined as a childbirth outside a health facility, that is at home or on the way to the health facility, with or without assistance and was classified into 1) mothers who delivered at home unassisted, 2) mothers who delivered at home assisted by an unskilled birth attendant (such as traditional birth attendants, community health workers, and relatives/friends), and 3) mothers who delivered at home assisted by a SBA (such as a doctor, nurse-midwife, village midwife, medical assistance, or health visitor).

Household wealth index was constructed from an inventory of 20 household facilities and assets including material of the dwelling floor, roof, and walls; number of persons per sleeping room; fuel used for cooking; availability of electricity; ownership of radio, television, mobile phone, telephone, refrigerator, and watch; ownership of transport devices such as bicycles, motorcycles/scooters, animal-drawn carts, cars/trucks, and boats; source of drinking water and type of sanitation facility; and ownership of livelihood assets such as animals and land. Details of the wealth index have been reported with a principal components analysis to weight the contribution of items to the index (26). The index was divided into three categories; the bottom one-third of households referred to as poor households, the central one-third as middle level households, and the top one-third as relatively well-off or richer households.

We also generated a variable referred to as quality of ANC services from the ANC services received during pregnancy, which included measuring blood pressure, examining urine and blood samples, administering tetanus toxoid injections, use of iron/folic acid supplements, preventive treatment for malaria, and information on the mode and place of delivery. A woman was considered to have a good quality of ANC service when she received four or more of the above services and to have a lower quality of ANC services when she received fewer than four services (27).

Ethical approval

The ethics committee of the department of Ministry of Health, Government of South Sudan, approved the survey design of the SSHHSII. All survey respondents

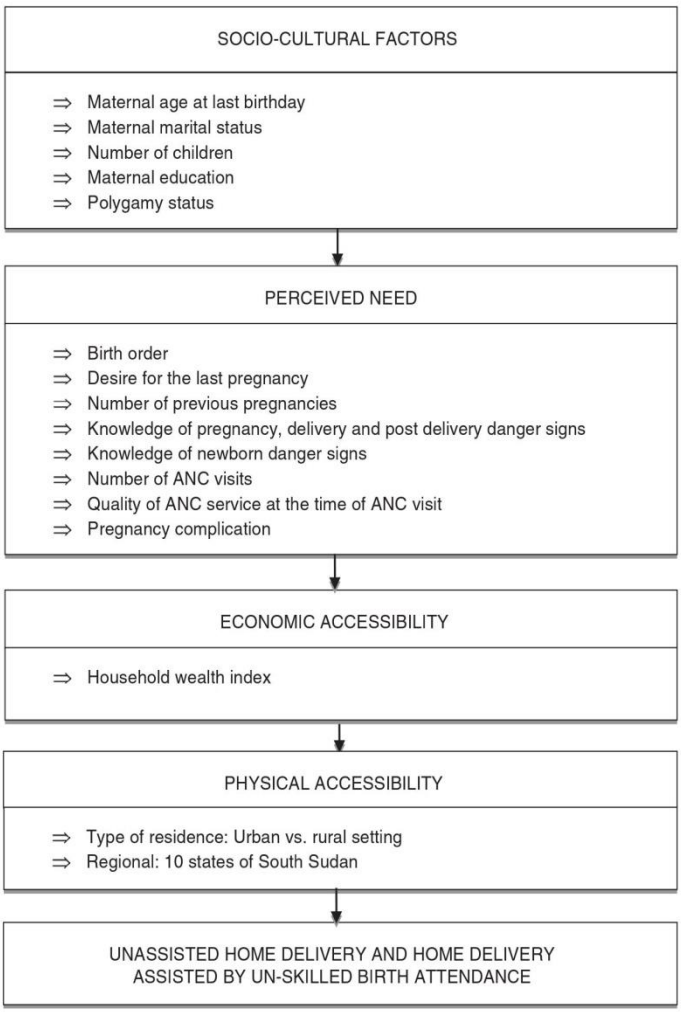

Fig. 2. Theoretical framework of risk factors associated with home delivery in South Sudan. This framework was adopted by Gabrysch and Campbell, from the Thaddeus and Maine's three delays model.

provided verbal informed consent; consent for children was obtained through parents, caregivers, or guardians. To maintain participants' privacy, records were de-identified. The dataset of SSHHSII is not available as a public domain dataset. The first author requested access to the data from Director of Health Social and Demographic Statistics and from the Ministry of Health of South Sudan, and access was granted to use the data for this research.

Statistical analysis

Analyses were carried out using STATA/MP version 12 (StataCorp, College Station, TX, USA). The 'Svy' survey commands were used to allow for adjustments for the cluster-sampling design and sampling weights (28). First, frequency tabulations were conducted with the Taylor series linearization method to estimate confidence intervals (CIs) around prevalence estimates (24). This was followed by contingency table analyses to examine the impact of potential predictors on unassisted delivery or delivery by unskilled birth attendants. Because the outcome variable had three categories, univariable multinomial logistic regressions were conducted to determine the unadjusted odd ratios for unassisted delivery or delivery by unskilled birth attendants. This was followed by multivariable multinomial logistic regression analysis as a four-stage model guided by the conceptual framework to determine the adjusted odds ratios for factors associated with unassisted delivery or delivery by unskilled birth attendants (29).

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In the first stage, socio-cultural factors were entered and a manual backward elimination method was used to determine risk factors. In the second stage, the significant factors in the first stage were added to perceived need factors and this was followed by a backward elimination procedure. A similar approach was used for economic accessibility factors and physical accessibility factors in the third and fourth stages. In the final model, the knowledge of newborn and obstetrical danger signs appeared collinear because their univariable and multivariable odds ratios were different; this was explored using chi-square tests. From the multivariable model, odds ratios with 95% CI were used to assess the adjusted independent risk factors associated with unassisted or assisted delivery.

Results

Main findings

A total of 3,504 women age 15–49 years gave birth within 2 years prior to the survey of whom 2,767 delivered their babies at home. Of the home deliveries, 19% (95% CI 17.0, 20.5) were unassisted, 45% (95% CI 42.4, 47.0) were assisted by an unskilled birth attendant and only 36% (95% CI 34.2, 38.6) were assisted by an SBA.

Characteristics of the study population

Table 1 shows the demographics of the study population, which was mainly young married women giving birth for the first time in a monogamous relationship. The women were mostly from rural areas, uneducated, and lacked knowledge about newborn and obstetric danger signs and symptoms. Almost three-fifths of women had not had an ANC visit and three-quarters had a lower quality of ANC services. About one-third lived in poor households and four-fifths had desired their pregnancy. Across the states, the distribution of the study population varied from 8% in Unity to 13% in Upper Nile state.

Risks factors associated with home delivery

Table 2 shows the prevalence of delivery by type of birth attendant. The prevalence of delivery with an SBA was significantly higher for mothers with at least primary education, with a greater knowledge of obstetric and newborn danger signs, with four or more ANC visits, and with higher quality ANC. The prevalence rates for number of previous pregnancies, number of children, polygamy status, desire for pregnancy, and urban/rural residence were similar across the type of birth attendant.

Table 3 shows the unadjusted odds ratios from the univariable and multivariable analyses, which indicated that a lower level of education, fewer ANC visits, and poorer quality ANC were risk factors for unassisted delivery and delivery by an unskilled birth attendant. In addition, lacking knowledge about obstetric danger signs,

Table 1. Characteristics of the study population according to socio-cultural factors, perceived need, economic accessibility, and physical accessibility, South Sudan household survey second round 2010 ($n = 2,767$)

Variable	*N*	%
Socio-cultural factors		
Maternal age at last birthday		
15–19 years	212	7.7
20–34 years	1,993	72.0
35–49 years	562	20.3
Maternal marital status		
Currently married	2,137	77.2
Formerly married	454	16.4
Never married (single)	176	6.3
Number of children		
1–2 children	1,345	48.6
3–4 children	828	29.9
5 or more children	593	21.4
Maternal education ($n = 2,766$)		
Primary + education	511	18.5
No education	2,255	81.5
Polygamy status ($n = 2,527$)		
Husband has one wife	1,500	59.4
Husband has more than one wife	1,027	40.6
Perceived need		
Birth order ($n = 2,428$)		
First birth	1,158	47.7
Second birth	773	31.9
Third or more birth	497	20.5
Desire for last pregnancy ($n = 2,713$)		
Wanted to get pregnant	2,395	88.3
Wanted to get pregnant later/never wanted to get pregnant	318	11.7
Number of previous pregnancies		
1 pregnancy	2,643	95.5
2 or more pregnancies	124	4.5
Knowledge of obstetric danger signs during pregnancy, delivery and post delivery		
Adequate (correct answers for 5 or more questions)	469	17.0
Inadequate (correct answers for 1–4 questions)	2,160	78.1
None (all answers incorrect)	138	5.0
Knowledge on newborn danger signs		
Adequate (correct answers for 5 or more questions)	505	18.3
Inadequate (correct answers for between 1 and 4 questions)	2,133	77.1
None (all answers incorrect)	129	4.6
Number of ANC visits		
4 or more visits	429	15.5
1–3 visits	710	25.7
No visits	1,628	58.8

Table 1 (*Continued*)

Variable	*N*	%
Quality of ANC service at the time of ANC visits		
Good quality ANC (receiving more than 4 ANC services)	729	26.4
Lower quality ANC (receiving fewer than 4 ANC services)	2,037	73.6
Pregnancy complications[a]		
Yes with 1–2 complications	1,046	37.8
Yes with 3 and more complications	960	34.7
No without complications	760	27.5
Economic accessibility		
Household wealth index		
Rich	930	33.6
Middle	921	33.3
Poor	916	33.1
Physical accessibility		
Type of resident (total)		
Urban	579	20.9
Rural	2,188	79.1
Geographic location (state)		
Central Equatoria	270.3	9.8
Western Equatoria	288.4	10.4
Eastern Equatoria	236.5	8.5
Lakes	296.1	10.7
Western Bahr el Ghazal	252.5	9.1
Northern Bahr el Ghazal	334.3	12.1
Warap	231.6	8.4
Unity	218.1	7.9
Jounglei	270.1	9.8
Upper Nile	368.9	13.3

[a]Pregnancy complications included excessive vaginal bleeding, high blood pressure, convulsions, high fever, painful urination, abdominal/back pain, foul-smelling vaginal discharge, and jaundice.

lacking experience with pregnancy complications, being a never-married single mother, and being from a poor household were also significant risk factors for unassisted delivery and the use of unskilled birth attendants.

In the univariable analyses, knowledge of both newborn and obstetrical danger signs were significantly associated with unassisted delivery or delivery with unskilled attendants. However these two variables were collinear (chi-square = 1210.0, $p = < 0.0001$) and could not both be included in the final multivariable model. Therefore, only knowledge of obstetric danger signs was used.

Discussion

The results of this study indicate that a high proportion of South Sudanese mothers still deliver at home, often unassisted or assisted by unskilled birth attendants, thus increasing their risk of maternal morbidity. The prolonged civil war may have further contributed to the country having the world's lowest percentage of births attended by SBAs (11). Since the majority of births take place at home, high priority should be given the short-term strategy of making every delivery safe by providing the presence of a trained SBA. In the long term, in order to reduce maternal morbidity and mortality, the focus should be to expand access to improved delivery care in equipped maternity facilities to accommodate the needs of women during pregnancy, delivery, and post-delivery.

The main factors associated with unassisted delivery and delivery assisted by an unskilled attendant were low levels of education, inadequate prior knowledge of pregnancy, lack of knowledge of delivery and post-delivery danger signs, and the failure to use maternity care services. These factors were significantly associated with women's choice to deliver without an SBA.

The failure to use maternal health services, such as ANC visits, was a predictor of women delivering without an SBA. We found that women who had no ANC visits were at an increased risk of delivery with unskilled birth attendants or unassisted delivery, in comparison with women who had at least one to three ANC visits. This finding is similar to that of other studies in Tanzania, Cambodia, Ethiopia, and South Sudan (21, 30–32). ANC visits allow the early detection of obstetrical complications and also give the health provider an opportunity to discuss delivery plans and influence the decision to have an SBA. However, low access to and use of these services may be the result of inadequate or absent services at the local health facility, which may negatively impact mothers seeking medical care from SBAs (21, 32). Hence, there is a need for better trained community-based health staff in order to increase the uptake of delivery by SBAs. The government of South Sudan needs to improve locally available and accessible antenatal, intra-partum, and immediate prenatal care. It is also essential carry out community outreach in order to educate and increase awareness on family planning and the availability and importance of maternal health services.

The quality of services during ANC visits is an important factor that can influence where mothers deliver their babies. We found that mothers who had lower quality ANC services, such as examining their blood pressure and blood and urine sample tests, were at increased risk of unassisted delivery or delivery with an unskilled birth attendant. This finding is consistent with that of studies in Nepal, Ghana, and Congo (33–35). In South Sudan, low quality ANC services are associated with poor health infrastructure, coupled with lack of medical supplies. The supply of medical supplies may be affected not only shortages of medicines but also, in most of the country,

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Table 2. The prevalence for factors associated with unattended home delivery and home delivery attended by unskilled birth attendants and SBAs according to socio-cultural factors, perceived need, economic accessibility, and physical accessibility from the South Sudan household survey, 2010 ($n = 2,767$)

	Unattended home birth		Home birth attended by unskilled health provider		Home birth attended by skilled health provider		
Variables	%	95% CI	%	95% CI	%	95% CI	*p*
Socio-cultural factors							
Maternal age at her last birthday (years)							
15–19 years	7.0	4.8, 10.0	7.7	6.0, 9.9	8.0	6.0, 9.9	
20–34years	73.2	68.6, 77.4	70.2	66.9, 73.2	73.6	70.4, 76.5	
35–49 years	19.8	16.1, 24.0	22.1	19.5, 24.0	18.4	15.9, 21.1	0.55
Maternal marital status							
Currently married	78.6	73.9, 82.7	73.9	70.6, 76.9	80.7	77.5, 83.5	
Formerly married	16.8	13.0, 21.5	17.6	15.1, 20.4	14.7	12.1, 17.7	
Never married (single)	4.6	3.1, 6.8	8.5	6.7, 10.8	4.6	3.3, 6.3	0.02
Number of children							
1–2 children	47.0	42.1, 51.9	48.2	44.7, 51.9	50.2	44.0, 51.0	
3–4 children	34.8	30.3, 39.7	28.9	25.8, 32.3	28.7	31.7, 38.4	
5 children and more	18.2	14.6, 22.9	22.8	20.0, 25.9	21.1	14.9, 20.5	0.04
Maternal education ($n = 2,766$)							
Primary + education	13.4	10.1, 17.6	14.5	12.3, 17.1	25.9	22.7, 29.3	
No education	86.6	82.4, 89.9	85.5	82.9, 87.7	74.0	70.5, 77.2	<0.0001
Polygamy status ($n = 2,527$)							
Husband has one wife	55.0	49.9, 59.9	52.5	49.1, 55.9	56.0	52.4, 59.5	
Husband has more than one wife	39.7	34.9, 44.7	37.1	34.0, 40.3	35.8	32.7, 39.1	0.10
Perceived need							
Birth order ($n = 2,428$)							
First birth	42.0	37.2, 47.1	45.2	41.9, 48.5	37.5	34.3, 40.7	
Second birth	25.9	21.7, 30.6	27.0	24.3, 29.8	30.4	27.4, 33.6	
Third or more birth	17.4	13.9, 21.5	17.0	14.8, 19.5	19.3	16.7, 22.3	0.049
Desire for last pregnancy ($n = 2,713$)							
Wanted to get pregnant then	83.3	79.8, 87.0	89.6	87.3, 91.6	84.5	81.9, 86.8	
Wanted to get pregnant later/never wanted to get pregnant	14.8	11.3, 19.1	8.9	7.1, 11.2	12.9	10.8, 15.2	0.03
Number of previous pregnancies							
1 pregnancy	94.2	91.3, 96.2	97.1	96.0, 97.9	94.2	92.1, 95.8	
2 or more pregnancies	5.8	3.8, 8.7	2.9	2.1, 4.0	5.8	4.2, 7.9	0.02
Knowledge of obstetric danger signs during pregnancy, delivery and post delivery							
Adequate for (correct answer 5 or more)	13.8	10.7, 17.7	15.4	13.1, 17.9	20.6	17.6, 24.0	
Inadequate for (correct answer between 1 and 4)	76.9	72.1, 81.1	79.6	76.7, 82.2	76.9	73.5, 80.0	
None for (all incorrect answer)	9.3	6.5, 13.1	5.1	3.8, 6.7	2.5	1.7, 3.7	<0.0001
Knowledge on newborn danger signs							
Adequate for (correct answer 5 or more)	18.4	14.6, 22.9	14.3	12.3, 16.7	23.1	20.0, 26.5	
Inadequate for (correct answer between 1 and 4)	74.2	69.2, 78.5	81.5	78.9, 83.9	73.2	69.7, 76.4	
None for (all incorrect answer)	7.5	5.1, 10.8	4.1	2.9, 5.9	3.7	2.6, 5.3	<0.0001

Table 2 (*Continued*)

Variables	Unattended home birth %	Unattended home birth 95% CI	Home birth attended by unskilled health provider %	Home birth attended by unskilled health provider 95% CI	Home birth attended by skilled health provider %	Home birth attended by skilled health provider 95% CI	*p*
Number of ANC visit							
4 or more visits	8.7	6.1, 12.1	11.2	9.3, 13.5	24.2	21.1, 27.6	
1–3 visits	19.6	15.9, 23.9	20.6	18.0, 23.5	35.0	31.6, 38.6	
No visits	71.8	66.9, 76.2	68.1	64.8, 71.3	40.7	37.3, 44.3	<0.0001
Quality of ANC service at the time of ANC visits							
Good quality ANC (receiving >4 ANC services)	20.1	16.2, 24.6	16.7	14.3, 19.3	41.6	38.1, 45.1	
Lower quality ANC (receiving <4 ANC services)	79.9	75.4, 83.8	83.3	80.7, 85.7	58.4	54.9, 61.9	<0.0001
Pregnancy complications[a]							
Yes, with 1–2 complications	41.6	36.8, 46.6	35.5	32.3, 38.7	38.6	35.2, 42.1	
Yes, with 3 and more complications	29.0	24.5, 33.9	34.2	31.2, 37.4	38.4	35.0, 42.0	
No, without complications	29.4	24.9, 34.2	30.3	27.4, 33.5	23.0	20.2, 26.0	0.002
Economic accessibility							
Household wealth index							
Rich	31.6	27.0, 36.5	31.4	28.2, 34.7	37.4	34.1, 41.0	
Middle	35.5	30.8, 40.6	32.3	29.2, 35.6	33.2	29.9, 36.6	
Poor	32.9	28.1, 38.0	36.3	33.0, 39.7	29.4	26.2, 32.7	0.04
Physical accessibility							
Type of resident (total)							
Urban	19.9	16.1, 24.4	18.6	15.9, 21.5	24.3	21.0, 27.8	0.04
Rural	80.1	75.6, 83.9	81.4	78.5, 84.1	75.7	72.2, 79.0	
Geographic location (state)							
Central Equatoria	12.6	9.2, 17.0	8.7	6.7, 11.2	9.5	7.1, 12.6	0.77
Western Equatoria	10.1	7.2, 14.1	9.4	7.2, 12.3	11.9	9.2, 15.3	
Eastern Equatoria	9.6	6.7, 13.6	7.9	5.9, 10.7	8.8	6.6, 11.7	
Lakes	10.4	7.6, 14.0	11.3	9.1, 13.9	10.2	7.9, 13.2	
Western Bahr el Ghazal	8.5	6.0, 11.9	8.8	7.0, 10.9	10.0	7.8, 12.7	
Northern Bahr el Ghazal	10.1	7.3, 13.9	12.8	10.1, 16.3	12.1	9.6, 15.0	
Warap	7.5	5.2, 10.7	9.5	7.6, 11.9	7.5	5.6, 9.8	
Unity	7.3	5.1, 10.3	9.2	7.3, 11.5	6.7	5.0, 8.8	
Jounglei	10.4	7.5, 14.2	9.9	7.7, 12.6	9.3	6.9, 12.4	
Upper Nile	13.5	9.6, 18.6	12.5	10.0, 15.5	14.2	11.1, 17.9	

[a]Pregnancy complications include excessive vaginal bleeding, high blood pressure, convulsions, high fever, painful urination, abdominal/back pain, foul-smelling vaginal discharge, and jaundice.

the unavailability of refrigeration, which is necessary for the long-term storage of drugs (11, 36). In addition, health providers are insufficiently trained to meet the health needs of mothers and are often confronted with the inadequate and delayed payment of their salaries (11). Therefore, there is a need for the government to improve existing health facilities and ensure the proper training of health providers, including emergency care services. Improving the payment of salaries to health providers across the health sector, as well as providing incentives to health providers in remote and rural areas, would go a long way to increase the rate of delivery of babies at health facilities or at home with assistance from an SBA.

In Ghana and Turkey (37–39), household poverty is strongly associated with unskilled birth attendants, a conclusion that was confirmed in our study, which showed that mothers from poor households had a significantly higher risk of unassisted delivery or delivery by an unskilled birth attendant. In South Sudan, poverty affects most households (17) and most mothers from poor households reside in rural and remote areas and have had no schooling (21). Mothers who live in such

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Table 3. Unadjusted and adjusted odds ratios for factors associated with unassisted home delivery and home delivery assisted by unskilled health provider compared to deliveries assisted by SBAs according to socio-cultural factors, perceived need, economic accessibility, and physical accessibility, South Sudan household survey, 2010 ($n = 2{,}767$)

	Unattended home birth						Home birth attended by unskilled health provider					
	Unadjusted odd ratios			Adjusted odd ratios[a]			Unadjusted odd ratios			Adjusted odd ratios[a]		
Variables	OR	95% CI	P	AOR	95% CI	P	OR	95% CI	P	AOR	95% CI	P
Socio-cultural factors												
Maternal age at her last birthday (years)												
15–19 years	1.00						1.00					
20–34 years	1.14	0.71, 1.84	0.58				1.00	0.69, 1.44	0.98			
35–49 years	1.24	0.73, 2.09	0.43				1.26	0.84, 1.88	0.27			
Maternal marital status												
Currently married	1.00			1.00			1.00			1.00		
Formerly married	1.17	0.81, 1.70	0.40	1.00	0.68, 1.48	0.99	1.31	0.99, 1.72	0.06	1.20	0.88, 1.63	0.25
Never married (single)	1.02	0.60, 1.75	0.94	0.89	0.48, 1.66	0.71	2.02	1.32, 3.09	0.001	1.73	1.11, 2.70	0.02
Number of children												
1–2 children	1.00						1.00					
3–4 children	1.29	0.99, 1.70	0.06				1.05	0.84, 1.31	0.69			
5 children and more	0.92	0.66, 1.28	0.62				1.12	0.88, 1.44	0.35			
Maternal education ($n = 2{,}766$)												
Primary or more education	1.00			1.00			1.00			1.00		
No education	2.26	1.58, 3.24	<0.0001	1.65	1.08, 2.51	0.02	2.06	1.58, 2.68	<0.0001	1.43	1.07, 1.91	0.02
Polygamy status ($n = 2{,}527$)												
Husband has one wife	1.00						1.00					
Husband has more than one wife	1.13	0.88, 1.46	0.35				1.10	0.90, 1.35	0.34			
Perceived need												
Birth order ($n = 2{,}428$)												
First birth	1.00			1.00			1.00			1.00		
Second birth	0.76	0.56, 1.03	0.07	0.80	0.59, 1.09	0.16	0.74	0.59, 0.92	0.01	0.77	0.61, 0.97	0.03
Third or more birth	0.80	0.57, 1.13	0.21	0.81	0.56, 1.15	0.24	0.73	0.56, 0.95	0.02	0.75	0.57, 0.98	0.04
Desire for last pregnancy ($n = 2{,}713$)												
Wanted to get pregnant then	1.00						1.00					
Wanted to get pregnant later/never wanted to get pregnant	1.16	0.81, 1.67	0.41				0.65	0.48, 0.89	0.01			
Number of previous pregnancies												
1 pregnancy	1.00						1.00					
2+ pregnancy	1.01	0.57, 1.76	0.98				0.49	0.30, 0.79	0.004			

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Table 3 (*Continued*)

	Unattended home birth						Home birth attended by unskilled health provider					
	Unadjusted odd ratios			Adjusted odd ratios[a]			Unadjusted odd ratios			Adjusted odd ratios[a]		
Variables	OR	95% CI	P	AOR	95% CI	P	OR	95% CI	P	AOR	95% CI	P
Knowledge of obstetric danger signs during pregnancy, delivery and post delivery												
Adequate for (correct answer 5 or more)	1.00			1.00			1.00			1.00		
Inadequate for (correct answer between 1 and 4)	1.49	1.05, 2.12	0.03	1.45	0.97, 2.16	0.07	1.39	1.059, 1.82	0.02	1.32	0.98, 1.77	0.07
None for (all incorrect answer)	5.49	2.92, 10.3	<0.0001	3.67	1.89, 7.13	<0.0001	2.70	1.56, 4.65	<0.0001	2.08	1.17, 3.71	0.01
Knowledge on newborn danger signs												
Adequate for (correct answer 5 or more)	1.00						1.00					
Inadequate for (correct answer between 1 and 4)	1.27	0.92, 1.77	0.152				1.79	1.38, 2.33	<0.0001			
None for (all incorrect answer)	2.53	1.37, 4.69	0.00				1.80	1.01, 3.20	0.045			
Number of ANC visit												
4 or more visits	1.00			1.00			1.00			1.00		
1–3 visits	1.56	0.99, 2.47	0.058	1.33	0.80, 2.20	0.28	1.27	0.94, 1.71	0.12	1.09	0.79, 1.51	0.59
No visits.	4.92	3.21, 7.55	<0.0001	3.87	2.28, 6.58	<0.0001	3.60	2.71, 4.78	<0.0001	2.13	1.49, 3.04	<0.0001
Quality of ANC service at the time of ANC visits												
Good quality ANC (receiving more than 4 ANC services)	1.00			1.00			1.00			1.00		
Lower quality ANC (receiving fewer than 4 ANC services)	2.83	2.10, 3.80	<0.0001	1.17	0.77, 1.76	0.46	3.55	2.82, 4.48	<0.0001	2.04	1.51, 2.75	<0.0001
Pregnancy complications[b]												
Yes, with 1–2 complications	1.00			1.00			1.00			1.00		
Yes, with 3 and more complications	0.70	0.53, 0.93	0.013	0.65	0.47, 0.90	0.01	0.97	0.77, 1.22	0.79	0.86	0.67, 1.11	0.25
No, without complications	1.19	0.89, 1.59	0.25	0.95	0.68, 1.32	0.76	1.44	1.13, 1.83	0.003	1.11	0.85, 1.45	0.44
Economic accessibility												
Household wealth index												
Rich	1.00			1.00			1.00			1.00		
Middle	1.27	0.95, 1.71	0.11	1.16	0.84, 1.61	0.36	1.16	0.92, 1.47	0.20	1.10	0.86, 1.42	0.45
Poor	1.33	0.97, 1.80	0.07	1.27	0.90, 1.80	0.18	1.47	1.16, 1.88	0.002	1.34	1.03, 1.76	0.03
Physical accessibility												
Type of resident (total)												
Urban	1.00						1.00					
Rural	1.29	0.94, 1.76	0.11				1.41	1.09, 1.82	0.009			
Geographic location (state)												
Central Equatoria	1.00						1.00					
Western Equatoria	0.64	0.36, 1.134	0.13				0.87	0.55, 1.39	0.56			
Eastern Equatoria	0.82	0.45, 1.47	0.50				0.99	0.59, 1.65	0.96			

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Table 3 (Continued)

Variables	Unattended home birth						Home birth attended by unskilled health provider					
	Unadjusted odd ratios			Adjusted odd ratios[a]			Unadjusted odd ratios			Adjusted odd ratios[a]		
	OR	95% CI	P	AOR	95% CI	P	OR	95% CI	P	AOR	95% CI	P
Lakes	0.76	0.44, 1.33	0.34				1.20	0.75, 1.94	0.44			
Western Bahr el Ghazal	0.64	0.36, 1.14	0.13				0.96	0.60, 1.56	0.87			
Northern Bahr el Ghazal	0.63	0.37, 1.07	0.09				1.17	0.73, 1.87	0.52			
Warap	0.75	0.42, 1.35	0.34				1.39	0.86, 2.27	0.18			
Unity	0.82	0.46, 1.47	0.51				1.50	0.92, 2.46	0.11			
Jounglei	0.84	0.47, 1.50	0.56				1.16	0.69, 1.96	0.57			
Upper Nile	0.71	0.41, 1.25	0.24				0.97	0.60, 1.55	0.89			

[a]There are a total number (348) of missing observations, and the odd ratio adjusted for all other variables in the table.
[b]Pregnancy complications include excessive vaginal bleeding, high blood pressure, convulsions, high fever, painful urination, abdominal/back pain, foul-smelling vaginal discharge, and jaundice.

conditions are confronted with challenges such as minimal access to health services as a result of distance, lack of transport, or the high cost of transport to services (40). In order to increase access to SBAs for all births, the government needs to implement policies that would ensure that all women, regardless of their ability to pay, have access to appropriate and affordable services for maternal and newborn care (16). Women should also be offered conditional cash transfers to encourage them to deliver by SBA, either at home or in a health facility.

Mothers in South Sudan lack the essential knowledge to take basic preventive measures for their own health during pregnancy and childbirth, and that of their newborns, which is in line with previous studies in Mali and Zambia (41, 42). Inadequate health knowledge was linked to not using ANC services in this study and a previous study in South Sudan (21). The South Sudan government needs to implement innovative strategies to increase awareness and access to reproductive health services, such as access to routine ANC visits, and to identify women early in pregnancy and encourage them to use these services. This could be achieved at the village level through enhanced health promotion and by training community health workers, such as TBAs, to provide education about maternal and child health and services. Encouraging girls to attain at least primary level of education is essential to improve access to ANC services, and knowledge and access to SBAs at the delivery of their children.

Strengths and limitations

This paper is the first analysis of the potential risk factors associated with unassisted delivery or delivery assisted by unskilled attendants. The important strengths include a high response rate (78%) and an appropriate adjustment in the analyses for the sampling design. Due to the large sample size, we were able to identify a variety of risk factors associated with the delivery method. We collected data from the most recent birth within 2 years of the survey to minimize the potential recall bias of the mothers.

The limitations of this study include the use of cross-sectional survey data that restricted the interpretation of the causality of risk factors associated with home birth. The potential risk factors were restricted to factors available in SSHHSII data and the data relied on the mother's recall of details about her pregnancy and childbirth.

Conclusions

In this study, births that were either unattended or attended by an unskilled assistant was higher among women who were poorer and more marginalized, and had less access to care during pregnancy. Implementing strategies that target women at the community level, for example, by training and deploying community health workers to identify women who need access to care, could

increase the number of women who deliver with SBAs and could help overcome the barriers to accessing this service. The government needs to address the socio-economic factors that prevent women from using maternal health services and provide free reproductive services and conditional cash transfers to encourage women to deliver with SBAs. Also, more attention should be paid to improving infrastructure (such as better access to paved roads, as well as adequate maternal health services and medical supplies) in both rural and remote areas. Training and improving the skills of both TBAs and health staff is essential in order to reduce maternal mortality and morbidity in South Sudan.

Authors' contributions

NSM and MJD contributed in the study design. NSM and KA performed the analysis, and NSM prepared the manuscript. The revision of the manuscript and advice on the analysis of data were provided by MJD, ABZ, and KA. All authors read and approved the final manuscript.

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Disclaimers

Each author stated that the views expressed in the submitted article are his or her own and not an official position of the institution or funder.

Paper Context

Globally unassisted delivery or delivery assisted by unskilled birth attendants is associated with high maternal mortality and morbidity. In South Sudan, most pregnant women often deliver at home unattended by skilled birth attendants (SBAs), but the various factors leading to these unattended deliveries have not been assessed. Therefore, to fill this knowledge gap, this study investigated the risk factors associated with delivery in the absence of any assistance and delivery by unskilled birth attendants compared with deliveries attended by an SBA.

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Section III: Determinants of under-five mortality in South Sudan

In this section the first manuscript (publication 5) discusses the determinants of neonatal, infant and under-five mortality in South Sudan, which use 2010 South Sudan household survey data. The key finding show higher risk of under-five mortality among disadvantaged populations of children, such as urban dwellers, children born to teenager mother, children born to mothers, who ever had a child that died later, and male children.

Chapter 7: Determinants of neonatal, infant and under-five mortality in a war-affected country: analysis of 2010 household health Survey in South Sudan

BMJ Global Health

Determinants of neonatal, infant and under-five mortality in a war-affected country: analysis of the 2010 Household Health Survey in South Sudan

Ngatho Samuel Mugo,[1] Kingsley E Agho,[2] Anthony B Zwi,[3] Eliaba Yona Damundu,[4] Michael J Dibley[1]

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[1]School of Public Health, University of Sydney, Sydney, New South Wales, Australia
[2]School of Science and Health, Western Sydney University, Penrith, New South Wales, Australia
[3]School of Social Sciences, University of New South Wales, Sydney, New South Wales, Australia
[4]UNICEF South Sudan, Toto Chan Compound, Juba, South Sudan

Correspondence to
Ngatho Samuel Mugo;
n.mugo@hotmail.com

ABSTRACT

Background Under-five children born in a fragile and war-affected setting of South Sudan are faced with a high risk of death as reflecting in high under-five mortality. In South Sudan health inequities and inequitable condition of daily living play a significant role in childhood mortality. This study examines factors associated with under-five mortality in South Sudan.

Methods The study population includes 8125 singleton, live birth, under-five children born in South Sudan within 5 years prior to the 2010 South Sudan Household Survey. Factors associated with neonatal, infant and under-five deaths were examined using generalised linear latent and mixed models with the logit link and binomial family that adjusted for cluster and survey weights.

Results The multivariate analysis showed that mothers who reported a previous death of a child reported significantly higher risk of neonatal (adjusted OR (AOR)=3.74, 95% confidence interval (CI 2.88 to 4.87), P<0.001), infant (AOR=3.19, 95% CI (2.62 to 3.88), P<0.001) and under-five deaths (AOR=3.07, 95% CI (2.58 to 3.64), P<0.001). Other associated factors included urban dwellers (AOR=1.37, 95% CI (1.01 to 1.87), P=0.045) for neonatal, (AOR=1.35, 95% CI (1.08 to 1.69), P=0.009) for infants and (AOR=1.39, 95% CI (1.13 to 1.71), P=0.002) for under-five death. Unimproved sources of drinking water were significantly associated with neonatal mortality (AOR=1.91, 95% CI (1.11 to 3.31), P=0.02).

Conclusions This study suggested that the condition and circumstances in which the child is born into, and lives with, play a role in under-five mortality, such as higher mortality among children born to teenage mothers. Ensuring equitable healthcare service delivery to all disadvantaged populations of children in both urban and rural areas is essential but remains a challenge, while violence continues in South Sudan.

Key messages

What is already known about this topic?

- Children born in a fragile and war-affected setting of South Sudan are at increased risk of a high rate of neonatal, infant and under-five mortality.

What are the new findings?

- In South Sudan, exposure to indoor air pollution and use of unimproved source of drinking water were associated with increased risk of neonatal mortality.
- Children born in urban areas of South Sudan were at greater risk of death than other children born in rural areas.

Recommendations for policy

- Implementing and enabling policy environment and reforms to alleviate poor living conditions of the household is essential.
- Improving services in population subgroups, which might not usually be the focus of child survival programmes, for example, among returnees, and internally displaced persons in urban populations is essential.

BACKGROUND

Reduction of the under-five mortality rate of 25 or fewer deaths per 1000 live births by 2030 is one of the priorities of the Sustainable Development Goals and the target for the child survival indicator specially in a country like South Sudan.[1] Over the past 25 years progress has been made globally in reducing under-five mortality rate by 51%, from 91 deaths per 1000 live births in 1990 to 43 in 2015.[2] However, the global decline of under-five mortality fell short of the two-thirds reduction envisaged in the Millennium Development Goals era.[3] Many low-income countries in Sub-Saharan Africa and South Asia continue to face high rates of under-five mortality estimated at 83 and 51 per 1000 live births in 2015, respectively.[3 4]

In many countries affected by war, the risk of under-five mortality was found to be 80 times higher than those countries not affected by war.[4 5] According to World Bank estimates, of the 20 countries with the highest under-five mortality rate in the world, nine were from war-torn countries including South Sudan.[4]

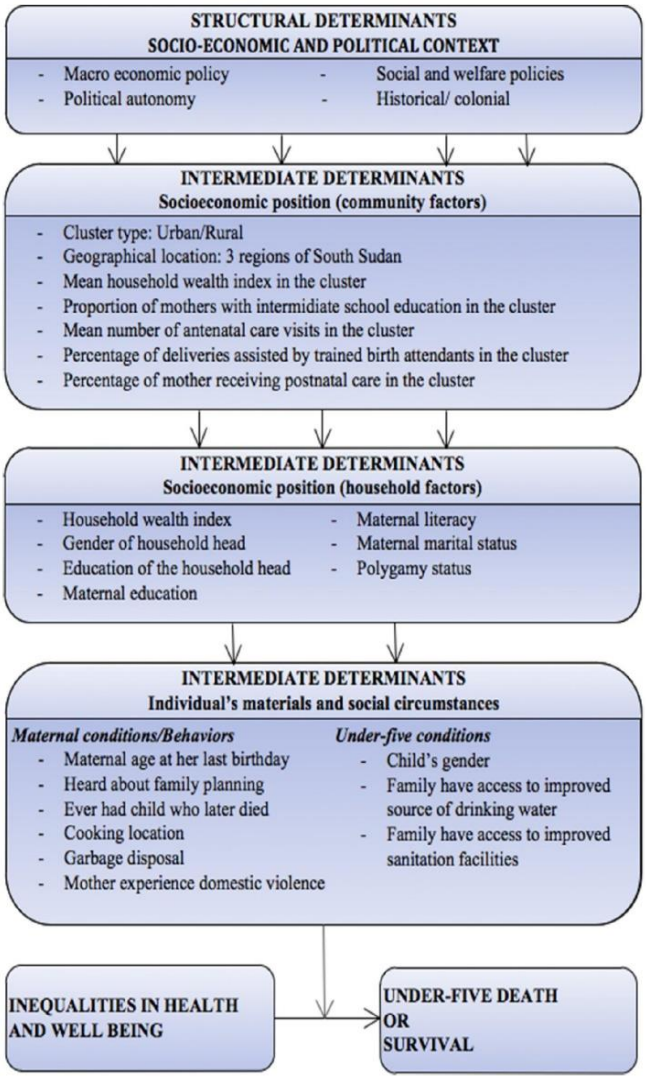

Figure 1 Conceptual framework for factors associated with under-five mortality, adapted from the WHO social determinants of health inequalities.

The rate of under-five mortality per 1000 births in these countries was between 139 per 1000 births in Chad and 93 per 1000 births in South Sudan.[6]

South Sudan is the world's youngest country that is still affected by war after gaining independence in 2011.[7] The war has severely affected the country's socioeconomic development and has claimed over 2 million of lives since 1956.[8] In South Sudan, it is estimated that about 75% of the population has no access to healthcare services, 63% of adult population is illiterate and over 50% of the population is living on less than US$1 per day.[9] Children from low socioeconomic households are at increased risk of premature death and disability due to low access to essential lifesaving interventions than those children with access to established public health interventions.[10 11] On average, about 50% of under-five children in South Sudan have no access to evidence-based interventions, such as access to insecticide-treated mosquito nets (34%), improved sources of drinking water (69%), improved sanitation facilities (7%), rehydration treatment for diarrhoea (49%), antibiotic treatment for pneumonia (33%) and childhood immunisations (6%).[12] Therefore, in South Sudan health inequities and inequitable condition of daily living can be explained by poor social policies, unfair economic arrangements and bad politics.[13]

In order to address the social determinates of health inequality that are preventable, avoidable and unfair, the WHO established in 2005 the Commission on Social Determinants of Health as a global strategic mechanism to address the problems associated with health equity.[14] According to the WHO model, the chance of dying in childhood is strongly determined by the living conditions into which the child is born and the systems in place to deal with illness.[14 15] For example, the probability of dying in childhood is strongly related to remoteness, rural dwelling and the socioeconomic position of the parents or household.[16 17] These factors are further shaped by the socioeconomic and political mechanisms, such as macroeconomic policy. Therefore, social and economic policies have a determining impact on whether a child can develop to her/his full potential and live and flourish or whether her/his life will be withered.[15]

Past studies from the postconflict settings indicate that children are particularly vulnerable to the consequences of violence, poverty, being a child solider, landmine injuries and mental health impairment,[18–20] which might increase their risk of mortality. Therefore, examining under-five mortality in the postconflict setting of South Sudan is a valid indicator for monitoring child health and survival, and for developing programmes aimed at improving access to evidence-based interventions for child health. This study aims to identify factors associated with neonatal, infant and under-five mortality in South Sudan. Findings from this study will enable policymakers and public health practitioners to develop cost-effective lifesaving interventions targeting the subpopulation of children at risk.

METHODS

Data sources

We used a data set collected during the 2010 South Sudan Household Health Survey second round (SSHHSII), which is a nationally representative, stratified, cluster sample survey, covering the 10 states of South Sudan. The survey was largely based on the Unicef's Multiple Indicator Cluster Survey (MICS) methodology.[21] It aimed to collect health and related indicators essential for identifying the health needs of women and children, and for establishing priorities for evidence-based planning, decision-making and reporting. The SSHHSII comprised a general questionnaire to collect basic demographic information on all household members, with three individual questionnaires addressed to specific target groups: women and men aged 15–49 years and under-five children. The individual questionnaire was used to collect information on reproductive history, use of family planning, information about child health indicators and other health-related issues. The questionnaire for under-five children was administered to mothers or caretakers of children under 5 years of age.[21]

A two-stage cluster sampling design was employed for the selection of the sample in each of the 10 states of South Sudan. The first stage consisted of the selection of the required number of enumeration areas separately by urban and rural strata. Systematic probability proportional to size sampling procedure was used for the selection of 40 enumeration sites in each of the 10 states of South Sudan. The second stage was the selection of the total number of households in each cluster using random systematic selection procedures to select on average 25 households in each enumeration area. From the selected households, a total sample of 9369 households were interviewed with information from 9069 ever-married women, and 4344 men aged 15–49 years, and information from 8338 under-five children collected from their mother/caretaker yielding a response rate of 83%. The details of the SSHHSII sampling method have been reported elsewhere.[21]

Study population

Our study population consisted of 9125 (8125 weighted) singleton live-born children under the age of 5 years, who were born within 5 years prior to the survey. We excluded multiple pregnancies (n=303) in this analysis because of higher risk of newborn death, as the result of preterm birth and pregnancy complications among this group compared with singleton pregnancies.[22]

Conceptual framework

We modified and used the conceptual framework developed by WHO[14] as a guide in identifying the key social determinants of health inequalities and their impact on the well-being of under-five children in this study. According to this framework, a set of the social economic positions, such as education, income, occupation, gender and social class, is shaped by the structural social, economic and political context.[14] Furthermore, these socioeconomic positions influence an individual's health and well-being through more specific factors called intermediate factors such as material circumstances, behaviours, biological factors and health services. According to the framework, we identified 26 possible determinants and predictors of under-five mortality in South Sudan based on the available information from the 2010 SSHHSII data sets. Figure 1 presents the modified conceptual framework used in this analysis.

Study variables

The outcome variable for this analysis was neonatal, infant and under-five mortality expressed in a binary form (0 for living child and 1 for a child death). Neonatal mortality is defined as the probability of dying in the first month of life (0 to 28 days), infant mortality is the probability of dying between birth and first birthday (0 to <12 months) and under-five mortality is the death of a child under the age of 5 years (0 to <60 months). We obtained information on under-five deaths collected from the birth history section of the questionnaire administered to individual female respondents aged 15–49 years, who had ever given birth during the 5-year period prior to

Table 1 The prevalence of the study variables and the under-five mortality rate according to socioeconomic and intermediate factors, South Sudan Household Survey, 2010 (n=8215)

	Number (percentage)		Mortality rate*		
Variables	**N**	**n (%)***	**Neonatal**	**Infant**	**Under-five**
Intermediate determinants					
Socioeconomic position					
Community factors					
Type of cluster					
Rural	7146	6134 (74.7)	37	69	95
Urban	2630	2081 (25.3)	50	90	120
Geographical regions					
Greater Upper Nile	2840	2639 (32.1)	38	70	96
Greater Bahr el Ghazal	3838	2733 (33.3)	37	74	98
Greater Equatoria	3098	2843 (34.6)	46	78	109
Household factors					
Household wealth index					
Wealthier	2708	2734 (33.3)	43	74	101
Middle	2737	2741 (33.4)	38	72	99
Poor	2794	2740 (33.4)	41	77	103
Gender of household head					
Male	5405	4472 (57.1)	40	73	100
Female	3930	3364 (42.9)	40	74	103
Education of the household head					
Secondary+ education	766	628 (8.0)	49	70	95
No education/primary education	8569	7209 (92.0)	39	74	102
Maternal education					
Intermediate+ education	310	322 (3.9)	29	68	86
Primary/informal adult education	1277	1286 (15.7)	30	69	93
No education	6638	6597 (80.4)	42	73	100
Maternal literacy					
Able to read	794	823 (10.4)	35	58	84
Unable to read	7155	7096 (89.6)	40	75	105
Maternal marital status					
Never married (single)	1155	1123 (13.7)	36	61	89
Formerly married	1220	1256 (15.3)	42	75	93
Currently married	5864	5835 (71.0)	41	76	105
Polygamy status					
Husband has one wife.	3890	3950 (57.3)	39	76	103
Husband has more than one wife	2978	2947 (42.7)	42	76	104
Individual's circumstances					
Maternal conditions/behaviours					
Maternal age at her last birthday (years)					
20–34	5251	5206 (63.4)	37	70	96
15–19	901	873 (10.6)	46	84	111
35–49	2087	2136 (26.0)	47	80	109
Heard about family planning					
No	6738	6630 (81.0)	38	70	96

Continued

Table 1 Continued

Variables	Number (percentage)		Mortality rate*		
	N	n (%)*	Neonatal	Infant	Under-five
Yes	1476	1557 (19.0)	51	90	121
Ever had child who later died					
No	5175	5210 (72.3)	23	48	69
Yes	2019	1994 (27.7)	83	140	180
Cooking location					
Kitchen	2696	2245 (29.2)	45	78	109
Elsewhere in the house	1868	1556 (20.2)	41	71	91
Outdoors	4592	3896 (50.6)	37	72	91
Garbage disposal					
Burning	3580	3019 (39.0)	40	76	101
Dumping (throwing outside the house)	5655	4732 (61.1)	39	72	102
Mother experienced domestic violence in the past year					
No	6138	6072 (77.1)	41	76	101
Yes	1748	1808 (22.9)	40	71	102
Under-five condition					
Under-five gender					
Female	4839	4057 (49.4)	40	76	97
Male	4937	4158 (50.6)	41	72	105
Family have access to improved source of drinking water					
Yes	970	807 (10.4)	24	58	88
No	8244	6927 (89.6)	42	75	102
Family have access to improved sanitation facilities					
Yes	1068	877 (11.2)	37	68	98
No	8255	6949 (88.8)	40	74	101
Community-level factors					
Mean household wealth index in the cluster, mean (SD)	NA	2.22 (0.36)	NA	NA	NA
Proportion of mothers who attended intermediate education in the cluster, mean (SD)	NA	0.04 (0.09)	NA	NA	NA
Mean number of antenatal care visits in the cluster, mean (SD)	NA	2.73 (0.28)	NA	NA	NA
Percentage of deliveries assisted by trained birth attendants in the cluster, mean (SD)	NA	0.19 (0.17)	NA	NA	NA
Percentage of mothers receiving postnatal care in the cluster, mean (SD)	NA	0.09 (0.12)	NA	NA	NA

*Weighted for the sampling probability.
NA, not applicable.

the survey. The under-five mortality rate was estimated directly from the information on the birth history using the child's date of birth, date of interview and age at death. We calculated the mortality rate for this analysis as the number of children dying during each age period (neonatal, infant and under-five) per 1000 live births in a given year.

The independent variables for this analysis were categorised based on the WHO conceptual framework. At the socioeconomic position, 14 distal factors were identified and classified as follows: (1) community factors consisting of cluster type and region (representing the characteristics of a cluster); the mean household wealth index (representing economic status); the proportion of mothers with at least intermediate education (representing maternal factors); and the mean number of antenatal care visits, percentage of mothers receiving postnatal care and the percentage of deliveries assisted by skilled birth attendants in the cluster (representing community access to maternal health services); and (2) household factors

Table 2 Adjusted and unadjusted ORs for factors associated with neonatal mortality according to socioeconomic and intermediate factors, analysis of South Sudan Household Survey, 2010 (n=8215)

Variables	OR*	95% CI†	P value	AOR‡	95% CI	P value
Intermediate determinants						
Socioeconomic position						
Community factors						
Type of cluster						
Rural	1.00			1.00		
Urban	1.37	(1.01 to 1.87)	0.045	1.37	(1.01 to 1.87)	0.045
Geographical location (regions)						
Greater Upper Nile	1.00					
Greater Bahr el Ghazal	1.00	(0.70 to 1.14)	0.984			
Greater Equatoria	1.24	(0.88 to 1.74)	0.223			
Mean household wealth index in the cluster	0.86	(0.60 to 1.23)	0.418			
Proportion of mothers with intermediate school education in the cluster	1.52	(0.36 to 6.54)	0.571			
Mean number of antenatal care visits in the cluster	0.84	(0.01 to 1.34)	0.493			
Percentage of deliveries assisted by trained birth attendants in the cluster	0.91	(0.40 to 2.06)	0.812			
Percentage of mothers receiving postnatal care in the cluster	1.26	(0.37 to 4.22)	0.713			
Household factors						
Household wealth index						
Wealthier	1.00					
Middle	0.97	(0.74 to 1.29)	0.856			
Poor	0.97	(0.74 to 1.28)	0.844			
Gender of household head						
Male	1.00					
Female	0.99	(0.78 to 1.25)	0.931			
Education of the household head						
Secondary+ education	1.00					
No education/primary education	0.81	(0.55 to 1.20)	0.292			
Maternal education						
Intermediate+ education	1.00					
Primary education	0.71	(0.39 to 1.29)	0.260			
No education	0.83	(0.48 to 1.44)	0.517			
Maternal literacy						
Able to read	1.00					
Unable to read	1.28	(0.85 to 1.92)	0.245			
Maternal marital status						
Never married (single)	1.00					
Formerly married	1.13	(0.73 to 1.73)	0.588			
Currently married	1.1	(0.78 to 1.56)	0.587			
Polygamy status						
Husband had one wife	1.00					
Husband had more than one wife	1.04	(0.81 to 1.34)	0.736			
Individual's circumstances						

Continued

Table 2 Continued

Variables	OR*	95% CI†	P value	AOR‡	95% CI	P value
Maternal conditions/behaviours						
Maternal age at her last birthday (years)						
20–34	1.00					
15–19	1.26	(0.88 to 0.80)	0.212			
35–49	1.33	(1.03 to 1.72)	0.027			
Heard about family planning						
No	1.00					
Yes	1.27	(0.96 to 1.69)	0.100			
Ever had child who later died						
No	1.00			1.00		
Yes	4.06	(3.15 to 5.24)	<0.001	3.74	(2.88 to 4.87)	<0.001
Cooking location						
Kitchen	1.00			1.00		
Elsewhere in the house	0.85	(0.61 to 1.18)	0.324	0.77	(0.54 to 1.11)	0.167
Outdoors	0.80	(0.61 to 1.04)	0.100	0.70	(0.53 to 0.94)	0.018
Garbage disposal						
Burning	1.00					
Dumping (throwing outside the house)	0.98	(0.77 to 1.14)	0.835			
Mother experienced domestic violence in the past year.						
No	1.00					
Yes	0.99	(0.75 to 1.30)	0.926			
Neonatal condition						
Neonatal gender						
Female	1.00					
Male	0.97	(0.78 to 1.21)	0.798			
Family have access to improved source of drinking water						
Yes	1.00			1.00		
No	1.76	(1.10 to 2.81)	0.019	1.91	(1.11 to 3.31)	0.02
Family have access to improved sanitation facilities.						
Yes	1.00					
No	1.10	(0.75 to 1.60)	0.639			

*Unadjusted odds ratio (OR).
†Confidence interval (CI).
‡Adjusted OR (AOR), and the odds ratio adjusted for all other variables in the table.

including household wealth, the gender and education of the household head, maternal literacy and education, maternal marital status and polygamy status. The entire list of the independent variables with their definitions and the categories can be found in the online supplementary material.

In this analysis, we constructed the household wealth index variable from an inventory of 24 household facilities and assets (such as the material of the dwelling floor, roof and walls; the number of persons per sleeping room; the fuel used for cooking; main source of drinking water; availability of electricity; ownership of radio, television, mobile phone, telephone, refrigerator and watch; ownership of transport devices, such as bicycles, motorcycles/scooters, animal-drawn carts, cars/trucks, and boats; the source of drinking water and type of sanitation facility; ownership land) using principal components analysis to weight the contribution of the items to the index.[23] This index was divided into three categories: the bottom one-third of households that were referred to as poor households, the next one-third as the middle-level households and the top one-third as the wealthier households.

At the proximal individual's circumstances/conditions, nine factors were identified and categorised according

to: (1) maternal conditions/behaviours including maternal age at childbirth, ever had a child who later died, cooking location, garbage disposal, ever heard of family planning and mother's experience of domestic violence; and (2) under-five conditions including the child's gender, access to improved sanitation facilities and access to improved source of drinking water. Unimproved source of water consisted of unprotected wells and springs; unfiltered water from rivers, streams, dams and hafirs; water transported by tankers/carts; and bottled water from unimproved source. Improved source of drinking water consisted of piped water (into dwelling, compound, yard or plot, to neighbour, public tap/standpipe), tube wells/boreholes, protected wells, protected springs, bottled water and water transported by tankers/carts from improved source.

Ethical approval

All respondents to the survey provided verbal informed consent; consent for children was obtained through parents, caregivers or guardians when data were originally collected. In 2013, the first author requested for data access from the director of Health Social and Demographic Statistics and from the Ministry of Health of South Sudan, and access was granted to use the data for research. Currently, the data are available from MICS website (http://mics.unicef.org/surveys).

Statistical analysis

Preliminary analyses were conducted by producing frequency tabulations of all the selected characteristics examined in this study. The preliminary analyses were carried out using STATA/MP V.12 (StataCorp, College Station, TX, USA).[24] The 'Svy' survey commands were used to allow for adjustments for the cluster sampling design and sampling weights. This was followed by calculating neonatal, infant and under-five mortality rate using a method similar to that described by Rutstein and Rojas.[25]

Univariable and multivariable logistic regression generalised linear latent and mixed models with the logit link and binomial family[25] that adjusted for cluster and survey weights were used to identify those factors associated with neonatal, infant and under-five mortality. Univariable logistic regression was conducted to determine the unadjusted ORs of the study factors for neonatal, infant and under-five mortality.

In the multivariable logistic regression analysis, a three-stage hierarchical model based on a conceptual framework described by Victora *et al*[26] was performed in this analysis. According to this approach, the effect of distal variables could be assessed without inappropriate adjustment by proximate or intermediate variables that could be mediators of the effects of more distal variables.[26]

In the first-stage model (model 1), all the distal socioeconomic community factors were entered into the model and this was followed by manually executed backward elimination process. Only variables associated with the outcome were retained (model 1). In the second-stage model (model 2), the significant factors (P<0.05) in model 1 were added to socioeconomic (household) level factors and this was followed by a backward elimination procedure but retaining all the significant factors from model 1. In the third and final-stage model (model 3), the individual (maternal and child condition and circumstance) factors were added into model 2 and those variables with P<0.05 in model 3 were retained in the final model including all factors from model 2. The ORs and their 95% CIs obtained from the adjusted multiple logistics model were used to measure the factors associated with neonatal, infant and under-five mortality.

RESULTS

There was a total of 785 under-five deaths, with an estimated under-five mortality rate of 101 per 1000 live births, a child mortality rate of 27 per 1000 live births, an infant mortality rate of 74 per 1000 live births, a post-neonatal mortality rate of 34 per 1000 live births and neonatal mortality rate of 40 per 1000 live births

Table 1 describes the socioeconomic inequalities between the communities/households alongside under-five mortality rates. This study showed that about three-fourths (75%) of the study population resided in rural areas, but there was higher mortality in the urban population (120 per 1000 live births). Nearly all mothers (90%) were illiterate and children born to this group of women had a higher rate of under-five mortality (105 per 1000 live births) than those born to literate mothers. Family planning methods were not widely used with only 19% of women having heard about family planning but surprisingly their under-five children were more likely to die (121 per 1000 live births) compared with those women who never heard about family planning. Our study found a higher under-five mortality rate (180 per 1000 live births) among mothers, who had had a child that later died.

Table 2 shows the unadjusted OR and the adjusted OR (AOR) for factors associated with neonatal mortality. Exposure to indoor air pollution due to use of polluting fuels for cooking was associated with neonatal mortality, with neonates born in households that cooked their food outdoors being significantly protected from neonatal death (AOR=0.70, 95% confidence interval (CI 0.53 to 0.94), P 0.018). Higher mortality was found among newborns living in households with unimproved source of drinking water (AOR=1.91, 95% CI (1.13 to 3.38), P 0.016).

Tables 3 and 4 show the univariate and multivariate analyses for factors associated with infant and under-five mortality. Maternal conditions and circumstances, such as teenage pregnancy, were associated with under-five mortality. For instance, children born to mothers aged 15–19 years were at increased risk of deaths than other children born to older mothers (AOR=1.85, 95% CI (1.20 to 2.85), P=0.005) for infant and (AOR=1.77,

Table 3 Adjusted and unadjusted ORs for factors associated with infant mortality according to socioeconomic and intermediate factors, analysis of South Sudan Household Survey, 2010 (n=8215)

Variables	OR*	95% CI†	P value	AOR‡	95% CI	P value
Intermediate determinants						
Socioeconomic position						
Community factors						
Type of cluster						
Rural	1.00			1.00		
Urban	1.35	(1.08 to1.69)	0.009	1.35	(1.08 to 1.69)	0.009
Geographical location (regions)						
Greater Upper Nile	1.00					
Greater Bahr el Ghazal	1.09	(0.85 to 1.41)	0.505			
Greater Equatoria	1.15	(0.89 to 1.49)	0.281			
Mean household wealth index in the cluster	0.97	(0.74 to 1.26)	0.798			
Proportion of mothers with intermediate school education in the cluster	1.66	(0.57 to 4.81)	0.351			
Mean number of antenatal care visits in the cluster	0.71	(0.50 to 1.03)	0.068			
Percentage of deliveries assisted by trained birth attendants in the cluster	1.10	(0.61 to 2.00)	0.755			
Percentage of mothers receiving postnatal care in the cluster	1.79	(0.76 to 4.22)	0.180			
Household factors						
Household wealth index						
Wealthier	1.00					
Middle	0.94	(0.76 to 1.16)	0.562			
Poor	1.01	(0.82 to 1.24)	0.920			
Gender of household head						
Male	1.00					
Female	1.00	(0.83 to 1.19)	0.967			
Education of the household head						
Secondary+ education	1.00					
No education/primary education	1.14	(0.82 to 1.58)	0.45			
Maternal education						
Intermediate+ education	1.00					
Primary education	0.75	(0.48 to 1.17)	0.206			
No education	0.80	(0.53 to 1.21)	0.298			
Maternal literacy						
Able to read	1.00			1.00		
Unable to read	1.43	(1.04 to 1.98)	0.029	1.38	(1.00 to 1.92)	0.051
Maternal marital status						
Never married (single)	1.00			1.00		
Formerly married	1.27	(0.91 to 1.77)	0.167	1.42	(0.99 to 2.04)	0.057
Currently married	1.27	(0.97 to 1.67)	0.082	1.41	(1.04 to 1.90)	0.026
Polygamy status						
Husband had one wife	1.00					
Husband had more than one wife	0.96	(0.80 to 1.16)	0.669			
Individual's circumstances						

Continued

Table 3 Continued

Variables	OR*	95% CI†	P value	AOR‡	95% CI	P value
Maternal conditions/behaviours						
Maternal age at her last birthday (years)						
20–34	1.00			1.00		
15–19	1.25	(0.95 to 1.63)	0.108	1.85	(1.20 to 2.85)	0.005
35–49	1.21	(0.99 to 1.47)	0.059	1.07	(0.87 to 1.32)	0.511
Heard about family planning						
No	1.00					
Yes	1.34	(1.08 to 1.66)	0.008			
Ever had child who later died						
No	1.00			1.00		
Yes	3.21	(2.67 to 3.87)	<0.001	3.19	(2.62 to 3.88)	<0.001
Cooking location						
Kitchen	1.00					
Elsewhere in the house	0.89	(0.70 to 1.15)	0.388			
Outdoors	0.90	(0.74 to 1.10)	0.321			
Garbage disposal						
Burning	1.00					
Dumping (throwing outside the house)	0.97	(0.81 to 1.16)	0.752			
Mother experienced domestic violence in the past year						
No	1.00					
Yes	0.96	(0.77 to 1.18)	0.670			
Infant condition						
Infant gender						
Female	1.00			1.00		
Male	1.11	(0.94 to 1.31)	0.241	1.22	(1.01 to 1.47)	0.035
Family have access to improved source of drinking water						
Yes	1.00					
No	1.36	(0.99 to 1.87)	0.055			
Family have access to improved sanitation facilities						
Yes	1.00					
No	1.14	(0.85 to 1.52)	0.378			

*Unadjusted odds ratio (OR).
†Confidence interval (CI).
‡Adjusted odds ratio (AOR), and the odds ratio adjusted for all other variables in the table.

95% CI (1.21 to 2.59), P 0.003) for under-five deaths. Other factors significantly associated with infant and under-five deaths included maternal marital status, maternal literacy and gender of the child.

Across all the age ranges (tables 2–4), the results from the multivariate analyses show that children born to mothers who experienced a previous death of a child were at increased risk of neonatal mortality (AOR=3.74, 95% CI (2.88 to 4.87), P<0.001), infant mortality (AOR=3.19, 95% CI (2.62 to 3.88), P<0.001) and under-five mortality (AOR=3.07, 95% CI (2.58 to 3.64), P<0.001). Among the community-level factors living in an urban area was associated with increased risk of neonatal mortality (AOR=1.37, 95% CI (1.01 to 1.87), P 0.045), infant mortality (AOR=1.35, 95% CI (1.08 to 1.69), P 0.009) and under-five mortality (AOR=1.39, 95% CI (1.13 to 1.71), P 0.002).

DISCUSSION

This study shows the impact of social and material circumstances in which the children are born into, and live with, is significantly associated with increased risk of neonatal, infant and under-five mortality. We found that children of teenage mothers, children living in urban areas, children whose mothers had

Table 4 Adjusted and unadjusted ORs for factors associated with undermortality according to socioeconomic and intermediate factors, analysis of South Sudan Household Survey, 2010 (n=8215)

Variables	OR*	95% CI†	P value	AOR‡	95% CI	P value
Intermediate determinants						
Socioeconomic position						
Community factors						
Type of cluster						
Rural	1.00			1.00		
Urban	1.39	(1.13 to 1.71)	0.002	1.39	(1.13 to1.71)	0.002
Geographical location (regions)						
Greater Upper Nile	1.00					
Greater Bahr el Ghazal	1.10	(0.87 to 1.39)	0.44			
Greater Equatoria	1.19	(0.93 to 1.50)	0.16			
Mean household wealth index in the cluster	0.99	(0.78 to 1.27)	0.96			
Proportion of mothers with intermediate school education in the cluster	1.68	(0.62 to 4.56)	0.31			
Mean number of antenatal care visits in the cluster	0.79	(0.56 to 1.11)	0.17			
Percentage of deliveries assisted by trained birth attendants in the cluster	0.99	(0.57 to 1.72)	0.96			
Percentage of mothers receiving postnatal care in the cluster	1.66	(0.74 to 3.72)	0.22			
Household factors						
Household wealth index						
Wealthier	1.00					
Middle	0.93	(0.77 to 1.13)	0.46			
Poor	0.96	(0.79 to 1.16)	0.68			
Gender of household head						
Male	1.00					
Female	1.10	(0.94 to 1.29)	0.25			
Education of the household head						
Secondary+ education	1.00					
No education/primary education	1.20	(0.89 to 1.62)	0.24			
Maternal education						
Intermediate+ education	1.00					
Primary education	0.96	(0.63 to 1.46)	0.85			
No education	0.92	(0.62 to 1.36)	0.67			
Maternal literacy						
Able to read	1.00					
Unable to read	1.33	(1.01 to 1.77)	0.046			
Maternal marital status						
Never married (single)	1.00					
Formerly married	1.16	(0.86 to 1.57)	0.33			
Currently married	1.24	(0.97 to 1.58)	0.08			
Polygamy status						
Husband had one wife	1.00					
Husband had more than one wife	0.95	(0.80 to 1.12)	0.54			
Individual's circumstances						

Continued

Table 4 Continued

Variables	OR*	95% CI†	P value	AOR‡	95% CI	P value
Maternal conditions/behaviours						
Maternal age at her last birthday (years)						
20–34	1.00			1.00		
15–19	1.17	(0.91 to 1.50)	0.22	1.77	(1.21 to 2.59)	0.003
35–49	1.19	(1.00 to 1.43)	0.05	1.04	(0.87 to 1.25)	0.674
Heard about family planning						
No	1.00					
Yes	1.31	(1.07 to 1.59)	0.007			
Ever had child who later died						
No	1.00			1.00		
Yes	3.02	(2.55 to 3.57)	<0.001	3.07	(2.58 to 3.64)	<0.001
Cooking location						
Kitchen	1.00					
Elsewhere in the house	0.84	(0.66 to 1.05)	0.13			
Outdoors	0.92	(0.77 to 1.11)	0.40			
Garbage disposal						
Burning	1.00					
Dumping (throwing outside the house)	0.98	(0.83 to 1.15)	0.76			
Mother experienced domestic violence in the past year.						
No	1.00					
Yes	0.99	(0.82 to 1.20)	0.91			
Under-five condition						
Under-five gender						
Female	1.00			1.00		
Male	1.11	(0.95 to 1.29)	0.18	1.20	(1.02 to 1.41)	0.029
Family have access to improved source of drinking water						
Yes	1.00					
No	1.28	(0.97 to 1.69)	0.09			
Family have access to improved sanitation facilities						
Yes	1.00					
No	1.01	(0.79 to 1.30)	0.93			

*Unadjusted odds ratio (OR).
†Confidence interval (CI).
‡Adjusted odds ratio (AOR), and the odds ratio adjusted for all other variables in the table.

had a prior child death, children born to illiterate mothers and male children all had higher odds of dying before the age of 5. These results are important as they highlight the need for services in population subgroups, which might not usually be the focus of child survival programmes, for example, urban populations.

Studies from postconflict settings, such as Mozambique and Ethiopia, have found children of urban migrants experience a higher rate of under-five mortality than urban non-migrant children during the period of civil war and conflict.[18 19 27–29] This study reported similar findings with under-five children living in urban South Sudan having a higher odds of death compared with those living in the rural areas. This could be due to the in-migration of large numbers of socially and economically disadvantaged groups of South Sudanese returnees, and internally displaced people from North Sudan, after the end of the war for independence searching for work and better social services for their families in Juba.[30] Under-five children born or growing up in

such harsh conditions would be more likely to die than children who were better off in rural areas of South Sudan. The Government of South Sudan and non-governmental organization needs to improve and adequately resource services for vulnerable populations but especially in urban areas.

In this study, we found children born to teenage mothers (15–19 years) were at greater risk of death, which is in line with other studies from low/middle-income countries.[31 32] In South Sudan, young girls are exposed to early marriage even as early as 12 years old.[33] This harmful practice, which is culturally acceptable throughout South Sudan, puts the girl and her offspring at risk of death. Early marriage is harmful because it is a violation of the girl's rights to health, as early pregnancy and childbirth increase her risk of dying or ill health.[34] Therefore, the government needs to take action to apply the legislation for the legal age of girls in marriage, and take immediate and long-term steps to protect the rights of girls against early or forced marriage to ensure the fulfilment of their human rights. Implementing conditional cash transfer programme targeting poor families to keep their daughters in school and unmarried until secondary school might have a long-term impact on girls' rights for education and reduce teenage marriage.

In this study, children born to mothers with a history of child death had greatly increased the odds of death before the age of 5 years, which is similar to the findings reported in other studies.[31 35] This indicator is found in 28% of women and it increases the risk of neonatal, infant and under-five death substantially. An analysis of the characteristics of these women and their households suggests that children born to these mothers face a higher risk of death possibly due to household poverty, having siblings less than 2 years and a father with more than one wife. Policies to alleviate the socioeconomic disparity within the communities, and to address the factors associated with poor living conditions are essential, such as provision of a social safety net and welfare support for disadvantaged households.

In this study, we found under-five male children having 20% higher odds of dying than female children, and similar findings have been reported in other studies.[16 36–38] Several studies indicate that under-five male children are at higher risk of death as a result of biological factors, such as immunodeficiency due to late maturity and congenital malformations of urogenital system,[39 40] which make them more vulnerable to infectious diseases. Reducing the risks for under-five mortality for both female and male children will be a challenge in South Sudan since access to newborn, infant and child health services is relatively low. The Government of South Sudan will need to address the access problem at both the community and individual levels, and deal with the lack of qualified staff and healthcare facilities in order to meet the needs of under-five children.

In this study, exposure to indoor air pollution and use of unimproved source of drinking water were associated with increased risk of neonatal mortality, which was consistent with previous studies from low/middle-income countries.[41–44] In South Sudan, the majority of households with newborn children lack access to sanitary facilities (89%), have poor personal hygiene practices, lack access to improved sources of drinking water (90%) and use polluting fuels for cooking (99%). Under-five children born and growing up in such an unhygienic environment are at increased risk for childhood diseases such as diarrhoea and pneumonia. Therefore, implementing a cost-effective public health-related intervention to improve household environmental conditions, such as access to improved source of drinking water and sanitation facility, might have a positive impact on reducing environmental health and thus childhood mortality.

Previous studies indicate that maternal education can influence the survival of under-five children.[45 46] Our study reported similar findings with infants born to illiterate mothers being more likely to die than those born to literate mothers. Therefore, long-term investments in South Sudan in child education for both girls and boys are essential since educational attainment is associated with improved socioeconomic status in adulthood, increased use of maternal and child healthcare services, and reduced teenage marriage and pregnancy.

The results from this analysis might not reflect the current situation of under-five children and their needs for access to lifesaving interventions because of the continuation of armed violence that broke out in multiple cities of South Sudan in December 2013.[47] It is estimated that since December 2013, nearly 3 million people in South Sudan have been displaced, and of these 1.1 million people sought refuge in neighbouring countries with children comprising 70% of refugees.[48] Also about 31% of the population are food insecure and 276 343 children are likely to be affected by severe acute malnutrition.[49 50] Women and children are at immediate risks of violence, sexual abuse, exploitation and life-threatening diseases. Further complicating the situation is a deterioration of the economic situation, renewed conflict since July 2016 and increased insecurity throughout the country.[50] Nonetheless, our findings remain important for future assessment of the cost-effective lifesaving intervention for under-five children once the conflict ceases in South Sudan.

This is the first analysis that reports the determinants of under-five mortality in South Sudan. The study strengths include a representative national sample of women and their children, a high response rate (81%) and appropriate adjustments in the analysis for the sampling design. We were able to identify the risk factors that could help with targeting programmes for under-five children in South Sudan. Also data on birth history were collected for 5 years prior to the survey to minimise potential maternal recall bias. The limitations in our study include the use of cross-sectional survey data that restricts the interpretation of the causality of factors associated with under-five mortality. Nonetheless, several of the key factors we examined were present

before the child mortality outcomes, for example, maternal age, and maternal history of a child death, strengthening the case for them having a causal role in child deaths in South Sudan. The potential factors associated with under-five deaths examined in this analysis were restricted to those factors available in SSHHSII data. The survey data used relied on a mother's ability to remember details about her birth history.

CONCLUSIONS

This study highlights the role of social and material circumstances in which the children are born into, and live with, and their association with higher risk of neonatal, infant and under-five mortality. Implementing programmes targeting the structural and intermediate determinates of health inequality is essential in South Sudan but remains a challenge, while violence continues in South Sudan. Government and policymakers should develop regional and local policies to tackle the upstream causes of socioeconomic health inequalities. Improving and adequately resourcing services, as well as ensuring equitable service delivery to all disadvantaged populations of women and children in both urban and rural areas should be a priority. The Government of South Sudan and international agencies need to implement programmes to alleviate poverty among poor households in order to increase the demand for education and health services among the poor. For instance, implementing a cash transfer programme targeting poor families to keep their daughters in school and unmarried throughout their secondary education is essential. In order to improve under-five survival, it is also essential to develop interventions targeting poor households and mothers with a history of child death. Incentive programmes are also needed to encourage disadvantaged women to attend health services during pregnancy, delivery and when their child is born to improve health outcomes for themselves and for their children.

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Determinants of neonatal, infant and under-five mortality in a war-affected country: analysis of the 2010 Household Health Survey in South Sudan

Ngatho Samuel Mugo, Kingsley E Agho, Anthony B Zwi, Eliaba Yona Damundu and Michael J Dibley

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Section IV: Delivery and access barriers to healthcare services in South Sudan

The results from the cross-sectional data analysis of South Sudan household survey (publication 2-5) identified the determinants of non-utilization of maternal and child health care services at individual and household levels. However, these studies did not address all the factors the South Sudanese women experience in accessing maternal and child health services such as social dynamics, political and economic instability, insecurity and socio-cultural norms and traditions. Therefore, examining the root cause of the social determinants of health in the ongoing conflict setting of South Sudan is essential for developing programs aimed at improving access to evidence-based interventions for maternal and child health. This section presents the qualitative analysis, which investigated the barriers and challenges for access to and use of maternal and child health care services at individuals, household, community and at the health care service levels.

The first manuscript (Chapter 8) explores the challenges facing health care providers to delivery appropriate care to their client. The main barriers identify are those related to health system such as, lack of medical supplies, equipment, utilities, and lack of supervision, training opportunity and low salary.

The second manuscript in this section (Chapter 9) investigates the barriers and challenges facing the community member to access health care services during, pregnancy delivery and post-delivery. The main reasons contributed to high percentage of home birth in this study were sudden onset of the labor and lack of safety and security.

Chapter 8: Barriers faced by the health workers to deliver maternal care services and their perceptions of the factors preventing their clients from receiving the services: A qualitative study in South Sudan

The manuscript has been submitted to Maternal and Child Health Journal (MACI-D-17-00104) on February 14, 2017. At present, we have submitted a revised manuscript and it is under revision.

Barriers faced by the health workers to deliver maternal care services and their perceptions of the factors preventing their clients from receiving the services: A qualitative study in South Sudan

Ngatho S Mugo[1,*]

[*]Corresponding author

Email: ngatho.mugo@sydney.edu.au

Michael J Dibley[1]

Email: michael.dibley@sydney.edu.au

Eliaba Yona Damundu[2]

edamundu@unicef.org

Ashraful Alam[1]

Email: neeloy.alam@sydney.edu.au

Address:

[1] School of Public Health, Edward Ford Building (A27), University of Sydney, NSW, 2006, Australia.

[2] UNICEF South Sudan, Toto Chan Compound, P.O. Box 45, Juba South Sudan

Abstract

Background: In South Sudan healthcare providers face several challenges and barriers to deliver maternal health services. Limited resources and underdeveloped health infrastructure that was further damaged by the civil war may have further impacted their service delivery and performance. This study explores the challenges confronted by the health care providers to deliver adequate quality health services to mothers.

Methods: We conducted 18 in-depth-interviews with health professionals including midwives/nurses, trained traditional birth attendants (TBAs), gynecologists, and pediatricians in three public health facilities in Juba, South Sudan. We purposively selected these health professionals to obtain insights into the service delivery process at these facilities.

Results: The data showed that the limited support from the heath system, such as poor management and coordination of staff, lack of medical equipment and supplies and lack of utilities such as electricity and water supply were the major barriers to the provision of health services. In addition, lack of supervision and training opportunity, low salary and absence of other forms of non-financial incentives were the major elements of health workers' de-motivation and low performance. Furthermore, security instability as a result of political and armed conflicts have further impacted their services delivery.

Conclusions: This study highlighted the need for the government of South Sudan to make additional investment to improve the health system infrastructure, availability of medical supplies, equipment and utilities. The necessity of equal training opportunities for the health workers at different levels were also stressed by our findings. Regular and timely payment of the health staff is found to be essential. Assurance of safety of the health workers, especially on night shifts, appeared to be essential for providing services.

Keywords: Maternal health, Health care providers, Health service delivery, Barriers to service delivery, Qualitative methods, South Sudan.

Significance

What is already known on this subject?

South Sudan faces the greatest challenge of shortage of skilled health care providers. Only about 10% of the government health posts in the civil service sector are filled by qualified health workers.

What this study adds?

Health workers faced a combination of barriers to provide appropriate maternal care services such as lack of essential medical equipment, supplies and utilities, shortage of trained doctors and supervisors, low salary, lack of safety and security and lack of maternal health awareness in the community.

Introduction

It is well established that shortages of skilled health care providers negatively influences the quality of health care services, service delivery and performance of health workers.[1] Sub-Saharan Africa faces the greatest challenge of shortage of skilled health care providers with only 3% of the world's health workers.[2] Lack of skilled health care providers has a direct impact not only on the quality of health services but also the survival of mothers during childbirth and their newborn children.[3] As a result maternal mortality (546 per 100,000 live births) is high across Sub-Saharan Africa, which alone accounts for 66% (201,000) of all global maternal deaths.[4] Also, Sub-Saharan Africa has high under-five mortality estimated at 83 per 1000 live birth.[5]

The world youngest country, South Sudan, is a low-income country with the world's highest rate of maternal mortality (2,054 per 100,000 live births), which translates into one in seven women dying during pregnancy or childbirth, and high neonatal mortality (43 per 1000 live birth) and under-five mortality (108 per 1000 live birth).[6,7] The decades of civil war has severely affected the country's social and economic development and has contributed to inadequate and dilapidated health system and infrastructure.[8] Since independence in 2011, this new nation has faced a shortage of trained human resources in all the sectors, including health. For example, it has a very low ratio of physicians to total population (1 per 65,574 population), and similarly for midwives (1 per 39,088 population).[8,9] Only about 10% of the government health posts in the civil service sector are filled by qualified health workers.[8] As a result of absent or

insufficient health care providers, about 58% of pregnant women have no access to antenatal care during pregnancy, 81% of births take place at home, and 54-59% of deliveries are assisted by unskilled attendants.[7,10]

The young government of South Sudan also confronts many other difficulties, such as political instability, tribal conflict, insecurity as well as providing its people with reproductive health services. Despite the government's commitment to ensure 'equitable access to quality healthcare especially for women and children' as outlined in the 2011-2013 South Sudan Development Plan and the 2012-2015 Health Sector Development Plan, [11,12] mortality among these groups is still high. Therefore, there is an urgent need to address the poor health outcome of women and their newborn babies by training and deployment of health care providers. To make proper utilization of the existing and future health care providers in South Sudan, assessing the barriers faced by both the health care providers and the mothers to receive health services is imperative.

Evidence indicates that human resources are an essential input into the delivery and provision of health care services.[13,14] Several studies have explored the factors influencing health workers' performance and motivation, such as adequacy of resources, health system infrastructure, work environment, competency of health workers, and the individual willingness to perform their duty.[1,15-17] In South Sudan, there has been no study that assessed health workers' perspectives on the barriers to service delivery. This study aims to explore the challenges and barriers confronted by the health care providers to deliver

adequate and good quality health services to mothers and their newborn children, as well as their perceptions of the barriers faced by their clients to attend the services.

Methods

Study sites and sampling

This study was conducted in early December 2015 to end of January 2016 in Juba County with an estimated population of 500,000 and one of the six counties of Central Equatoria State.[18,19] We purposively selected the Juba Municipality for the study as it is located in Juba County and serves as the capital city of the Republic of South Sudan. Out of sixteen payams (counties) of Juba, Juba town, Kator, and Munuki were selected because of their better security and ease of accessibility. The study samples included the maternal and child health care staff at the Juba Teaching Hospital, the Juba Military Hospital, and the Nykory primary health care center (NPHCC).

Study participants

The study participants consisted of 18 healthcare providers, 6 in each of the health care facilities, and included i) doctors, ii) midwives/nurses and iii) trained traditional birth attendants (Trained-TBAs). The skilled healthcare providers were purposively selected to generate information on the whole process of delivery of services at the health facilities. Trained-TBAs linked to one of the above facilities, and who attended to the needs of women in the community,

were selected in order to gain insights into the perspectives of health providers delivering services in the community.

Data collection

One field assistant was recruited and trained in qualitative data collection methods prior to data collection. In-depth, one-on-one interviews were conducted with all selected health care providers to investigate each individual's perspectives on the barriers to deliver maternal and child health related services. Each interview was conducted in a confidential setting mostly in the premises of the health facility. All interviews were conducted in local South Sudan Arabic. We developed and used separate guidelines to administer the in-depth interviews with each type of respondents. All the interviews were audio recorded.

Data analysis

We followed multiple steps to analyze the data. First, the lead researcher (NSM) transcribed verbatim each audio-recorded interview conducted in the local language and then translated it into English and stored in Microsoft Word documents. Second, a team of two researchers crosschecked the translation against the audio recording and the transcription. Third, NSM prepared a draft code list by carefully reading two transcripts, which was independently checked by another researcher (AA). Subsequently NSM and AA discussed the draft code list and developed a code list. NSM then manually coded all transcripts. As the study was explorative and descriptive in nature, we applied an inductive coding procedure where themes were derived empirically from the data that were related

to our research questions.[20] Fourth, the data were organized and compiled into separate files based on each thematic codes. The fifth step, involved themes development, which were classified according to the objectives of the study. We applied an inductive thematic approach for data analysis.[21] The analysis team discussed the text pertaining to each thematic code. After several discussions these were consolidated and summarised in a document for each theme with relevant quotes and text tables. At the end we performed a triangulation of data to compare different responses from the three types of health care providers.[22]

Analytical framework

The Figure 1 is the framework used to scrutinize the main challenges encountered by the health care providers and the perceived barriers faced by their clients. We have classified the challenges into four main categories including: 1) health services/infrastructure (lack of work space for the health providers, lack of medical equipment and supplies, availability of electricity, generators, fuel or water, lack of blood in the blood bank and, lack of ambulances); 2) human resources for health (the challenges impacting the effectiveness of health worker performance/service delivery such as shortage of skilled providers and supervisors, lack of training, coordination and proper management; 3) security and economic factors (the impact of economic and security instability on health workers' performance and service delivery; and 4) community awareness (lack of community awareness on the benefit and use of modern health care services and practices).

Ethical approval

The ethical review committee of the Department of Policy, Planning, Budgeting and Research of the Ministry of Health, Government of South Sudan (MoH-GoSS), Juba, the Republic of South Sudan reviewed and approved the study. We obtained informed consent from each participant for his or her participation in the study.

Results

The majority of the healthcare workers in this study have acquired their midwifery skills from an elder lady. Most of healthcare providers received a monthly salary according to their grade which varied from (500-700 South Sudan pounds) at tertiary level compared to (300-500 South Sudan pounds) at the state level. The majority of the health care providers have performed pre and post-delivery care and all have recognized the delivery and post-delivery danger signs as indicated in Table 1.

Health services and infrastructure

Poor infrastructure of maternity wards/ delivery rooms

The health workers who participated in the study perceived that health facilities lack the basic infrastructure, which influenced service delivery and utilization. In all of the facilities the head of the department of midwifery raised issues of inadequate number of beds at the maternity ward, with 13 beds reported at the Juba Teaching Hospital and 7 beds reported at both military hospital and health care center.

> *"At this hospital we have an average of 600 deliveries per month and only 13 beds. Due to overcrowding and lack of bed women who deliver normally without complication will rest for 2 hours before discharge".* Midwife at Juba Teaching Hospital

Lack of workspace was another challenge perceived by the midwives and trained-TBAs in this study and all acknowledged sharing rooms with patients.

Poor infrastructure of newborn intensive care unit

Nurses and pediatricians at the newborn intensive care unit mentioned that poor resources and infrastructure affected their service delivery since they received many newborns with complications from other health facilities.

> "*This unit consists of one room and is crowded with many newborns with various types of complications. We do our best to help these babies but without enough space, incubator and medication, it's very difficult"*. Pediatrician at a Newborn Intensive Care Unit, Juba Teaching Hospital

Lack of utilities

All of the midwives, doctors and trained-TBAs in the study perceived the lack of access to utilities such as electricity, generators, fuels and water supply as major barriers for service delivery.

> *"It has been months and there is no power at the hospital. Without power you cannot operate, you cannot sterilize or save mothers life in case of obstetrics emergency and as the result all the blood in the blood bank was destroy due to the electricity."* Gynecologist at Juba Teaching Hospital

Lack of electricity was another issue perceived by the nurses and pediatricians at the newborn intensive care units, since many preterm babies and those with breathing problem require oxygen.

> *"We continue facing issues of oxygen because of lack of power and when there is no power then the oxygen machine will not work, and many children died as the result of difficulty to breath."* Pediatrician at Juba Teaching Hospital

Insufficient medical supplies

All of the health workers participated in the study stated that during their practices, medical supplies, such as gloves, cotton, syringes and cord clips and all the necessary supplies to safely handle the women and her newborn, were unavailable or extremely inadequate.

> *"Even the cord clips is not available at the hospital and we used what is available such as thread to tight the newborn cord so it will not bleed and some time we do cut the dressing wound and used it as the thread. We have to use our brain to save the mother and the newborn".* Trained-TBA at Military Hospital

Most of the trained-TBAs reported that even the medication for bleeding such as oxytocin was not available.

"As 'dia' (midwife) I do my best to save mothers' lives but without medication to stop bleeding, a woman's life cannot be saved. When we are out of stock of

supplies I always do request family member to hurry and buy medication from a private pharmacy". Midwife at Nykory Primary Health Care Center

Lack of medical equipment

Lack of medical equipment for assessing pregnant women attending antenatal care clinic was a major challenge experienced by the midwives.

"At antenatal care visit we only used the old Pinard horn stethoscope to assess the fetus. Most of the mothers are discourage because of that and many of them would like to know the sex of the fetus but we have failed their expectation". Midwife at Juba Teaching Hospital

The Doctors considered other challenges as major issues, such as lack of the lab equipment to assess viral load for those HIV positive mothers and modern equipment for caring of premature babies, as impacting health service delivery.

> *"In the whole South Sudan, we don't have equipment for assessing the viral load if a women was found HIV positive during antenatal care. Therefore, it's difficult to know which women should go for normal delivery and which one should go for C-section because that decision is based on the viral load".* Gynecologist at Juba Teaching Hospital

They also highlighted the lack of coordination among government and international organizations in delivering medical supplies. This was highlighted as a significant detrimental factor to availability of medical equipment in the health centers since South Sudan relies heavily on donor support for medical equipment and medicines.

Health human resources

Shortage of skilled health staff and supervision

Insufficient numbers of doctors and supervisors were another common challenge perceived by the trained-TBAs, nurses and midwives that affected their performance to handle difficult cases of delivery especially in the night shift.

> *"I feel difficulties to handle some cases when a woman bleeds or the baby (*fetus*) doesn't move and there is no doctor nearby to help me at night. [In such cases] I have to refer the women to the Juba Hospital even when we don't have an ambulance [in the clinic]".* Trained-TBA at Nykory Primary Health Care Center

Most of the health workers perceived that they needed training to improve their skills.

> *"We do need a lot of training since we have* trained-TBAs*, nurse and midwife and the training will help us handle the baby with complications and also attend the needs of the mother".* Head of Midwife at the Military Hospital

Security and economic factors

Low salaries and lack of promotion

Our study participants perceived low salary as a major challenge. They associated it with de-motivation, low performance and staff attrition in the public sector. Even senior doctors had similar experiences.

> "*Salaries were not enough even for me as a senior doctor to support [my family] and encourage and motivate [me to work in the government hospitals]. Many specialists have left the hospital and now working at the*

Ministry of Health because they are better paid there". Gynecologist at the Juba Teaching Hospital

The base salary of a graduate health worker at tertiary hospital was 2,000 South Sudan Pound SSP per month compared to 1,100 SSP for a staff with the same qualification at a state level facility.

"Salaries is not enough and were not increased over years and I do private work among community because of the market prices but it's not easy to do the 2 jobs". Trained-TBA at Nykory Primary Health Care Center

Also, in addition to the low salary, salary inequality was perceived to be unfair.

"We are paid less by the state government and also there is no promotion, no bonus or reward, and salary is not enough for us to feed our family". Midwife at the Nykory Primary Health Care Center

Lack of security and safety

All the trained-TBAs and midwives perceived the impact of security and safety when they were out in the community to deliver services. Most of them said that they even did not want to attend deliveries at night fearing for their safety.

"I only work during the daylight in the community because I fear for my own safety at night. Even if the family member called me at night to help a woman with her delivery, I don't go out because it's not safe [outside at night] and you can get killed". Trained-TBA at Nykory Primary Health Care Center

Furthermore, health workers on night shifts at the health centers also perceived their work place unsafe due to robberies, violent activities and unavailability of a security guard.

"The night shift is very dangerous. Sometimes there are thieves who will beat the Midwife at night demanding for money from them. All of us here are women and we don't have strength to fight if anyone attacks us. We only pray to God so we can be safe at night". Midwife at Nykory Primary Health Care Center

At night security concerns were a challenge to the health workers when transporting critically ill patients to a referral hospital, even if an ambulance was available. As the result of this of insecurity health workers attending to the needs of the patient at a health centre were often reluctant to accompany the patient in the ambulance at night. The quote from another trained-TBA at Nykory Primary Health Care Centre reflects this concern.

"Transporting an ill person by an ambulance at night is a big issue, because the car can be stopped by the robbers putting us in danger; we work in fear".

Community awareness

Lack of community awareness

Most of the doctors and midwives mentioned about the need of increasing awareness and 'educating' the communities about maternal health since the communities tend not to except the differences in midwifery practice they recommend.

"When I attended a home delivery and saw a woman who required an urgent transfer to the nearest hospital, I got resistance from the community due to the belief and concept that labor can take up to 2-4 day until the delivery".
Midwife at Juba Teaching Hospital

Delayed decision-making by the family members for the C-section was perceived as a major barrier to saving the lives of the mother and her fetus. In most of the cases the decision was made in the last minutes when the mother and her fetus were at great danger. In some cases it was too late to save their lives.

"*In emergency cases when the women had to undergo C-section, there is a big problem here because they have to call all the members of the family to have them agreed to the operation, and its time consuming and delay the process of saving the woman's her unborn baby's lives".* Gynecologist at Juba teaching hospital

Lack of health awareness among the women

Another important challenge perceived by the midwives and the nurses was the lack of health awareness among pregnant woman of the benefits of utilization of maternal care, such as antenatal care services.

"Lack of awareness among mothers is a big issue. They only come to get an antenatal care card because when they get sick, they will be asked for it, and also at the time of delivery [they will be asked for it]". Midwife at Juba Teaching Hospital

Challenges faced women

This section will describe the healthcare providers' perceptions and observation about the barriers that were faced by the pregnant women to receiving services from them. Most of the health care providers perceived that physical accessibility factors, such as, distance, transport, poor road and remoteness were important obstacles for many women to attend maternal health care services. They also perceived that women are burdened by cost of accessing the services since transport was very expensive.

> *"Transport is very difficult [to afford]. If you want to travel by a 'boada'* (motorbike) *it will cost about 10 SSP and if you are living far away it might cost about 20 SSP, and sometimes they will ask for 50 SSP and poor woman can't afford such cost".* Midwife at Nykory Primary Health Care Center

Lack of security was the main perceived reasons for home delivery since most of the births happened at night and women and her family members could not travel at night to a facility for the delivery fearing for their safety in the streets.

Discussion

Main finding

This study explores the health service providers' perspectives on the challenges and constraints affecting their service delivery and performance in the public health facilities in the Republic of South Sudan. Our study revealed that health workers faced a combination of barriers related to infrastructure, personnel, socio-economic factors, geography and culture to provide appropriate maternal

care. The main challenges identified in this study included lack of essential medical equipment, supplies and utilities, shortage of trained doctors and supervisors, low salary and lack of maternal health awareness in the community. In addition, overall safety and security as a result of internal conflicts was mentioned as a significant factor further impacting service delivery at the facility as well as the community outreach services.

Several studies from low-resource counties have linked hospital-working environment to job satisfaction and motivation, [23-26] which was consistent with our study. In South Sudan health workers operate under a harsh and difficult environment with limited system support, such as management and coordination of staff, stock out of medical supplies and equipment, and lack of utilities such as electricity or water supply. In addition, lack of supervision and training opportunity may have further impacted on the quality of their services and performance. Therefore, Government of South Sudan should make additional investments to improve the physical aspect of health system, ensuring equal training opportunity for all the health workers, and availability and on time distribution of medical supplies and equipment.

Low salary and lack of other forms of financial and non-financial incentives were the major source of health workers' de-motivation and low performance in this study, and these observations are supported by other studies in low-income countries.[27-31] In South Sudan, health workers employed by the public sector earned a poor salary. The current economic crisis is making the situation worse

and health workers cannot meet the needs of their family due to the low and irregular payments that can be delayed for several months. This situation has forced the health providers to be absent from work in order to earn extra income or leave public sector for a job with a better salary. The Government should evaluate and improve the current health workers' payments for lower carders as well as standardize salaries across the states and territories. The government should take measures for timely payment of its health staff. If financial incentives are not feasible for this war-torn and infant nation, the Government should introduce non-financial incentives, such as job awards, appreciation certificates to boost the motivation of high-performing health care staff.

Our study discovered that health workers' performance and service delivery were hampered by a lack of safety and security in the work places and the community. Similar findings were reported in studies in Papua New Guinea, Malawi and Myanmar.[32-35] In South Sudan, the current internal conflict has accelerated violent activities at night and many civilians as well as health workers have been killed as a result. The evidence revealed in this study of armed robbery at the facilities at night certainly jeopardized the already inadequate health service infrastructure. This necessitates the Government to act and implement workplace safety and security for health workers. Deployment of security guards at each healthcare facility and when transporting a patient to referral hospital should be implemented.

In our study low use of ANC services was linked to women's dissatisfaction with the service delivery at the public health facilities which was similar to findings with another study from Ethiopia.[36] Lack of modern medical equipment, such as ultrasound machine, has been shown to reduce health workers' performance to examine pregnant woman at each antenatal care check-up. Therefore, the Government should invest and coordinate with international organizations to upgrade the existing health facilities with essential modern tools and equipment to meet the demands and needs of the growing population.

Limitations of the study

Our study has some limitations that should be considered when interpreting the results. First, we could not explore the perceptions of the health workers in a sample of the health facilities from across the different regions of South Sudan due to the limited budget and for security reasons. However, generalization is not the primary goal of this qualitative study. Our study participants were selected from three public health facilities, in order to explore in-depth, the perceptions of a diverse group of health workers as was possible within the scope of the study. Secondly, this study accounts on the opinion and perceptions of the health workers only and there is a chance of potential biases. However, we attempted to minimize the bias by collecting and triangulating data from various types of health providers from a number of health facilities. We could not capture the perceived barriers faced by the health care providers in the rural areas due to security reasons, but information collected in this study remain important for implementation of interventions in both rural and urban areas.

Conclusion

In South Sudan health workers are experiencing many challenges to deliver appropriate care to woman and to their newborn children. This study highlights the needs for the Government of South Sudan to make additional investments to improve the physical assets and capacity of the health system including the availability of medical supplies, equipment, utilities and training opportunities for the health workers across different levels within the public health sector. The Government should also make resources available for disbursing the staff salaries on time and introduce non-financial incentives for the staff. Wider socio-political aspects such as safety and security must be considered in the long-term policies of the Government that will have direct and indirect impact on the maternal health services.

Authors' contributions

NSM, AA and MJD contributed in the study designed. NSM, AA performed the analysis and interpreted the data and NSM prepared the manuscript. NA, MJD and EYD reviewed all draft versions of the manuscript. All authors read and approved the final manuscript.

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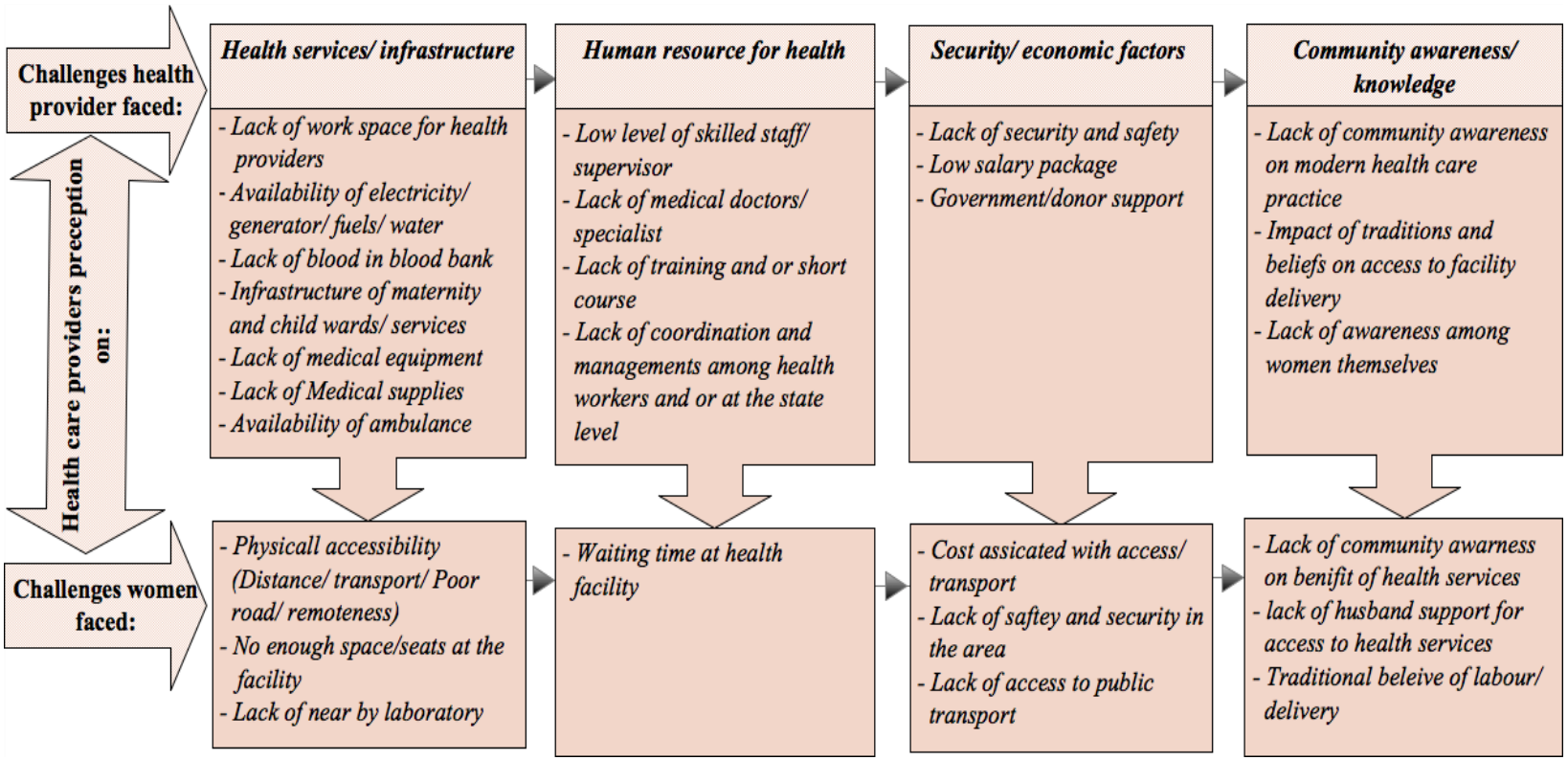
Table 1. Socio-demographic Characteristics of health care workers, in depth interview (n = 18 participants)

Socio-demographic characteristics	**N**
Gender	3
Male	15
Female	
Age	
>35	8
<35	10
Education	
Diploma/university	8
Secondary/ primary school	
Attended training in the last year	
yes	5
No	12
Would like to attend a training/short course	
yes	18
No	0
Profession/occupation	
Medical doctor/ specialist	2
Midwife/nurse	6
Trained-TBAs	10
Salary	
>800SSp	8
<800 SSP	10
Performed delivery in the last week	
yes	17
No	1
Knowledge of danger signs of labor/delivery	
Yes	18
No	0
Immediate care and post-delivery care for (mother and babe)	
yes	18
No	0
Have private work other than hospital	
yes	18
No	0

Figure 1: Challenges facing health care providers and their perception on issues facing mother access to their services



Chapter 9: *The system here isn't on patients' side"* - perspectives of women and men on the barriers to accessing and utilizing maternal and newborn healthcare services in South Sudan

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RESEARCH ARTICLE Open Access

"The system here isn't on patients' side"- perspectives of women and men on the barriers to accessing and utilizing maternal healthcare services in South Sudan

Ngatho S. Mugo[1*], Michael J. Dibley[1], Eliaba Yona Damundu[2] and Ashraful Alam[1]

Abstract

Background: In fragile and war-affected setting such as South Sudan, a combination of physical environmental, socioeconomic factors and healthcare's characteristic contributes to higher rates of home delivery attended by unskilled attendants. This study aims to understand the community members' experience, perceptions and the barriers in relation to accessing and utilizing maternal healthcare services in South Sudan.

Methods: We conducted in-depth one-on-one interview with 30 women and 15 men to investigate their perspectives on the barriers to access maternal and child health related services. We purposively selected women and their partners in this study.

Results: Our study revealed that inadequate quality of antenatal care services such as lack of essential medicine, supplies and tools was linked to individual's mothers dissatisfaction with the services they received. In addition, sudden onset of labor and lack of safety and security were important reasons for home delivery in this study. Furthermore, lack of transport as a result of a combination of long distance to a facility and associated costs either restricted or delayed women reaching the health facilities.

Conclusions: Our study highlighted an urgent need for the government of South Sudan to implement security and safety measures in order to improved access to delivery service at night. Incorporating private transports to provide access to affordable and reliable transport services for pregnant and post-partum women is also important. Increasing the budget allocation for medicine and health supplies and improving management of medicine and supply chain logistics are essential.

Keywords: Barriers, Maternal health care, Perceptions, Qualitative research, South Sudan

Background

The reduction of the maternal mortality ratio to less than 70 per 100,000 live births between 2016 and 2030 is one of the global priority targets of the Sustainable Development Goals [1]. Globally, during the millennium development goals era the proportion of deliveries attended by a skilled attendant increased from 59 to 71% from 1990 to 2015 [2]. Yet more than one in four newborns and their mothers still have no access to essential medical care during childbirth [2]. Evidence suggests positive associations between access to facility-based services from skilled birth attendants during pregnancy, delivery and post-delivery, and improved maternal health outcomes [3–7]. However, in a setting affected by conflicts, displacement, and natural disasters, access to such services is very limited and the risk of death following pregnancy and childbirth is high [8, 9].

South Sudan is a fragile and war-affected setting that gained independence in 2011 [10]. Since then, the country has experienced internal arm conflict, political instability, insecurity and the closure or destruction of the healthcare facility. In 2015 South Sudan was among

* Correspondence: ngatho.mugo@sydney.edu.au
[1]Sydney School of Public Health, Edward Ford Building (A27), University of Sydney, Sydney, NSW 2006, Australia
Full list of author information is available at the end of the article

the developing countries with the highest maternal mortality rate and it was estimated at 789 per 100,000 live birth [9]. The lifetime risk of maternal mortality from maternal causes in South Sudan is still very high at 1 in 50 deaths in 2015 compared to 1 in 180 in developing countries verses 1 in 4900 in developed countries [9, 11]. A combination of physical environment, social and economic factors, and the individual woman's characteristics and behaviors increases the lifetime risk of maternal mortality among women of reproductive age and among their under-five children. According to 2010 South Sudan household survey report the neonatal mortality rate was estimated at 40 per 1000 live birth, an infant mortality rate of 74 per 1000 live birth and under-five mortality rates of 101 per 1000 live birth [12, 13].

In response to higher maternal and under-five mortality, the government of South Sudan made a commitment to implement free access to maternity and child healthcare services [14, 15]. However, the decades of the civil war have severely contributed to collapse of the public health system. Currently Non-Governmental Organizations (NGOs) provided approximately 80% of the basic healthcare services [16]. These services are provided though facilities based clinical care. The primary health care unit is the immediate point of contact for antenatal and postnatal care services and provide basic preventive and curative services. In addition to the services offered by health care units, Primary Health Care Centers offer basic diagnostic laboratory services and maternity care [17]. County and State Hospitals provide secondary care including comprehensive obstetric care, in-patient care and surgery [17–19].

Yet coverage of maternal health care services is generally very low with high levels of inequalities in South Sudan (see Figs. 1 and 2). As a result only 19% of deliveries take place at a facility as oppose to eight in ten births (81%) taking place at home [13]. In order to prevent maternal mortality following pregnancy, delivery and post-delivery in South Sudan, there is an urgent need to understand the reasons for low utilization of maternal and child health services.

Previous analysis of South Sudan household survey data identified factors associated with non-use of maternal health care services and health facilities for delivery [20–22]. However, these studies did not address the factors the South Sudanese women experience in accessing maternal and child health services. This study aims to understand the community members' perceptions and experience of and barriers they face to use maternal health services.

Methods

Study sites and sampling

This analysis was part of a wider study conducted in early December 2015 to end of January 2016 in Juba county central Equatoria State. We purposively selected health services located in Juba town, Kator, and Munuki for security and accessibility reasons. The wider study aimed to explore the perceived and experienced barriers faced by the community members to access healthcare services, as well as the barriers faced by the healthcare providers to deliver healthcare services to their client.

The current paper reports the findings generated from the women and their husbands on perceived and experienced barriers to receiving maternal health services at the Juba Teaching Hospital, the Juba Military Hospital, and the Nykory Primary Health Care Center. Our study participants consisted of 30 mothers, 10 in each type of health care facility, with children aged less than 3 months, who had given birth either at home or in a health facility, and 15 husbands (5 in each health care facility).

Data collection

Prior to data collection we recruited and trained one research assistant in qualitative data collection methods. We conducted in-depth one-on-one interviews firstly

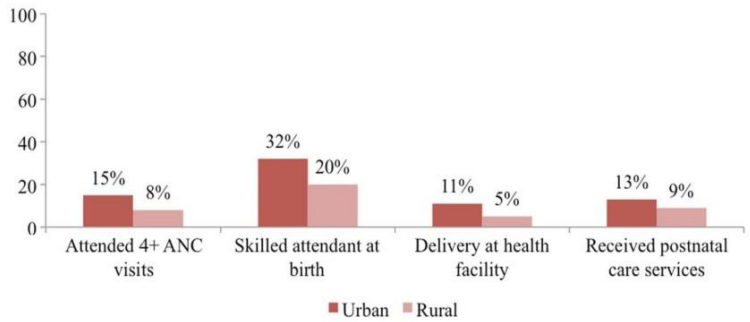

Fig. 1 Inequalities in coverage of maternal healthcare services by place of residence ** Source: South Sudan household survey 2010

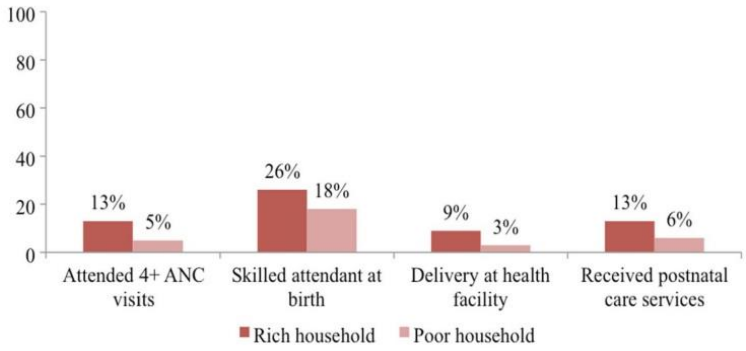

Fig. 2 Inequalities in coverage of maternal healthcare services by household wealth** Source: South Sudan household survey 2010

with all mothers then secondly we cross check the information with their husbands to investigate each individual's perspectives on the barriers to access to maternal and child health related services. Interviews with women were conducted in a confidential place mostly on the premises of the health facility at each of the selected health facility for their convenience and ease accessibility. Interviews with husbands were conducted at the Juba Staff Club. To recruit the husbands, firstly we purposively selected eligible women who were willing to participate in the study. The husbands who were accompanying their wife were invited to participate and the consented husbands were interviewed. If the woman was alone or accompanied by anyone other than her husband, we collected the husband's contact details to make an attempt to contact him. Through this process we finally interviewed 15 husbands. All interviews were conducted in local South Sudan Arabic. We developed and used separate guidelines to administer the in-depth interviews with each type of respondent. All the interviews were audio recorded.

Data analysis

We followed multiple steps to analyze the data. First, the lead researcher (NSM) transcribed verbatim each audio-recorded interview conducted in the local language and then translated the interview into English and saved it as Microsoft Word document. Second, a team of two researchers crosschecked the translation against the audio recording and the transcription. Third, NSM prepared a draft code list by carefully reading two transcripts, which were independently checked by another researcher (AA). Subsequently NSM and AA discussed the draft code list and developed a code list. NSM then manually coded all transcripts. As the study was explorative and descriptive in nature, we applied an inductive coding procedure where themes were derived from the data that were related to our research questions [23]. Fourth, the data were organized and compiled into separate files based on each thematic code. Fifth, involved the development of themes, which were classified according to the objective of the study. We applied an inductive thematic approach for data analysis [24]. The analysis team discussed the text pertaining to each thematic code. After several discussions these were consolidated and summarised in a document for each theme with relevant quotes and text tables. At the end we performed a triangulation of data to compare different responses from mothers and their spouses [25].

Conceptual framework

We modified and used the framework developed by Peter at el [26] as a guide to examine and group the key challenges and barriers facing women to access health care services in South Sudan. Figure 3 presents the main challenges identified in this study. According to the framework the distal factors such as policy and or macro-environment have direct effects on the household, community and health facility. In turn, the characteristics of the health facility and the household and community affect the individual mother's use or nonuse of the services. We classified the challenges into five main categories including: 1) geographical accessibility (the impact of distance and transport to maternal health care services); 2) availability (having access to appropriate types of care to the women who need them); 3) affordability (capacity and willingness to pay for the services); 4) acceptability (the response of health care providers to the social and cultural expectation of the community and the women attending their services); and 5) Security factors (the impact of safety and security instability on community access to healthcare services).

Result

Table 1 describes the socio-demographic characteristics of the female participants. The majority of the

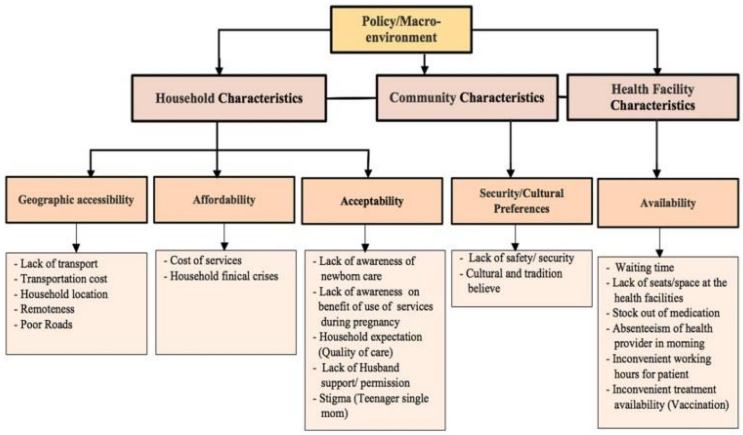

Fig. 3 Perceptions of community members on the challenges faced by woman to access and utilize health service. This framework was developed from Peter at el framework

mothers had just had their first child, were unemployed, and had never attended school. Most of the mothers traveled long distances by public transport for 1–2 h to the nearest health facility and had planned for facility delivery.

Household characteristics

Geographical accessibility

All of the men participated in this study perceived poor condition of the roads, remoteness, lack of transport, and long distance to the nearest health facilities as the major obstacles for women reaching a health facility for delivery, or when they developed complications.

> *"In this area, most of women do deliver at home not because of their intention to deliver here (home) but because it's the easiest option for them."* Male participant.

In addition, many women mentioned that delivery at a facility was their first preference, however, their labor happened at night and transport was an issue to reaching the health facility.

> *"My labor started at midnight and I gave birth in early morning at home. There was no way that I could make it to Juba teaching hospital since there is no public transport neither any type of transport at night time." Female participant.*

Several women were alone at home during the labor and felt unable to make it to hospital since distance was

Table 1 Socio-demographic characteristics of women, in depth interview ($n = 30$ women)

Socio-demographic	N
Age	
20–29	20
30–49	10
Maternal Education	
No education	19
Primary and above education	11
Employment	
Yes	5
No	25
Birth order	
1st -2nd birth	16
3rd birth and over	14
Distance to near by health facility (by public transport)	
< Hours	9
> Hours	21
Attended antenatal care visits	
Yes	30
No	0
Birth preparation	
Yes	25
No	5
Birth preference	
Hospital	30
Home	0
Place of delivery	
Hospital	10
Home	20

an issue and they could not find someone to help them to get to hospital.

> *"I was alone at home and then I sensed that the baby is about to come out. I did ask for help form an elder woman who lived nearby. She's not a 'Dia' (midwife) but I did not have any other option." Female participant.*

Affordability

User fees All the mothers perceived paying a small fee reasonable (i.e. about 10 South Sudanese pound (SSP) equivalent to (0.14 USD) for antenatal card and around 5 SSP equivalent to (0.071 USD) for each visit as well as for a pathology test). However, in practice, restricted antenatal services due to financial constraint were also reported.

> *"I only attended one antenatal care services during my pregnancy. Everything here (at hospital) is at the cost and we are suffering financially. The little (money) we have is to mange to buy some food." Female participant.*

Men in this study perceived user fees as responsible for delayed women's access to care when women experienced complications such as prolong labor, excessive vaginal bleeding, or any other complication of delivery and post delivery. Men, who were financially responsible for the family, were burdened by expenses for transportation, specialists and medicines to treat their wife with complications. The medical center was perceived to have a limited capacity for treatment and would refer patients to higher levels of care in case of complications. This increased the financial burden of men.

> *"My wife developed pregnancy complications (postpartum hemorrhage) and it cost me a lot of money to see a gynecology and also for transport. Many family cannot afford the cost and therefore it become an obstacle to access health services for (maternal) complications and saving mothers' lives." Male participant.*

Most of the families were affected by the country's financial crises. Men perceived reduced income and irregular salary disbursement as a major cause of home delivery since families often cannot afford transportation and hospital costs.

Acceptability

Quality of services Our study revealed inadequate quality of maternal healthcare as a major constrain for accessing public health services. The quality of public facilities was described as poor, inconvenient and managed by unqualified healthcare providers such as trained- traditional birth attendance (trained-TBAs).

> *"In my understanding* government facility *is not well equipped for pregnant women to follow-up there. Also women will not receive adequate services they are expecting and know the sex of the baby since they do not have ultra sound. In case of complication this is a real problem since a specialist is not available and trained-TBAs or midwifery practice are very limited."* Male participant.

Sudden onset of labor Men and women in this study mentioned that hospital delivery was the first preference in their planning. However, sudden onset of labor and labor starting at night were the major reasons perceived for home delivery.

> *"I went for all my antenatal care visits and I gave birth at home. It happens at night and I had no severer pain. I thought its only the beginning but when I was ready to go to hospital it was time and the babe was about to come out, then I have to deliver at home." Female participant.*

Community factors

Community and cultural preferences and norms

Mothers and their husbands highlighted the impact of tradition on pregnancy and delivery outcomes. Men in this study mentioned that pregnant women were discouraged to eat some type of foods such as eggs, white cheese and cheese product since it was perceived by the community to induce pregnancy and delivery complication such as high blood pressure, preeclampsia or even swollen of the feats or giving birth to a big babe.

> *"Pregnant woman are discouraged to eat the food that will make her fat such as eggs because once the women put on weight it also means the baby will put on weight and it will be very difficult for the mother to deliver the baby." Male participant.*

Lack of husband's support, lack of women's autonomy in decision-making concerning use of maternal healthcare services and stigma on unmarried teenage pregnancy were perceived as barriers for accessing medical care. In addition, mothers' attitude and beliefs were perceived as a barrier to facility delivery in this study. Men also perceived home delivery as safe in the rural community and women were convinced to deliver at their home.

"In my understanding, if a woman is healthy during pregnancy, she can give birth at home without any issues but the women who are ill are the ones who can developed some problem during delivery." Female participant.

Security factors

Both women and men in this study perceived insecurity and lack of safety at night as a major reason for home delivery.

"My labor happened at 10PM. In this area no one will risk his/her live to come out at night because you can lose your life so easily if you meet with those robberies. In spite of the danger, my family managed to bring trained-TBAs whom we know and then I gave birth at home." Female participant.

Health services characteristics

Availability

Stock out of medication Many participants, specifically men, perceived the health facilities as lacking essential resources including medicines, childhood vaccines and logistics such as refrigerators to maintain the cold chain.

The stock-out of the medication was the most common factor perceived by mothers during in-depth interviews and was associated with dissatisfaction with use of antenatal care services.

"Most of the time, there is no enough medicine and after long waiting time we are asked to come back next day. It's hard for me since I am unwell and too weak to do that. If I had money, I would have bought these medications from the private pharmacy." Female participant.

Long waiting due to lack of staff Women were also discouraged by the health system failure to timely attend their needs. Long waiting times at the health facility were perceived as a barrier to receiving antenatal care child vaccination services.

"The system here (at hospital) is not on patients' side. The doctor has quite a lot of preparation such as drinking morning tea, dressing. It takes them a lot of time to do all these before they can attend to our needs." Female participant.

Lack of beds/seats at maternity care services In addition to waiting time, women perceived lack of space and seats in the waiting area as barriers. They had to stand during the long wait holding their infants.

Inadequate number of beds forced the local health center authorities to release patients early. Most of the men perceived that discharging the women after two hours of delivery from the local hospital was associated with post-delivery complications, such as postpartum hemorrhage, and in some cases death.

"My wife developed complication just a few hours after she returned home (from the local health center) and I have to rush her to the private hospital because she was losing a lot of blood. I do think that the health facilities have the responsibility of discharging her too early after birth without being sure of her health." Male participant.

Discussion

In Juba county in Central Equatorial State of South Sudan, our study participants experienced barriers to receive pregnancy, delivery, post delivery and neonatal care at three different levels: household, community and health system. At the household level, women were challenged by financial ability to avail the services. Community barriers included traditional and cultural believe and overall security challenges. Inadequate service availability and other health system-related barriers such as lack of infrastructure and medical amenities in the facility also had a crucial role in women's uptake of the services.

A the household level our study revealed that long distance to the healthcare facilities coupled with sudden onset of labor hindered the women's access to the health facility during delivery, which was similar to other studies from low-income countries [27, 28]. In Juba, pregnant women attending public health facility faced several barriers from timely access to appropriate care such as inconvenient traveling time, lack of transport and transportation cost and delivery fees in the facility. In addition, lack of welfare support and the household financial condition plays a vital role in women's access to health services, since over 50% of the population of the country live below the poverty line [10]. Therefore, the Government of South Sudan needs to implement interventions to minimize the distance barrier by initiating collaboration with private transport sector to provide access to affordable and reliable transport services to pregnant and post-partum women. It is also essential to remove hospital delivery fees, such as bed charge, in the public facilities. In the long term it is essential to implement birthing centre at each sub district to overcome the delay in reaching health services for delivery.

At the community level, our study highlighted security concerns as a prime reason for home delivery since most of the births happened at night and the mother and her family could not travel to the health facility due to an

Author details
[1]Sydney School of Public Health, Edward Ford Building (A27), University of Sydney, Sydney, NSW 2006, Australia. [2]UNICEF South Sudan, Toto Chan Compound, P.O. Box 45, Juba South, Sudan.

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Table1: Socio-demographic characteristics of men, in depth interview (n=15 men)

Socio-demographic	N
Age	
20-29	3
30-49	1
Education	
No education	0
Primary and above education	15
Employment	
Yes	15
No	0
Distance to nearby health facility (by public transport)	
1< Hours	2
1 > Hours	13
Knowledge of antenatal care services	
Yes	15
No	0
Knowledge on birth preparation	
Yes	15
No	0
Birth preference for their wives	
Hospital	15
Home	0

Erratum:

Typological	**correction**
cultural believe	*cultural beliefs*
exiting health services	*existing health services*
> hours	> one hours

Section V: Summary

Chapter 10: Summary and recommendation for policy and decision makers

10.1 Overview of key findings

The body of research presented in this thesis examines the factors associated with non-use of maternal and child healthcare services in South Sudan. A mixed-methods approach was employed in this research using both quantitative and qualitative methods to investigate the barriers to access to antenatal care, skilled birth attendants, facility delivery and child healthcare services.

Narrative review on maternal newborn and child health challenges in South Sudan[1]

The results from the narrative review highlight the challenges to improve the poor health status of mothers and of their children in South Sudan. It draws attention to improved health system functioning, performance, and the need to address the determinants of health if improved outcomes are to be achieved. Despite the many obstacles and challenges in South Sudan, peace and security, and addressing basic needs of nutrition, shelter, employment, and water and sanitation, among others, all require attention. Gender equality, and the low levels of education of girls and women were identified as major challenges and require high levels of government commitment and leadership. The literature also highlights the lack of skilled service providers as the greatest obstacle to achieving improved maternal and child health in South Sudan.

Prevalence of non-use of antenatal care services in South Sudan[2]

The analysis shows that the residence of pregnant women in Warab, Junglei and Unity regions was strongly associated with maternal non-use of ANC visits compared to their counterparts from the remaining regions. The result also shows that pregnant women from rural areas were more likely to underutilize ANC services compared to their counterparts from urban areas. The non-use of ANC services was also significantly higher among illiterate mothers and among mothers in a polygamous relationship.

Factors associated with unassisted home delivery and delivery assisted by un-skilled birth attendants in South Sudan[3,4]

The result from the analysis of the South Sudan household survey second round indicated a high percentage of South Sudanese mothers still deliver at home, often unassisted, or assisted by un-skilled birth attendants. Low utilization of antenatal care services during pregnancy due to low quality of care received at the antenatal care visits were an important factor for use of unskilled providers during home delivery. Unassisted home birth or home birth assisted by un-skilled providers was found among mothers from poor households, living in rural areas, uneducated mothers, single mothers, mothers who never experienced pregnancy complications, and those mothers who lacked essential knowledge to take basic preventive measures for their health during pregnancy and delivery.

The findings from the quantitative analysis (manuscripts 3-4) was consistent with the qualitative study, which investigated the community members perception on use of antenatal care and delivery services in Juba, South Sudan. In this qualitative study inadequate quality of antenatal care services, such as lack of essential medicines, supplies and tools was linked to individual's mother's dissatisfaction with the services they received. In addition, sudden onset of labor and lack of safety and security were important reasons for home delivery unassisted or assisted by un-skilled health providers. Furthermore, lack of transport as a result of a combination of long distance to a facility and associated costs either restricted or delayed women reaching the health facilities.

Delivery barriers to healthcare services in South Sudan[5,6]

In the quantitative analysis (manuscripts 2-4) the quality of care received at antenatal care services was associated with women's dissatisfaction with the services and the use of unskilled care providers at delivery. In order to understand the delivery barriers to maternal health services, a qualitative study were conducted in Juba, South to explore the challenges confronted by the health care providers, such as doctors, midwives, nurses and trained traditional birth attendants to deliver adequate quality health care to mothers attending their services.

Limited support from the heath system, such as poor management and coordination of staff, lack of medical equipment and supplies and lack of utilities

such as electricity and water supply were the major barriers to the provision of health services. In addition, lack of supervision and training opportunities, low salaries and absence of other forms of non-financial incentives were the major elements of health workers' de-motivation and low performance. Furthermore, security and instability as a result of the political and armed conflicts has further impacted their service delivery.

Determinants of under-five mortality in South Sudan[7]

The results from the analysis (manuscripts 2-4) shows that mothers from disadvantaged populations in South Sudan have a high prevalence of non-use of antenatal care services and use of unskilled providers at delivery. Children born in such households are at increased risk of ill health and thus faced with a high rate of under-five mortality. The South Sudan household survey 2010 dataset were used to explore the potential factors associated with neonatal, infant and under-five mortality. In this analysis, the social and material circumstances in which the children were born and live in, such as family use of unimproved sources of drinking water, exposure to indoor air pollution due to cooking location, and male child were all associated with an increased risk of dying before age of five. Maternal circumstances and conditions, such as children of teenage mothers, children living in urban areas, children whose mother had had a prior child death, and children born to illiterate mothers were significantly associated with childhood mortality.

10.2 Strengths and limitations of the research

A key strength of the analysis of the South Sudan household survey data presented in this body of research was the nationally representative sample of data used in theses analysis that covered the entire population of South Sudan. The sampling methods, appropriate adjustment for sampling design, including sampling weights, and an adequate individual and household response rate to the survey interviews are other important strengths of this study. In addition, the SSHSII was largely based on the UNICEF's Multiple Indicator Cluster Survey (MICS) methodology, which uses standardized questionnaires, protocols and survey methodology. To minimize potential recall bias and to increase the validity of the study, the data on health service utilization from the most recent births was obtained from women, who had given birth only during the two years preceding the survey. Also, data on birth history was collected for five years prior to the survey to minimize the potential recall bias. Furthermore, due to the large size of the survey, we were able to examine a variety of potential factors associated with non-use of maternal and child health services and to identify risk factors that could help with targeting of programs for pregnant women and for their under-five children in South Sudan.

To understand the barriers to health services delivery and the factors preventing women from accessing and utilizing antenatal care, delivery care services and child health services a qualitative analysis was performed in Juba South Sudan. The qualitative methods gave more in-depth details and explored the perceptions of a diverse group of health workers and women and their spouses on the delivery

of health services, and the barriers to access to healthcare facilities. Bias was minimized by collecting and triangulating data from various types of health providers, and from women and their spouses attending health services from a number of health facilities.

The limitations of the quantitative study include the use of cross- sectional survey data that restricts the interpretation of causality of factors associated with the outcome variables. Even though the health services utilizations data were collected within 2 years of the preceding survey, and the birth history within five years of the preceding survey, it was still potentially subject to recall bias. The recall bias may have occurred because the information collected relied on a mother's ability to remember details about her birth history and use of the health services, which might have been different in women who had experienced major adverse perinatal health events. Finally, the potential factors associated with the outcome variables examined in this analysis were restricted to those factors available in SSHHSII data and may not have included all the factors in the theoretical frameworks that guided the analyses.

In the qualitative study some limitations should be considered when interpreting the results. First, we could not explore the perceptions of the health workers or women attending their services in a sample of the health facilities from across the different regions of South Sudan due to the limited resources for the study, and for security reasons. Secondly, this study only reflected the situation of the study population and accounts on their opinion and perceptions. Therefore, there

is a chance of potential biases since the result from this study could not be generalized to the population of South Sudan. Thirdly, we could not capture the perceived barriers faced by women and the health care providers in the rural areas due to security reasons, but the information collected in this study remains important for implementation of interventions in both rural and urban areas.

10.3 Conclusion and recommendations for policy and decision makers

The results from the research presented in this thesis highlight the role of socio-economic factors, health services availability, and safety and security on utilization of maternal and children healthcare services in South Sudan.
Since the health services in Southern Sudan have been largely financed and run by numerous bilateral and multilateral partners such as international non-governmental organizations (INGOs) and local and church-based organizations.[8] It's essential for the donors and technical experts to provide intensive financial and technical assistance to build the capacity and skill of the Ministry of Health to lead the development and implementation of policies and plans for effective health systems delivery.[9] In addition, such joint efforts between the Government of South Sudan and NGOs will enhance the implementation of the comprehensive health strategies at the central level targeting the structural and intermediary determinants of health inequality at the local community as noted below.

At the household level

Household empowerment and poverty elevation scheme

Access to financial support services such as social safety nets and welfare support for disadvantaged and poor households is critically important in the conflict effected countries such as South Sudan.[10] The program can target marginalized segments of the population, such as poor households in both rural and urban areas of South Sudan and can reduce poverty, and improved resilience, education, health or employment. [10] Social safety net programs will also enable the target population to overcome the financial barriers associated with displacement, destruction and loss of assets and improved access to maternal and child health services.

The financial support services could include social service fee waivers, such as free access to maternal and child health care services; subsidies for transportation costs; conditional cash transfers to encourage pregnant women to attend antenatal care services during pregnancy and to deliver by SBA, either at home or in a health facility; and micro-finance in the form of small loans to help families start their own businesses and earn regular income, which is essential in transforming their lives and their children's futures and thus reduce health inequities.

In addition, women's empowerment programs, e.g. cash transfer programs, improve education attainment among young girls in developing countries such as

Zambia and Malawi.[11,12] The program empowers parents to educate their children and specifically their daughters since educational attainment is associated with child survival, increased access to maternal and child health services and reduced teenage marriage and pregnancy.[11,12] A cash transfer program has been implemented in one of region of South Sudan from 2014-2018.[13] Based on the Girl's Education South Sudan (GESS) report, the program has contributed to the school to remain open, increase girl's enrolment, as well as the increased in the attendance rate, despite the prevalence of ongoing conflict.[13] Therefore, scaling up cash transfer programs across the ten states of South Sudan targeting poor families to keep their children, specifically their daughters, in school and unmarried until the end of secondary level education is essential. Such programs might indirectly contribute to delaying teenage marriage and childbearing and thus prevent under-five mortality among teenagers.

In order to increase use of reproductive and child health care services in South Sudan husbands should be involved and educated on the importance of use of ANC services during pregnancy and facility delivery. Husbands should take responsibility to support and encourage their wives to utilize such services. Educational campaigns targeting both men and women of reproductive age about the importance of ANC services and facility delivery need intensification in South Sudan.

At the community level

Strengthening community initiatives and community mobilization to increase awareness on utilization of maternal and child health care services

Implementing community-based health promotion program such as education campaign to increase community awareness and knowledge about the importance of access to routine ANC visits during pregnancy, use of skilled birth attendants at delivery, and postnatal care services is essential in improving maternal and newborn health outcomes.[14]

This could be achieved at the village level through the training of community health workers, such as TBAs with first aid skills in order to provide education and support to pregnant women on the obstetric complications of pregnancy and delivery. Establishing a strong link between the community and the health facilities by involving community health providers in the outreach services, such as identifying women early in pregnancy and encouraging them to use these services during and after childbirth is critically important for better health outcomes for mothers and of their newborn children.

Mobilizing community members, such as community elders, and religious leaders, to spread messages about the importance of the use of mosquito nets as an effective preventive measure for malaria among under-five children; use of family planning and delivery health services to improve maternal and newborn outcomes, and the importance of enhancing female education. In addition, it is also important for the

community health initiatives to be allocated resources, such as communal funds and transportation for women with limited financial resources to prevent delays associated with the costs for accessing and utilizing health facilities during pregnancy, delivery and post-delivery.

At the health facility level

Improving the availability, accessibility, and quality of health care services

Improving the availability, accessibility, and quality of health care services

In South Sudan the existing health facilities are in poor condition, inadequately equipped and with minimal operational capacity.[15] As a result, the health workers operate under a harsh and difficult environment with limited system and government supports. In the recent years, the Canadian International Development Agency (CIDA) has made significant contributions to improving access to essential primary health care services in South Sudan.[16] For instance, CIDA has supported the rehabilitation of health facilities across the country and has placed major emphasis on increasing services for maternal and newborn care as part of the Muskoka Initiative.[16] Therefore, it is crucial for bilateral and multilateral donors to strengthen health service delivery in order for the Government of South Sudan to rebuild the public health system. Thus, improving health facility-working environments, such as rebuilding the health services infrastructure, and improving maintenance, upgrading the existing health facilities with essential modern tools and equipment, is essential in order to enhance service delivery and performance.[17]

In addition, the drug supply in South Sudan is highly fragmented and inefficient, with no functioning central purchasing, distribution or regulatory mechanisms in place. In recent years, UNICEF and *Médecins Sans Frontières* were the main organizations procuring medicines for South Sudan. Therefore, insuring availability of funding for regular procurement of medicines and health supplies, improving management of medicines, and supply chain logistics are critically important to improve availability and access to appropriate medicines and medical care.

Shortages in human resources for health in South Sudan lead to low quality and ineffective service delivery and performance. UNFPA, another key donor to the sector in South Sudan, has worked with the Juba College of Nursing and Midwifery and government authorities to improve the regulatory environment and training institutions supporting midwifery care.[16] In addition, it is critically important for the donors to implement programs that focus on improving quality of human resources. Examples of such programs include developing training modules to raise the educational level of TBAs/CMWs to a diploma in midwifery or nursing; enhancing equal training opportunities and establishing training programs for the staff; improving staffing levels by increasing retention, and improving overall workface management, coordination and supervision.

Low salaries and lack of other forms of financial and non-financial incentives are associated with health workers de-motivation and low performance.[18-20] In South

Sudan, health workers employed by the public sector earn low salaries with irregular, often delayed payments. Therefore, it is essential to evaluate and improve the current health workers' payments especially for lower level health care workers. New measures to ensure timely payment of health staff, as well as standardized salaries across the states and territories are needed. Introducing incentive packages, especially for rural based healthcare providers, and other forms of non-financial incentives, such as job awards, appreciation certificates to boost the motivation of high-performing health care staff.

To overcome the delay in reaching health services for delivery, implementation of interventions to minimize the distance barrier by initiating collaboration with private transport sector to provide access to affordable and reliable transport services to pregnant and post-partum women. It is also essential to remove hospital delivery fees, such as bed charge, in the public facilities. In the long term it is essential to implement birthing centers at each sub district to overcome the delay in reaching health services for delivery.

At the central level

Political commitment to increase health financing and resource allocations in remote areas, and to address demand and supply barriers to reproductive and maternal health services in both rural and urban settings is essential.

Implementing police reforms that effectively prevent crime, protect and serve the public regardless of political agendas, respect and values population rights, and enhance safety and security measures, throughout the country are critical in order to improve population access to medical care during the night.

Implementing enabling policy environment and reforms to alleviate the socioeconomic disparity within the communities, and to address the factors associated with poor living conditions are crucial, such as provision of a social safety net and welfare support for disadvantaged households.

The government needs to take action to apply the legislation that establishes 18 as the minimum and the legal marriage age of girls and takes immediate and long-term steps to protect the rights of girls against early or forced marriage to ensure the fulfillment of their human rights.

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Appendix A: Ethical approval documents and supplementary documents

Appendix A consists of ethical approval letters and supplementary documents for the qualitative study conducted in South Sudan. The following documents are present in this appendix:

1. Ethical approval clearance from the Ethics Committee of the Ministry of Health, Government of South Sudan, Juba, South Sudan.
2. Participant information statement for the qualitative study.
3. Participant consent form.

The Republic of South Sudan

Ministry of Health

27th October, 2015

Ngatho Mugo
University of Sydney
Sydney School of Public Health Faculty of Medicine
Australia

Dear Sir,

RESEARCH APPROVAL LETTER

UNDERSTANDING COMMUNITY MEMBERS' PERCEPTION & BARRIERS FOR USE OF MATERNAL &NEWBORN HEALTH CARE SERVICES. A QUALITATIVE STUDY IN CENTRAL EQUATORIA STATE, SOUTH SUDAN

I am writing in response to the request for authorization to the study on ***"Understanding Community Members' perception & Barriers for use of Maternal & Newborn Health Care Services. A qualitative Study in Central Equatoria State, South Sudan.*** As part of secondary data to explore and identity barriers to use of antenatal care, postnatal care and skilled birth attendance at delivery.

After close review on the proposal, I am glad to inform you that the ethical committee at the Ministry of Health for the Republic of South Sudan has approved the study. The Ministry acknowledges the importance of the study understanding the community members' experience, perceptions and barriers regarding use maternal care, and neonatal health services during pregnancy, delivery and post-delivery in Central Equatoria State. Please, keep the Ministry of Health, Republic of South Sudan informed on the finding of the study.

I look forward to the report and recommendations that will be generated from the study. Note that the study should not be published without the consent of the Ministry of Health, Republic of South Sudan.

Yours sincerely,

MINISTRY OF HEALTH
28 OCT 2015
REPUBLIC OF SOUTH SUDAN

Dr. Richard Loro Lino Lako
Director General
Policy, Planning, Budgeting & Research
Ministry of Health
Republic of South Sudan

cc: Under Secretary, MOH-RSS
Director General, State Ministry of Health - CES
Director General, Reproductive Health

ABN 15 211 513 464

Dr. Michael J Dibley MB BS MPH FRACP (Paediatrics)
Associate Professor in International Public Health

Sydney School of Public Health
Faculty of Medicine
Room 313, Edward Ford Building (A27)
The University of Sydney
NSW 2006, Australia
Tel+61 2 93515203
Fax: +61 2 93515049
Email: michael.dibley@sydney.edu.au

Understanding community members' perception and barriers for use of maternal and newborn health care services: A qualitative study in Central Equatoria State, South Sudan.

PARTICIPANT INFORMATION STATEMENT (FOR IN-DEPTH INTERVIEW)

(1) What is the study about?

The burden of high rates of maternal morbidity and mortality remains a major public health concern in South Sudan. Access to appropriate care from a skilled health provider during pregnancy, delivery and post-delivery is associated with improved maternal and newborn health outcome. However, in South Sudan access to and use of maternal and child healthcare related services is low. An estimated 58 per cent of women did not attend ANC services during pregnancy, 23 per cent had no assistance during delivery, and eight in ten women deliver at home with unskilled birth attendants. Several studies identified barriers to health services, notably knowledge and education, income, perceptions, cultural beliefs and norm, quality of care, as well as availably and accessible of the services.

Understanding community perceptions of use of maternal and child health services, as well as barriers to access of these services, is essential in order to improve maternal and newborn health in South Sudan. The aim of this study is to identify barriers to use of antenatal care, postnatal care and Skilled Birth Attendance (SBAs) at delivery.

We think it is likely that this study would inform international public health policy to address issues facing women and their newborn children in order to improving survival of mothers and neonatal in South Sudan.

(2) Who is carrying out the study?

The study will be conducted by the University of Sydney in Australia in collaboration with a team of trained local health workers.

(3) Why are we inviting you to participate in the study?

We are inviting women of reproductive age (15–49 years) in this area who are currently pregnant/ or those with newborn children aged (0-90 days) and their mothers-in-law/mothers or any other senior women plying similar role in the family to participate. Since you are a resident of the study area we are inviting you to participate in this study because your cooperation with the study may help us to understand the perceptions and barriers to access antenatal care, postnatal care and

Skilled Birth Attendance and, which in turn should help as to find ways to access to these services.

(4) What is expected from the participants of the research study?

If you agree to participate in this study, then I will want to talk to you to know about you or your daughter-in-law/daughter's health situation during pregnancy, care during pregnancy delivery & after delivery, experience of use of health care providers or the TBAs. It will take about 45 minutes to 1 hour to complete the conversion. I will also need your permission to tape-record the interview.

(5) Risk and benefits

There is no risk from participating in this study involving any procedure, which may harm you, your daughter-in-law/daughter or her child. The study may not benefit you directly. However, from your involvement in this study by giving some of your time will help us understand what issues facing women during pregnancy, delivery and post delivery to access appropriate care and how these issues might have impacted maternal and neonatal health in rural/urban areas of South Sudan. The information that we will obtain from this survey would have broader impact, guiding the development of policies and programs related to maternal and newborn health for community settings and will contribute to improve the child health services in South Sudan and elsewhere.

(6) Privacy, anonymity and confidentiality

We will keep all of your information strictly confidential, and none other than the staff of our study and the Human Research Ethics Committee of minster of health south Sudan that protects the interest of research participants will have an access to your information. If you wish we will inform you of any of the results of our interviews.

(7) Future use of information

This study has the potential to identify the barriers of use/access to maternal and child health services in order to the to improve access to these services. Finding of these research is likely to improve the exiting health programs/maternal and child health outreach to deliver appropriate care to many mothers and their children in the future and addressing the issues facing these group of women and their children.

(8) Right not to participate and withdraw

Your participation in this study is absolutely voluntary i.e. you are the one to decide for and against participation. You may also decide not to respond to any or all questions that we will ask you. You would also be able to withdraw your consent at any time during the interview.

During the interview you can ask to stop at any time if you do not wish to continue, and any audio recording will be erased and the information you provided will not be included in the study.

If you do not participate or if you withdraw your participation at any point, will not affect your current or future relationship with any of the researchers.

(9) Principle of compensation

Your participation in this study is absolutely voluntary. We will not be able to give you any compensation for participation in this study.

(10) Can I tell other people about the study?

You are free to tell other people about your involvement in this study.

(11) What if I require further information?

If you have any question regarding aspects of your or your child's health, or about our study, you may ask us now or in the future. You will also be able to contact the principal investigator of this research study, Ngatho S Mugo at school of public health university of Sydney at +61 2-9036 6304 (Telephone) at Sydney, Australia.

(12) What if I have a complaint or concerns?

If you want to know more about your rights as a participant in a research study or related issues you may contact Dr. Richard Loku Lino Loro, Director General, Ministry of Health, Government of South Sudan.

Alternatively any person with concerns or complaints about the conduct of this research study can contact the Deputy Manager, Human Ethics Administration, University of Sydney on +61 2 8627 8176 (Telephone); +61 2 8627 8177 (Facsimile) or ro.humanethics@sydney.edu.au (Email).

This information sheet is for you to keep

THE UNIVERSITY OF SYDNEY

ABN 15 211 513 464

Michael J Dibley MB BS MPH FRACP (Paediatrics)
Associate Professor in International Public Health

Sydney School of Public Health
Faculty of Medicine
Room 313, Edward Ford Building (A27)
The University of Sydney
NSW 2006, Australia
Tel+61 2 93515203
Fax: +61 2 93515049
Email: michael.dibley@sydney.edu.au

PARTICIPANT CONSENT FORM (FOR IN-DEPTH INTERVIEW)

I, ...[PRINT NAME], give consent to my participation in the research project

TITLE: **Understanding community members' perception and barriers for use of maternal and newborn health care services: A qualitative study in Central Equatoria State, South Sudan.**

In giving my consent I acknowledge that:

1. The procedures required for the project and the time involved have been explained to me, and any questions I have about the project have been answered to my satisfaction.

2. I have read the Participant Information Statement (for In-depth Interview) and have been given the opportunity to discuss the information and my involvement in the project with the researcher/s.

3. I understand that I can withdraw from the study at any time, without affecting my relationship with the researcher(s), or the Dhaka Hospital of ICDDR,B or the University of Sydney now or in the future.

4. I understand that my involvement is strictly confidential and no information about me will be used in any way that reveals my identity.

5. I understand that being in this study is completely voluntary – I am not under any obligation to consent.

6. I understand that I can stop the interview at any time if I do not wish to continue, the audio recording will be erased and the information provided will not be included in the study.

7. I consent to **participate in the interview** of the study**.**

Please indicate your consent by putting your signature or your left thumb impression at the specified space below

Thank you for your cooperation.

_____

_____

Signature or left thumb impression of subject

Date

_____

_____

Signature or left thumb impression **Date**

of attendant/Guardian

_____

_____

Signature or left thumb impression of the witness **Date**

_____

_____

Signature of the PI or his/her representative **Date**

(NOTE: In case of representative of the PI, she/he shall put her/his full name and designation and then sign)

Appendix B: List of the variables definition

Supplementary 1. The variables definition and their categorization used in this analysis South Sudan Household survey 2010

VARIABLES	DEFINITIONS AND CATEGORIZATION
INTERMEDIATE DETERMINANTS	
SOCIOECONOMIC POSITION	
Community factors	
Cluster type	The cluster type (1= Urban; 2 = Rural)
Geographical Regions	3 regions of South Sudan namely: 1= Greater Upper Nile (consisting of Unity, Jonglei, Upper Nile) 2= Greater Bahr el Ghazal (consisting of Lakes, Western Bahr El Ghazal, Northern Bahr El Ghazal, Warrap), 3 = Greater Equatoria (consisting of Central Equatoria, Western Equatoria, Eastern Equatoria)]
Mean household wealth index in the cluster	Mean household wealth index in the cluster
Proportion of mothers attended intermediate school education and above in the cluster	Proportion of mothers with at least intermediate school education in the cluster
Mean number of antenatal care visits in the cluster	Mean number of antenatal care visits in the cluster (only for the most recent birth prior the survey)
Percentage of deliveries assisted by trained birth attendants in the cluster	Percentage of births in the cluster assisted by trained birth attendants (only for the most recent birth prior the survey)
Percentage of mothers receiving postnatal care in the cluster	Percentage of mothers in the cluster who received postnatal care (only for the most recent birth prior the survey)
Household factors	
Household wealth index	Composite index of household possession (1= Wealthier, 2 = Middle and 3= Poor)
Gender of household head	Household head (1= male, 2 = female)
Education of the household head	Highest levels of schooling obtained (1 = Secondary + education, 2= Primary education, 3 = No education)
Maternal education	Maternal highest levels of schooling obtained (1 = Intermediate + education, 2= Primary education; 3= No education)
Maternal literacy	Maternal literacy [1 = Yes: able to read; 2= No: cannot read at all)]

Maternal marital status	The maternal marital status (1 = Never married (single); 2 = Formerly married (if woman is widowed, divorced or separated); 3 = Currently married
Polygamy status	The status of husband having more than one wife 1 = (No) if a husband has one wife); (2= (Yes) if a husband has more than one wife
Individuals circumstances	
Maternal condition/Behaviours	
Maternal age at her last birthday (years)	Age of a mother on her last birthday (1= 20-34 years, 2=15-19 years and 3= 35-49 years)
Heard about family planning	Mother have heard about family planning (1= no, 2 = yes
Ever had child who later died	Ever had child who later died (1=No, 2 =Yes)
Cooking location	Cooking location (1= kitchen, 2= Elsewhere in the house, 3= Outdoors)
Garbage disposal	Garbage disposal [1= Burning, 2= Dumping (Throwing outside the house)]
Mother experience domestic violence	Mother experience domestic violence in the past year (1= no, 2=yes)
Under-five condition	
Child's gender	Gender of under-five children (1=female, 2 = male)
Family have access to safe/treated drinking water	Access to safe/treated drinking water (1= yes, 2 =no)
Family have access to improved sanitation facilities	Access to improved sanitation facilities (1=Yes, 2=No)
Number of children	*The number of living children of each respondent*
Birth order	*The* order *in which a child is born for instance first-born and second-born.*
Child mortality rate	The probability of dying between the exact ages of one and five

Appendix C: Three stage models

Chapter 7 (manuscript 5)

Table 2. Adjusted and unadjusted odds ratio for factor associated with neonatal mortality according to socioeconomic and intermediate factors, analysis of South Sudan household 2010 (n = 8215)

	Univariate (unadjusted OR)			Multivariate adjusted OR								
				Final model			Second model			first model		
	OR [a]	95%CLc	p value	AOR[b]	95% CI	p value	AOR[b]	95% CI	p value	AOR[b]	95% CI	p value
VARIABLES												
INTERMEDIATE												
DETERMINANTS												
SOCIOECONOMIC POSITION												
Community factors												
Type of cluster												
Rural	1.00			1.00			1.00			1.00		
Urban	1.37	(1.01, 1.87)	0.045	1.37	(1.01, 1.87)	0.045	1.37	(1.01, 1.87)	0.045	1.37	(1.01, 1.87)	0.045
Geographical location (Regions)												
Greater Upper Nile	1.00											
Greater Bahr el Ghazal	1.00	(0.70, 1.14)	0.984									
Greater Equatoria	1.24	(0.88, 1.74)	0.223									
Mean household wealth index in the cluster	0.86	(0.60, 1.23)	0.418									

Proportion of mothers with intermediate school education in the cluster	1.52	(0.36, 6.54)	0.571
Mean number of antenatal care visits in the cluster	0.84	(0.01, 1.34)	0.493
Percentage of deliveries assisted by trained birth attendants in the cluster	0.91	(0.40, 2.06)	0.812
Percentage of mother receiving postnatal care in the cluster	1.26	(0.37, 4.22)	0.713
Household factors			
Household wealth index			
Wealthier	1.00		
Middle	0.97	(0.74, 1.29)	0.856
Poor	0.97	(0.74, 1.28)	0.844
Gender of household head			
Male	1.00		
Female	0.99	(0.78,1.25)	0.931
Education of the household head			
Secondary + education	1.00		

No education/primary education	0.81	(0.55, 1.20)	0.292
Maternal education			
Intermediate + education	1.00		
Primary education	0.71	(0.39, 1.29)	0.260
No education	0.83	(0.48, 1.44)	0.517
Maternal literacy			
Able to read	1.00		
Unable to read	1.28	(0.85, 1.92)	0.245
Maternal marital status			
Never married (Single)	1.00		
Formerly married	1.13	(0.73, 1.73)	0.588
Currently married	1.1	(0.78, 1.56)	0.587
Polygamy status			
Husband had one wife	1.00		
Husband had more than one wife	1.04	(0.81, 1.34)	0.736
Individual's circumstances			
Maternal condition/Behaviours			
Maternal age at her last birthday (years)			
20-34 years	1.00		

15-19 years	1.26	(0.88, 0.80)	0.212			
35-49 years	1.33	(1.03, 1.72)	0.027			
Heard about family planning						
No	1.00					
Yes	1.27	(0.96, 1.69)	0.100			
Ever had child who later died						
No	1.00			1.00		
Yes	4.06	(3.15, 5.24)	<0.001	3.74	(2.88, 4.87)	<0.001
Cooking location						
Kitchen	1.00			1.00		
Elsewhere in the house	0.85	(0.61, 1.18)	0.324	0.77	(0.54, 1.11)	0.167
Outdoors	0.80	(0.61, 1.04)	0.100	0.70	(0.53, 0.94)	0.018
Garbage disposal						
Burning	1.00					
Dumping	0.98	(0.77, 1.14)	0.835			
Mother experience domestic violence in the past year						
No	1.00					
Yes	0.99	(0.75, 1.30)	0.926			
Neonate condition						

Neonate gender						
Female	1.00					
Male	0.97	(0.78, 1.21)	0.798			
Family have access to safe drinking water						
Yes	1.00			1.00		
No	1.76	(1.10, 2.81)	0.019	1.91	(1.11, 3.31)	0.02
Family have access to improved sanitation facilities						
Yes	1.00					
No	1.10	(0.75, 1.60)	0.639			

Table 3. Adjusted and unadjusted odds ratio for factor associated with infant mortality according to socioeconomic and intermediate factors, analysis of South Sudan household 2010 (n = 8215)

	Univariate (unadjusted OR)			Multivariate adjusted OR								
				Final model			Second model			first model		
	OR [a]	95%CLc	p value	AOR[b]	95% CI	p value	AOR[b]	95% CI	p value	AOR[b]	95% CI	p value
VARIABLES												
INTERMEDIATE DETERMINANTS												
SOCIOECONOMIC POSITION												
Community factors												
Type of cluster	1.00			1.00			1.00			1.00		
Rural	1.35	(1.08,1.69)	0.009	1.35	(1.08,1.69)	0.009	1.38	(1.10,1.74)	0.006	1.35	(1.08,1.69)	0.009
Urban												
Geographical location (Regions)	1.00											
Greater Upper Nile	1.09	(0.85, 1.41)	0.505									
Greater Bahr el Ghazal	1.15	(0.89, 1.49)	0.281									
Greater Equatoria	0.97	(0.74, 1.26)	0.798									
Mean household wealth index in the cluster	1.66	(0.57, 4.81)	0.351									
Proportion of mothers with intermediate school education in the cluster	0.71	(0.50, 1.03)	0.068									

Mean number of antenatal care visits in the cluster	1.10	(0.61, 2.00)	0.755
Percentage of deliveries assisted by trained birth attendants in the cluster	1.79	(0.76, 4.22)	0.180
Percentage of mother receiving postnatal care in the cluster			
Household factors			
Household wealth index	1.00		
Wealthier	0.94	(0.76, 1.16)	0.562
Middle	1.01	(0.82, 1.24)	0.920
Poor			
Gender of household head	1.00		
Male	1.00	(0.83, 1.19)	0.967
Female			
Education of the household head	1.00		
Secondary + education	1.14	(0.82, 1.58)	0.45
No education/primary education			
Maternal education	1.00		
Intermediate + education	0.75	(0.48, 1.17)	0.206

Primary education	0.80	(0.53, 1.21)	0.298						
No education									
Maternal literacy	1.00			1.00			1.00		
Able to read	1.43	(1.04, 1.98)	0.029	1.38	(1.00, 1.92)	0.051	1.38	(1.00, 1.92)	0.051
Unable to read									
Maternal marital status	1.00			1.00			1.00		
Never married (Single)	1.27	(0.91, 1.77)	0.167	1.42	(0.99, 2.04)	0.057	1.42	(0.99, 2.04)	0.057
Formerly married	1.27	(0.97, 1.67)	0.082	1.41	(1.04, 1.90)	0.026	1.41	(1.04, 1.90)	0.026
Currently married									
Polygamy status	1.00								
Husband had one wife	0.96	(0.80, 1.16)	0.669						
Husband had more than one wife									
Individual's circumstances									
Maternal condition/Behaviours									
Maternal age at her last birthday (years)	1.00			1.00					
20-34 years	1.25	(0.95, 1.63)	0.108	1.85	(1.20, 2.85)	0.005			
15-19 years	1.21	(0.99, 1.47)	0.059	1.07	(0.87, 1.32)	0.511			
35-49 years									
Heard about family planning	1.00								

No	1.34	(1.08, 1.66)	0.008			
Yes						
Ever had child who later died	1.00			1.00		
No	3.21	(2.67, 3.87)	<0.001	3.19	(2.62, 3.88)	<0.001
Yes						
Cooking location	1.00					
Kitchen	0.89	(0.70, 1.15)	0.388			
Elsewhere in the house	0.90	(0.74, 1.10)	0.321			
Outdoors						
Garbage disposal	1.00					
Burning	0.97	(0.81, 1.16)	0.752			
Dumping						
Mother experience domestic violence in the past year	1.00					
No	0.96	(0.77, 1.18)	0.670			
Yes						
Neonate condition						
Neonate gender	1.00			1.00		
Female	1.11	(0.94, 1.31)	0.241	1.22	(1.01, 1.47)	0.035
Male						

Family have access to safe drinking water	1.00		
Yes	1.36	(0.99, 1.87)	0.055
No			
Family have access to improved sanitation facilities	1.00		
Yes	1.14	(0.85, 1.52)	0.378
No			

Table 3. Adjusted and unadjusted odds ratio for factor associated with under-five mortality according to socioeconomic and intermediate factors, analysis of South Sudan household 2010 (n = 8215)

	Univariate (unadjusted OR)			Multivariate adjusted OR								
				Final model			Second model			first model		
	OR [a]	95%CLc	p value	AOR[b]	95% CI	p value	AOR[b]	95% CI	p value	AOR[b]	95% CI	p value
VARIABLES												
INTERMEDIATE DETERMINANTS												
SOCIOECONOMIC POSITION												
Community factors												
Type of cluster	1.00			1.00			1.00			1.00		
Rural	1.39	(1.13,1.71)	0.002	1.39	(1.13,1.71)	0.002	1.39	(1.13,1.71)	0.002	1.39	(1.13,1.71)	0.002
Urban												
Geographical location (Regions)	1.00											
Greater Upper Nile	1.10	(0.87, 1.39)	0.44									
Greater Bahr el Ghazal	1.19	(0.93, 1.50)	0.16									
Greater Equatoria	0.99	(0.78, 1.27)	0.96									
Mean household wealth index in the cluster	1.68	(0.62, 4.56)	0.31									
Proportion of mothers with intermediate school education in the cluster	0.79	(0.56, 1.11)	0.17									

Mean number of antenatal care visits in the cluster	0.99	(0.57, 1.72)	0.96
Percentage of deliveries assisted by trained birth attendants in the cluster	1.66	(0.74, 3.72)	0.22
Percentage of mother receiving postnatal care in the cluster			
Household factors			
Household wealth index	1.00		
Wealthier	0.93	(0.77, 1.13)	0.46
Middle	0.96	(0.79, 1.16)	0.68
Poor			
Gender of household head	1.00		
Male	1.10	(0.94, 1.29)	0.25
Female			
Education of the household head	1.00		
Secondary + education	1.20	(0.89, 1.62)	0.24
No education/primary education			
Maternal education	1.00		
Intermediate + education	0.96	(0.63, 1.46)	0.85

Primary education	0.92	(0.62, 1.36)	0.67			
No education						
Maternal literacy	1.00					
Able to read	1.33	(1.01, 1.77)	0.046			
Unable to read						
Maternal marital status	1.00					
Never married (Single)	1.16	(0.86, 1.57)	0.33			
Formerly married	1.24	(0.97, 1.58)	0.08			
Currently married						
Polygamy status	1.00					
Husband had one wife	0.95	(0.80, 1.12)	0.54			
Husband had more than one wife						
Individual's circumstances						
Maternal condition/Behaviours						
Maternal age at her last birthday (years)	1.00			1.00		
20-34 years	1.17	(0.91, 1.50)	0.22	1.77	(1.21, 2.59)	0.003
15-19 years	1.19	(1.00, 1.43)	0.05	1.04	(0.87, 1.25)	0.674
35-49 years						
Heard about family planning	1.00					

No	1.31	(1.07, 1.59)	0.007			
Yes						
Ever had child who later died	1.00			1.00		
No	3.02	(2.55, 3.57)	<0.001	3.07	(2.58, 3.64)	<0.001
Yes						
Cooking location	1.00					
Kitchen	0.84	(0.66, 1.05)	0.13			
Elsewhere in the house	0.92	(0.77, 1.11)	0.40			
Outdoors						
Garbage disposal	1.00					
Burning	0.98	(0.83, 1.15)	0.76			
Dumping						
Mother experience domestic violence in the past year	1.00					
No	0.99	(0.82, 1.20)	0.91			
Yes						
Neonate condition						
Neonate gender	1.00			1.00		
Female	1.11	(0.95, 1.29)	0.18	1.20	(1.02, 1.41)	0.029
Male						

Family have access to safe drinking water	1.00		
Yes	1.28	(0.97, 1.69)	0.09
No			
Family have access to improved sanitation facilities	1.00		
Yes	1.01	(0.79, 1.30)	0.93
No			