UTS UNIVERSITY OF TECHNOLOGY SYDNEY

Antenatal Care Counselling, Health Literacy and Place of birth: An Analysis of Ethiopia Service Provision Assessment Plus Survey 2014

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Certificate of Original Authorship

I, Tebikew Yeneabat Mengist, declare that this thesis is submitted in fulfilment of the requirements for the award of Philosophy of Doctor in the School of Public Health at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise referenced or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

This document has not been submitted for qualifications at any other academic institution.

This research was supported by the Australian Government Research Training Program.

Signature: Production Note: Signature removed prior to publication.

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Abbreviations and acronyms

ANC	Antenatal Care
AOR	Adjusted Odds Ratio
ATT	Average treatment in treated
BPCR	Birth Preparedness and Complication Readiness
CHWs	Community Health Workers
CI	Confidence Interval
COR	Crude Odds Ratio
COVID-19	Coronavirus disease
EPHI	Ethiopian Public Health Institute
ESPA+	Ethiopia Service Provision Assessment Plus
FP	Family Planning
GANC	Group Antenatal Care
GSEM	Generalised Structural Equation Modelling
HRH	Human Resources for Health
HIV/AIDS	Human Immunodeficiency Virus/ Acquired Immunodeficiency Syndrome
HMIS	Health Management Information System
HSTP	Health Sector Transformation Plan
IOM	Institute of Medicine
JBI	Joanna Briggs Institute
LLMICs	Low- and Lower-Middle-Income Countries
MDG	Millennium Development Goals
MeSH	Medical Subject Heading

MMR	Maternal Mortality Ratio
PICO	Patient, Intervention, Control and Outcome
PNC	Postnatal Care
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PSM	Propensity score matching
RCT	Randomised Controlled Trial
SBA	Skilled Birth Attendant
SDGs	Sustainable Development Goals
SSA	sub-Saharan Africa
STIs	Sexually Transmitted Infections
TB	Tuberculosis
TBAs	Traditional Birth Attendants
UTS	University of Technology Sydney
WHO	World Health Organization

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Abstract

Maternal mortality is prevalent in low and lower-middle-income countries. Quality maternal healthcare, such as antenatal care (ANC) and facility-based birth, can prevent most maternal deaths. The World Health Organization recommends that every pregnant woman should receive all the recommended components of ANC, including counselling on obstetric danger signs and birth at a health facility assisted by skilled birth attendants. Studies demonstrate that ANC guidelines and trained ANC providers may improve the quality of ANC counselling and maternal health literacy leading to facility-based birth. A literature review identified knowledge gaps concerning the extent to which ANC counselling can increase health literacy and facility-based birth.

This research used the Ethiopian service provision assessment plus survey data (2014) to address this knowledge gap. Two related studies (Study 1 and 2) were conducted. Study 1 examined the availability of ANC guidelines at the facility level, ANC providers' uptake of in-service training in the last 24 months, and the effect of these on antenatal counselling on obstetric danger signs by applying propensity score matching method. Study 2 investigated the effect of ANC counselling on a woman's decision where to give birth, and if this is mediated by maternal health literacy by applying generalised structural equation modelling.

The results showed that national ANC guidelines at the facility level significantly increased the average number of obstetric danger signs counselled by 24%. Whereas providing refresher training for ANC providers increased the average number of obstetric danger signs counselled by 37%. The analysis identified that ANC counselling on obstetric danger signs indirectly increased women's decision to give birth at a health facility by 4%. This indirect influence was mediated by maternal health literacy. There was no evidence that ANC counselling directly influenced a woman's decision about where to give birth. However, ANC counselling significantly increased maternal health literacy. A woman's school attendance had a statistically significant direct, indirect, and total effect on her decision to give birth at a health facility.

This research suggests that improving the quality of ANC counselling in Ethiopia and other low-income countries requires health system strengthening efforts to ensure the ANC guidelines are in place and that the ANC providers are provided with continuous in-service training. This study also shows that increasing women's access to information about obstetric danger signs from ANC providers and school attendance can increase the rate of facility birth.

Introduction

This thesis presents my research on antenatal care (ANC) counselling, maternal health literacy, and women's decision on where they will give birth. The thesis is comprised of a systematic review study and two related research studies. The systematic review research explores the relationship between ANC counselling and maternal health literacy in low and lower-middle-income countries (LLMICs). The two related research studies, hereafter referred to as study 1 and study 2, involved analysing the 2014 Ethiopian service provision assessment plus (ESPA+) survey data. These studies examine the extent to which ANC guidelines and ANC providers' uptake of in-service training in Ethiopia influence the performance of ANC providers to counsel pregnant women on obstetric danger signs and the relationship between ANC counselling and maternal health literacy and a woman's decision where to give birth. The thesis is organised into seven chapters.

The first chapter provides a background to maternal health, maternal mortality, and the importance of quality maternal healthcare in preventing avoidable maternal mortality worldwide and in low-income settings, with a focus on Ethiopia. The quality of maternal healthcare is viewed through the lens of quality ANC counselling and its relationship with maternal health literacy, and how this may facilitate women to seek skilled care during childbirth. The terms and concepts related to ANC counselling, skilled birth attendants (SBAs), and maternal health literacy are described.

Chapter two presents the systematic literature review investigating the state of knowledge concerning ANC counselling and maternal health literacy in LLMICs, including Ethiopia. The review study, which included 38 peer-reviewed research articles, provides insight into understanding quality ANC counselling in low-income settings and the interventions used to counsel women on obstetric danger signs. The literature review concludes with a list of research questions that emerged from the findings.

The third chapter provides an overview of the methods, including the research questions and objectives, the research setting, study design, study variables, statistical analysis, and ethical considerations. The research method consisted of two components; each component addressed a specific research question. The first part describes a propensity score matching method used in study 1 to examine the effect of ANC guidelines and ANC providers' uptake of refresher training on ANC counselling about obstetric danger signs. The second part is a generalised structural equation modelling used in study 2 to examine whether ANC counselling affects a woman's decision where to give birth and whether this is mediated by maternal health literacy.

Chapter four presents the results of study 1 that focuses on the factors influencing the delivery of ANC counselling on obstetric danger signs. The influence of ANC guidelines and provider reception of refresher training on ANC counselling about obstetric danger signs in Ethiopia is determined by applying a propensity score matching method analysis on the 2014 ESPA+ data.

Chapter five presents study 2, which examines the influence of ANC counselling on a woman's decision to give birth at a health facility and the mediating role of maternal health literacy (knowledge of obstetric complications).

Chapter six discusses the research results in relation to the wider literature and the implications, and chapter seven presents conclusions and recommendations.

Chapter 1 Background

1.1. The global burden of maternal mortality

Maternal mortality, defined as the death of a mother while pregnant, during childbirth, or within the first 42 days after the termination of pregnancy (WHO 1977), is a global public health problem. On average, 211 maternal deaths per 100,000 live births occur every year worldwide. Women who survive life-threatening childbirth complications often suffer physical, sexual, mental, and social health problems from adverse consequences such as obstetric fistula (Amegavluie et al. 2022). LLMICs bear a disproportionately high burden of maternal mortality, accounting for 94% of all maternal deaths, with sub-Saharan Africa (SSA) countries contributing 66% (WHO 2019b, WHO and UNFPA 2021). The SSA countries' maternal mortality ratio (MMR) is as high as 542, while it is as low as 7 in Australia and New Zealand, and 12 in Europe and North America (WHO 2019b).

Preventable obstetric complications, such as haemorrhage, infections, and pre-eclampsia, are the causes of the majority of maternal deaths (WHO 2019d). Haemorrhage, for example, accounted for about 28% of all maternal deaths globally between 2003 and 2009 (Say et al. 2014), 43% of maternal deaths in Southwest Nigeria between 2015 and 2016 (Sageer et al. 2019) and 12% of maternal deaths in Ethiopia in 2013 (Tessema et al. 2017). Similarly, pre-eclampsia accounted for 37% of maternal deaths in Southwest Nigeria (Sageer et al. 2019) and 10% in Ethiopia (Tessema et al. 2017).

The causes of higher maternal mortality and morbidity in LLMICs are complex and often rooted in social determinants and healthcare system deficiencies (Jones et al. 2022, Miller et al. 2016). Social determinants are factors which can mediate an individual's living conditions, psychosocial circumstances, behavioural and biological factors, and access to healthcare facilities. These include age, educational status, obstetric history, ethnicity, and environmental factors (e.g., urban versus rural residence, infrastructure, and transport access) (Jones et al. 2022). Healthcare system factors include scarcity of

facilities, facilities with inadequate resources, i.e., inadequate number of skilled providers, insufficient training for the providers, insufficient supplies, guidelines, and drugs (Miller et al. 2016).

Maternal death has a wide range of detrimental effects on families, communities, and nations. It first impacts the family's well-being by leaving children without a mother. The newborn may die when the mother dies or may survive and live without receiving essential care such as breastfeeding. Children whose mothers have died are less likely to receive basic necessities such as food, clothing, and education. Maternal death also affects the psychosocial well-being of the family, which reduces productivity and contributes to poverty. This collectively puts a country's healthcare system under pressure and results in poor economic development (Molla et al. 2015, Zhou et al. 2016).

Maternal health has been on the global agenda since the 1980s when countries recognised higher maternal mortality rates (Rosenfield and Maine 1985). Representatives of countries set a call to action to reduce the MMR and launched various initiatives. The safe motherhood initiative, launched in 1987 in Nairobi, marked a paradigm shift in developing various policies to improve maternal health worldwide (Mahler 1987). The goal of the safe motherhood initiative was to reduce the MMR by half by the year 2000 by providing maternal healthcare services during and after pregnancy and childbirth (AbouZahr 2003). Safe motherhood was viewed as a human right, and maternal death was defined as "social injustice". Countries were required to prioritise maternal health so that every mother enjoys normal pregnancy and childbirth (AbouZahr 2003). However, maternal death remained high, with an MMR of 380 in 1990 and 330 in 2000, necessitating further commitment (UN 2015).

Improving maternal health became one of the eight Millennium Development Goals (MDGs) established in 2000. The fifth goal of MDGs was to reduce global maternal mortality by 75% between 1990 and 2015 by providing maternal healthcare services that included ANC, births assisted by a skilled birth attendant (SBA), and family planning (FP). However, the MMR was only reduced by 45% in 2015, less than planned (UN 2015). The

achievement also varied between countries. Only 15 of 145 countries had achieved the MDG target of reducing maternal mortality by three-quarters, 23 countries had made progress, and 88 had fallen short (WB and IMF 2015).

In 2015 the MDGs were later superseded by the Sustainable Development Goals (SDGs). The SDGs, consist of seventeen ambitious goals to address the unfinished development agenda, with maternal mortality reduction being one of the focus areas. The SDG target three aims to reduce maternal mortality to less than 70 deaths per 100,000 live births by 2030 with a 5.5% yearly reduction (UN 2016). Additionally, no country should have more than 140 maternal deaths per 100,000 live births by 2030 (UN 2016).

Since then, multifaceted country context intervention strategies aiming to end preventable maternal deaths have been undertaken worldwide. These strategies emphasise strengthening the healthcare system, improving quality, and ensuring a continuum of care during pregnancy, childbirth and postnatally. The interventions include expanding primary healthcare services to increase accessibility, increasing workforces that provide respectful maternity care, and empowering women to make informed decisions about their health (Smith et al. 2017, WHO and UNFPA 2021).

With a 2.9% annual reduction worldwide, the level of performance in reducing maternal mortality so far has progressed too slowly, and it is unsatisfactory to meet the SDG target of a 5.5% annual reduction to fewer than 70 maternal death per 100,000 live births by 2030 (UN 2017, WHO 2015a, 2021). According to the latest World Health Statistics report, MMR worldwide fell by 38%, from 342 per 100,000 live births in 2000 to 211 per 100,000 live births in 2017 (WHO 2021, 2019b). The annual decrease was also unevenly distributed across regions. The annual decrease in the maternal death rate was 2.8% in SSA, 5.3% in Central and Southern Asia and 4.6% in Northern Africa. Likewise, Ethiopia, an SSA country, decreased its MMR from 1,030 per 100,000 live births in 2000 to 401 per 100,000 live births in 2017, with a 5.5% annual reduction, demonstrating promising progress but falling short of the SDG target of less than 70 maternal deaths per 100,000 live births. The current MMR of 401 per 100,000 live births in Ethiopia in 2019 is very

high despite the country's goal to reduce MMR to less than 199 per 100,000 live births by 2020 (FMOH 2015, WHO 2019b).

1.2. Preventing maternal death through health care

The early detection and management of obstetric complications through quality maternal health care during and after pregnancy can prevent most maternal deaths worldwide (Kruk et al. 2018, Merdad and Ali 2018). ANC and having an SBA during childbirth are essential evidence-based care packages for the early detection and management of obstetric complications and are known to reduce maternal mortality (WHO 2016b, 2022).

The World Health Organization (WHO) has defined ANC as "the care provided by skilled healthcare professionals to pregnant women and adolescent girls to ensure the best health conditions for both mother and baby during pregnancy" (WHO 2016b, p. 1). ANC provides entry into the healthcare system for most women, particularly in settings where regular health care-seeking is rare or non-existent. In such cases, women attending ANC clinics may have the opportunity to speak with a healthcare provider about pregnancy, childbirth, and general health for the first time in life. Thus, ANC provides opportunities to deliver health education, counselling and clinical examinations. This facilitates early detection and timely management of pre-existing diseases and infections such as hypertension, human immunodeficiency virus and other sexually transmitted infections, and pregnancy-related complications, such as pre-eclampsia that ultimately lowers life-threatening complications (Kebede et al. 2021b) and ensures a positive pregnancy experience (Assaf 2018, Rosado et al. 2019, Roy 2018, Sarker et al. 2010, WHO 2016b).

Despite the benefits of ANC in preventing avoidable maternal and newborn morbidities and mortalities, only 59% of pregnant women globally received ANC four times (UNICEF 2021). Countries with higher MMR had lower ANC rates, although 90% coverage in four or more ANC contacts is required by 2025 to progress towards ending preventable

maternal mortality (WHO and UNFPA 2021). For example, in Nigeria, where MMR in 2018 was estimated to be 512 per 100,000 live births, the rate of four ANC contacts in the same year was 57% (NPC [Nigeria] and ICF 2019). Similarly, the rate of four ANC contacts in Somali was 24% in 2020 (Federal Government of Somalia 2020), and it was 43% in Ethiopia in 2019 (EPHI and ICF 2019).

Aside from the lower ANC rate, the quality of ANC in low-income countries is inadequate, or less than expected in terms of the number of visits and the contents (Bayou et al. 2016, Benova et al. 2018). While quality ANC can be defined in various ways, many agree to define it as providing a minimum level of care to every pregnant woman (Pittrof et al. 2002). The new WHO ANC guideline recommends that every pregnant woman, who has an uncomplicated pregnancy, receive at least eight ANC contacts that include counselling. The word "visit" has also been changed to "contact", emphasising the importance of communication between a pregnant woman and the ANC provider to ensure ANC is adequate. An increased number of ANC contacts enhances the early detection and management of complications and gives women more opportunities to talk to health professionals and build their knowledge and confidence to seek timely treatment (WHO 2016b).

Quality ANC can also be understood according to an existing framework that focuses on effective practices, the organisation of care, the philosophy and values of the care providers working in the health system, and the characteristics of care providers (Renfrew et al. 2014). The organisation of care entails delivering maternal healthcare services through the implementation of assessment, screening, care planning, education, information, health promotion and prevention of complications (Renfrew et al. 2014). The core concepts presented in this framework are captured in the WHO recommendations on ANC for a positive pregnancy experience (WHO 2016b). According to this guideline:

> *Effective communication should be facilitated at all ANC contacts to identify any symptoms; promotion of healthy pregnancies and newborns through lifestyle*

> *choices; individualised advice and support; timely information on tests, supplements, and treatments; birth-preparedness and complication-readiness planning; postnatal family planning options; and the timing and purpose of ANC contacts* (WHO 2016b, p. 106).

Therefore, providing comprehensive information about obstetric danger signs is a key indicator of quality ANC and a critical intervention to ensure that every pregnant woman knows where to seek care when unforeseen obstetric emergencies occur (WHO 2013, 2016b). Quality counselling interventions are required to communicate this information to educate women.

1.3. Antenatal care counselling

ANC counselling is defined as:

> *An interactive process between the skilled attendant/health worker and a woman and her family, during which information is exchanged, and support is provided so that a woman and her family can make decisions, design a plan and take action to improve their health (WHO 2013, p. 4).*

ANC counselling is recommended for every pregnant woman during the ANC contact to ensure the health and well-being of the mother and the growing foetus (Kuhnt and Vollmer 2017, WHO 2016b). The term *counselling* was first coined by American Psychologist and Psychotherapist Carl Rogers, while he focused on efforts to build the capacity of individuals to develop a positive concept of the self as part of his person-centred theory (Woolfe et al. 2003). The concept of counselling is usually related to psychotherapy or behavioural therapy in the mental healthcare setting. Counselling plays a significant role in primary healthcare for health promotion and disease prevention (Sommers-Flanagan and Sommers-Flanagan 2018).

In low health literacy settings, counselling is part of a suite of evidence-based interventions to improve health outcomes (Lee et al. 2012). It supports a woman's ability to make informed decisions and improves health care-seeking behaviour, enabling the early detection and prevention of obstetric complications (WHO 2014).

In addition to the early detection of obstetric danger signs and prevention of complications, women also need to be empowered to identify issues and alert their health providers. Obstetric danger signs during pregnancy include vaginal bleeding, convulsions or fits, severe headache, blurred vision, fever, severe abdominal pain, and fast or difficult breathing (WHO 2013). While some obstetric danger signs are more complicated than others to recognise, ANC counselling is important in educating women about what to expect during a normal pregnancy. During ANC counselling, the care providers can provide examples of signs and symptoms related to pregnancy that may be unusual so that women can easily recognise them and make an informed decision to seek timely treatment (Jhpiego 2004, WHO 2013).

1.4. Skilled birth attendance

Having an SBA during childbirth is another pillar of maternal healthcare that helps to prevent maternal morbidity and mortality during and after childbirth. Pre-eclampsia and haemorrhage, the leading causes of maternal death, are frequent during and following birth. Evidence has shown that having an SBA can reduce pre-eclampsia or eclampsia-related maternal death by up to 90% and newborn deaths and stillbirths by 25% (Hodgins et al. 2016).

The WHO has defined SBA as:

> *An accredited health professional — such as a midwife, doctor or nurse — who has been educated and trained to proficiency in the skills needed to manage normal (uncomplicated) pregnancies, childbirth and the immediate postnatal*

period, and in the identification, management and referral of complications in women and newborns (WHO 2004, p. 1).

The rate of births assisted by SBA is also an indicator (indicator 3.2.1) of the SDGs target 3 (UN 2017); hence, it is aimed to increase the global rate of births assisted by SBA to 90% in 2025. However, the SBA coverage is insufficient in many low-income countries despite the global rate (81%) being close to the required target of 90%. Most countries with a high MMR have been found to have very low SBA rates, such as South Sudan (19%) and Nigeria (43%) (WHO 2021).

1.5. Maternal health literacy and healthcare service uptake

While timely care can prevent obstetric complications in pregnant women, disparities in maternal healthcare service uptake exist due to complex socio-economic, socio-cultural, and healthcare facility-related factors (Adu et al. 2018, Akter et al. 2019, Budhathoki et al. 2017, Okedo-Alex et al. 2019, Tekelab et al. 2019). These disparities could be mediated by health literacy, a modifiable factor (Benjamin 2010, Stormacq et al. 2018).

Maternal health literacy comprises the cognitive and social skills that determine women's motivation and ability to gain access to, understand, and use information in ways that promote and maintain their health and that of their children (Renkert and Nutbeam 2001, p. 382). Figure 1 depicts the Institute of Medicine (IOM) health literacy framework. This framework illustrates that an individual's health literacy is the product of a complex set of skills and interactions on the part of individual characteristics such as school attainment, socio-cultural contexts, healthcare system and health education factors (Batterham et al. 2016, Kindig et al. 2004).

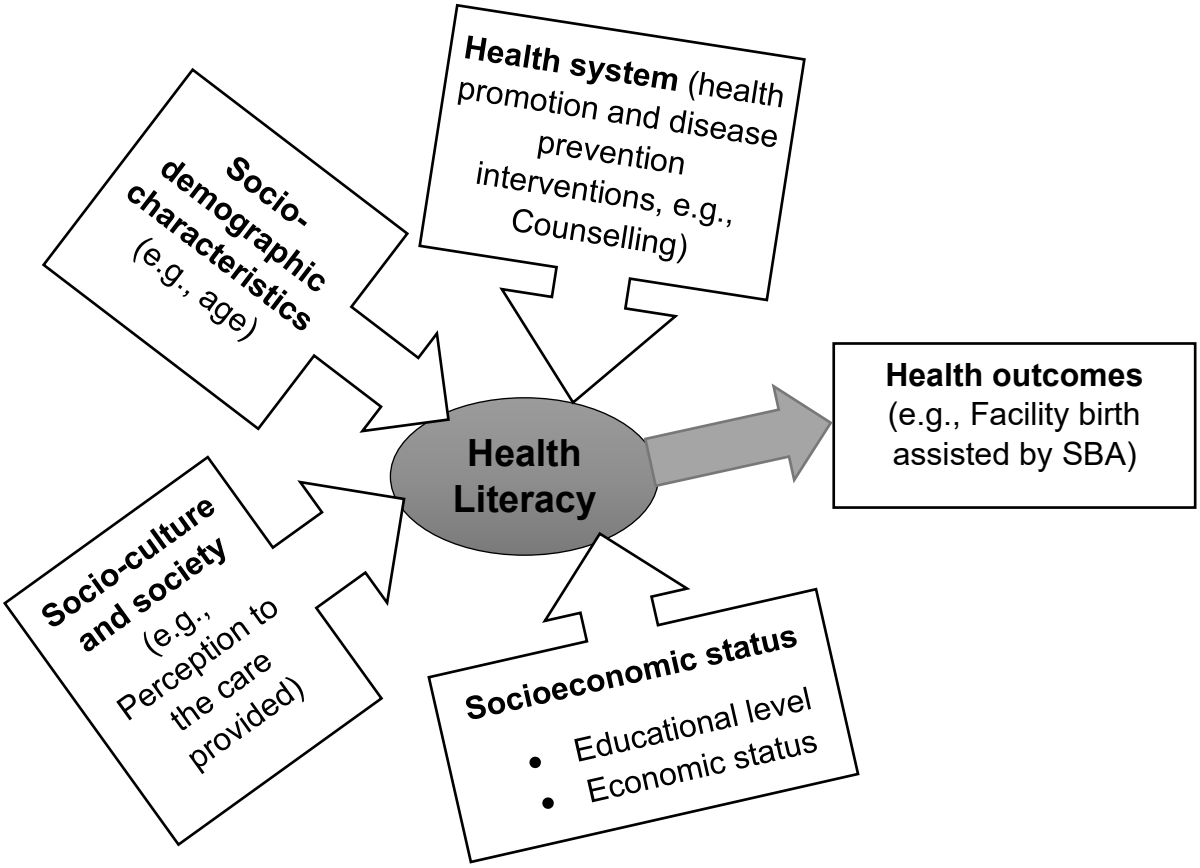


Figure 1 Health Literacy Conceptual framework

Source: Adapted from IOM (Kindig et al. 2004).

Maternal health literacy helps women take care of their own health and that of the growing foetus and the newborn by interacting with healthcare service providers, making informed decisions, and accessing healthcare services in a timely manner (Batterham et al. 2016). In contrast, limited maternal health literacy causes a delay in seeking treatment (Corrarino 2013). According to the three delays model (Thaddeus and Maine 1994), a delay in seeking health care is the most common factor contributing to maternal death (Calvello et al. 2015). Many delays in decisions to seek treatment occur when women cannot recognise obstetric danger signs (Sk et al. 2019). On the other hand, improved maternal knowledge and understanding of the importance of health care increase a woman's motivation and health care-seeking behaviour to prevent maternal death from obstetric complications (Moyo et al. 2018, Mwilike et al. 2018).

1.6. Maternal health in Ethiopia

Ethiopia has a healthcare policy that emphasises health promotion and disease prevention by strengthening primary healthcare services. The healthcare delivery system is structured into the three-tier system: primary healthcare, secondary healthcare, and tertiary healthcare (FMOH 2015) (Figure 2).

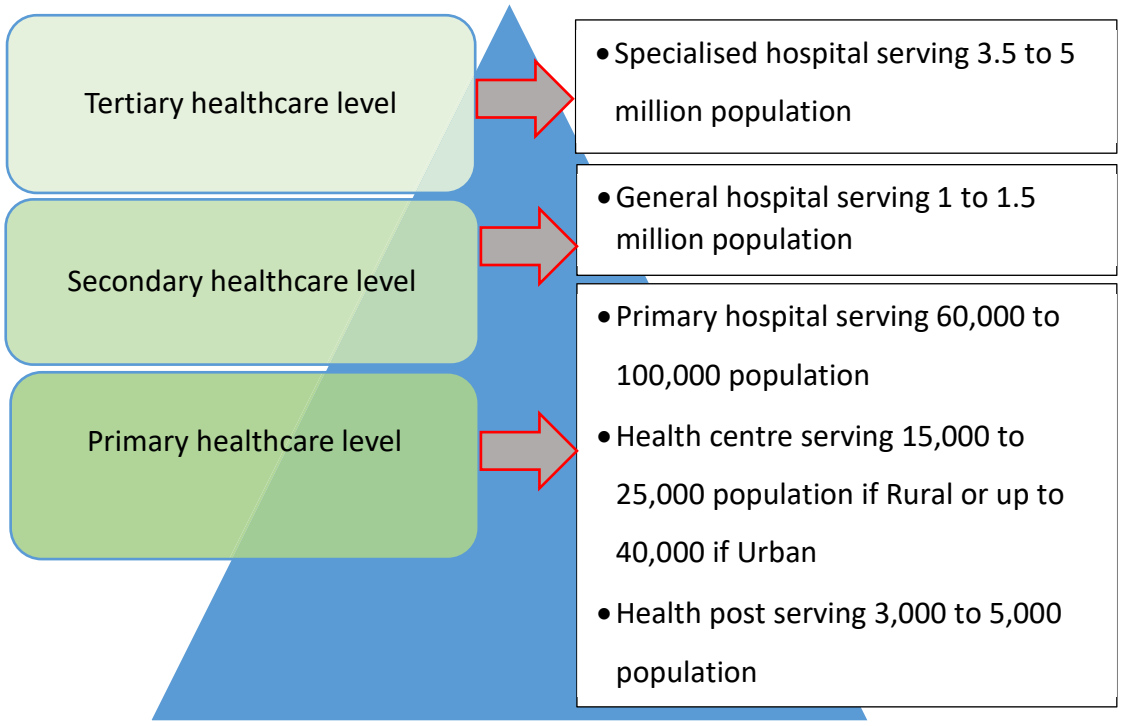


Figure 2 Three-tiered healthcare system in Ethiopia

Source: The Ethiopian HSTP (FMOH 2015).

This ranking is based on the type and depth of healthcare that can be provided to clients, and the referral system connects healthcare facilities at different levels. The primary healthcare level's main goals are health promotion and disease prevention, whereas secondary and tertiary healthcare levels primarily provide curative and rehabilitative healthcare services (FMOH 2015). Ethiopia's Ministry of Health has made tremendous efforts to realise this by expanding healthcare services, training, and deploying healthcare providers. For example, the health extension program, which began in 2003,

has helped the country in expanding primary healthcare services at the community level and improving maternal health (Assefa et al. 2019, Karim et al. 2013).

Improving maternal health is a priority in Ethiopia and is an objective in the country's health sector transformation plan (HSTP) that aimed to reduce MMR to less than 190 by 2020. Maternal healthcare services such as family planning (FP), ANC, childbirth aided by an SBA, and postnatal care (PNC) are among the highly promoted primary healthcare services. To avoid financial barriers, all public healthcare facilities offer these services for free. Additionally, the Ethiopian Ministry of Health has commitments in multisectoral collaboration and partnership to mobilise resources needed to save more lives (FMOH 2015).

However, progress towards reducing MMR to less than 190 per 100,000 live births has been unsatisfactory with 401 maternal deaths per 100,000 live births in 2019 (EPHI and ICF 2019, WHO 2021). The HSTP also aimed to improve the contraceptive prevalence rate to 55%, increase the number of women accessing four or more ANC contacts to 95% and increase the proportion of births attended by an SBA to 90%, and the uptake of PNC to 95% by the end of 2020 (FMOH 2015). However, there has been only a slight increment in maternal healthcare uptake over the last two decades and less achievement in increasing the quantity and quality of this care. In 2019 approximately one in four women did not receive ANC (EPHI and ICF 2019). While ANC counselling is a low-cost primary healthcare intervention that benefits pregnant women and their unborn babies (Duysburgh et al. 2013, Soubeiga et al. 2014), delivering such counselling has remained problematic in Ethiopia (Mehretie Adinew et al. 2018). According to 2011 data, Ethiopia ranked last among 41 low and middle-income countries regarding ANC counselling on obstetric danger signs (9%) (Hodgins and D'Agostino 2014). The most recent report showed that ANC counselling on obstetric danger signs was 45% (CSA/Ethiopia and ICF 2017). Only 47% of women in Ethiopia gave birth at health facilities assisted by an SBA (EPHI and ICF 2019), with the remainder giving birth at home without trained health care workers. In Ethiopia, health facilities such as health centres and hospitals provide an enabling environment where skilled personnel can assist

childbirth. Alternatively, less qualified persons who are not SBAs, such as health extension workers at the health post or a household level, can provide clean birth only and essential newborn care services. These include clean hands, clean delivery surface, clean cord cutting and tying, and proper cord care (EPHI et al. 2014).

1.7. Significance of the study

Poor socioeconomic status, sociocultural contexts, and issues associated with the healthcare system all contribute to disparities in maternal healthcare uptake and result in a higher MMR in LLMICs. More research is required to examine the country's context and provide insights to address this imbalance and end preventable maternal deaths. Designing country-specific and low-cost healthcare interventions in LLMICs such as Ethiopia requires understanding the relationship between ANC counselling, maternal health literacy, and the uptake of SBA at birth.

According to the IOM health literacy framework, the influence of poor socioeconomic and related factors on maternal health outcomes could be mediated by maternal health literacy (Arora et al. 2019, WHO 2015b). While some socioeconomic factors, such as age and ethnicity are non-modifiable factors, maternal health literacy is a modifiable factor that could influence maternal health outcomes. This indicates that health literacy interventions are required to improve maternal health outcomes. Potential intervention areas for increasing health literacy include the health system, sociocultural aspects, and education (Kindig et al. 2004). ANC counselling is a low-cost healthcare intervention that could improve maternal health literacy and enhance a positive pregnancy experience. Fewer studies in Ethiopia have attempted to establish a positive relationship between ANC uptake and SBA at birth (Fekadu et al. 2018, Tegegne et al. 2020). However, no research has been conducted in Ethiopia to determine what factors influence ANC counselling and how this intervention contributes to improvements in maternal health literacy (Geleto et al. 2019). In addition, previous studies that have assessed the overall quality of ANC have not taken into account the ANC counselling of women on obstetric danger signs despite it being a recommended component of ANC that should be

provided to every pregnant woman (Branco da Fonseca et al. 2014, Bobo et al. 2021, Heredia-Pi et al. 2016). Therefore, this research aims to contribute to the evidence for ANC counselling and examines the factors that influence the quality of ANC counselling in LLMICs. This research also investigates the extent to which ANC counselling increases maternal health literacy. Furthermore, it examines the direct and indirect influence of ANC counselling on the use of SBA at birth in the Ethiopian context.

This research has also emerged from my practice as an Ethiopian nurse-midwife and academic staff member at Debre Markos University in Ethiopia, where I was involved in mentoring nursing and midwifery undergraduate students. I have visited many health facilities in Ethiopia where home birth is common and noted that many pregnant women do not receive adequate ANC counselling on obstetric danger signs. In my experience, this appears to have affected women's decisions to give birth at home, and many women arrive late to health facilities after facing obstetric complications. This motivated me to undertake this research and contribute to improving maternal health care and saving lives.

Chapter 2 Literature Review

This chapter presents the findings of a systematic review of the research literature examining the relationship between ANC counselling on obstetric danger signs and maternal health literacy in LLMICs. This manuscript has been submitted to the BMJ Open Journal and is currently under review (Appendix 1). The first section of the systematic review provides background information on maternal deaths and the importance of quality healthcare in early detection and prevention. The background section also defines obstetric danger signs, ANC counselling and maternal health literacy. The search strategies, databases used, article screening process, quality appraisal techniques, and data extraction and synthesis approaches are also presented. This is followed by the presentation of the findings and a discussion of the implications in relation to other literature in the field.

2.1. Abstract

Objectives: This literature review study aimed to examine how ANC counselling on obstetric danger signs is delivered to pregnant women in low and lower-middle-income countries and its influence on women's health literacy.

Methods: I searched databases for peer-reviewed research articles published in English from 1990, guided by a question using the Patient, Intervention, Comparison, and Outcome (PICO) model and the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) framework. The Joanna Briggs Institute (JBI) quality appraisal tool was used to assess methodological quality. Data on ANC counselling and women's knowledge of danger signs were extracted, and content analysis was applied using a template to examine how women received ANC counselling, and the relationship between this ANC counselling and knowledge of obstetric danger signs.

Results: The systematic review included 38 research articles and 47,971 women in 23 LLMICs. Approaches to ANC counselling on obstetric danger signs included group ANC

(GANC), individual face-to-face ANC counselling, and home visits by trained ANC providers. Phone calls, radio message interventions and health education for women in the waiting area at ANC clinics were also used to provide supportive information on obstetric danger signs. Studies reported a range in the extent to which ANC counselling was provided across countries, from 13% to 85%. ANC counselling was positively associated with increased ANC visits, higher educational levels of ANC providers, ANC interventions such as GANC and home visits that used well-structured ANC guidelines. ANC counselling was negatively associated with a lack of counselling skills training for healthcare providers and short client-provider interactions. Thirteen to 87% of women involved in the studies were unable to cite any obstetric danger signs, nor could they demonstrate the skills needed to seek timely healthcare and this varied across countries. ANC counselling that involved GANC with counselling guidelines increased maternal health literacy by up to 20% to 30%, and home visits increased knowledge scores by 1.8 compared to 1.1 in the comparison group. Women who had more ANC exposure due to multiple pregnancies understood obstetric danger signs better than primigravida women. One study indicated that including male partners in ANC counselling sessions with their pregnant partners increased women's knowledge.

Discussion and Conclusion: ANC counselling approaches such as GANC and home visits by trained ANC providers supported by ANC guidelines, the availability of country-specific ANC guidelines and continuous staff development improved ANC counselling on obstetric danger signs. The more obstetric danger signs are included in ANC counselling, the more the women can recognise them, thus improving health literacy. Ministries of health in LLMICs should strengthen ANC counselling on obstetric danger signs by ensuring that quality guidelines are consistently applied and exploring options such as GANC. Studies that quantify the effect of ANC guidelines on providing counselling on obstetric danger signs in a standardised manner are needed to design country-specific interventions.

2.2. Background

Target three of the SDGs is to reduce the global MMR to less than 70 per 100,000 live births by 2030 (UN 2017, WHO 2015a). Maternal mortality is disproportionately high in LLMICs (94%) compared to high-income countries, with South-Eastern Asia and SSA alone accounting for 86% of the global maternal deaths (WHO 2019b). Maternal death can occur at any time during the antenatal, intrapartum, or postpartum periods (Kassebaum et al. 2014, Merdad and Ali 2018).

While most maternal deaths are due to preventable causes such as severe bleeding, infections, high blood pressure during or following pregnancy, complications from childbirth and unsafe abortion (WHO 2019d), quality healthcare, such as ANC, could half maternal deaths (Kruk et al. 2018) by the early detection of obstetric danger signs and management of complications (Merdad and Ali 2018). Interventions such as antenatal counselling for women on self-care behaviours can contribute to the early detection of obstetric danger signs and management of complications (Solhi et al. 2019). According to the WHO definition, self-care includes health promotion; disease prevention and control; self-medication; providing care to dependent persons; seeking hospital/specialist/primary care if necessary; and rehabilitation, including palliative care (WHO 2019c, p. 143).

Obstetric danger signs

Obstetric danger signs are symptoms indicating the occurrence of one or more obstetric complications. The three key danger signs during pregnancy include severe vaginal bleeding, swollen hands/face, and blurred vision. Severe vaginal bleeding, prolonged labour persisting over 12 hours, convulsions, and retained placenta are the four key danger signs during childbirth. Three key danger signs during the postpartum period include severe vaginal bleeding, foul-smelling vaginal discharge, and high fever (Jhpiego 2004). These danger signs can arise at any time during pregnancy or during and after childbirth; however, they can be timely detected and managed by providing ANC and

counselling to every woman about the danger signs (Kuhnt and Vollmer 2017, Rosado et al. 2019, WHO 2015b).

Antenatal care counselling

ANC counselling is an interactive process between the ANC provider and a pregnant woman and her family, involving the exchange of information and support so that the woman and her family can make informed decisions, set a plan and take action for a positive pregnancy experience (WHO 2013). This entails using plain language and visual aids to convey the intended message (Vamos et al. 2019). ANC counselling is emphasised to help pregnant women recognise obstetric danger signs and make timely informed decisions to improve birth preparedness and complication readiness (BPCR) (Jhpiego 2004, WHO 2014). BPCR is a maternal healthcare strategy to avoid preventable maternal deaths by preventing delays in maternal health care-seeking. The indicators of BPCR include if a woman has identified a skilled provider for birth, arranged the required funds to pay for associated transport and healthcare expenses, prepared transport and a blood donor if emergencies occur, and identified a health facility for childbirth (Jhpiego 2004).

ANC counselling promotes a positive pregnancy experience by increasing maternal health literacy (Renkert and Nutbeam 2001, WHO 2014). GANC is an ANC counselling approach to encourage a positive pregnancy experience. Group ANC stems from CenteringPregnancy® (Rising 1998), whereby groups of eight to twelve pregnant women of similar gestational age attend a health facility and receive ANC service that involves discussions facilitated by healthcare providers. Discussions on varieties of pregnancy-related topics take place within the group setting.

The WHO defines a positive pregnancy experience as:

> *maintaining physical and sociocultural normality, maintaining a healthy pregnancy for mother and baby (including preventing or treating risks, illness and death), having an effective transition to positive labour and birth, and achieving*

positive motherhood (including maternal self-esteem, competence and autonomy) (WHO 2016b, p. ix).

It includes women's receipt of skilled care during pregnancy and childbirth (Arora et al. 2019, Soubeiga et al. 2014). While the receipt of skilled care during pregnancy and childbirth can prevent up to 90% of maternal deaths and 25% of newborn deaths and still-births attributed to pre-eclampsia/eclampsia (Hodgins et al. 2016), improved maternal health literacy helps to enhance a positive pregnancy experience (WHO 2016b).

Maternal Health Literacy

Maternal health literacy is a woman's access to information and awareness of the physiologies of pregnancy and obstetric danger signs, childbirth, childcare, and exclusive breastfeeding (Corrarino 2013, WHO 2014). There are three types of health literacy. These are functional health literacy, interactive health literacy and critical health literacy. Functional health literacy is an individual's ability to obtain health information and apply it to a limited prescribed activity. Interactive health literacy is extracting information, deriving meaning for communication, and using it in changing situations. Critical health literacy is an individual's ability to critically analyse information and apply it in his or her life (Nutbeam 2015). Women's access to information and awareness of obstetric danger signs is measured in terms of the number of obstetric danger signs that women can recognise (Bililign and Mulatu 2017, Bogale and Markos 2015, Wulandari and Laksono 2020). In contrast, the Johns Hopkins Program for International Education in Gynaecology and Obstetrics (Jhpiego) safe motherhood guideline assessed women's knowledge of obstetric danger signs in terms of the percentage of women who could spontaneously mention three danger signs of pregnancy, four danger signs of labour/childbirth, and three danger signs during the postpartum period (Jhpiego 2004).

The WHO guideline on ANC recommends every pregnant woman, who has an uncomplicated pregnancy, receive at least eight ANC contacts that include counselling

to ensure the early detection and management of obstetric complications. A higher number of ANC contacts gives pregnant women a chance to talk to healthcare providers about health issues, gain knowledge and confidence, and prepare for childbirth (WHO 2016b). Several primary research and systematic review studies have established the importance of ANC counselling to enhance women's knowledge of obstetric danger signs (Geleto et al. 2019), BPCR (Gudayu and Araya 2019), women's adherence to iron and folic acid supplementation (Desta et al. 2019) and to encourage women to seek SBA during childbirth (Mehretie Adinew et al. 2018). Despite recommendations regarding the importance of ANC counselling on obstetric danger signs (Geleto et al. 2019), no systematic review study has investigated the relationship between ANC counselling and maternal health literacy (knowledge of obstetric danger signs) across LLMICs. Therefore, this systematic review sought to examine how ANC counselling on obstetric dangers signs is delivered to pregnant women in LLMICs and how this counselling has influenced women's health literacy.

2.3. The systematic review methods

The review question was developed using the Patient, Intervention, Comparison and Outcome (PICO) model (Schardt et al. 2007) (Appendix 2). The study sought to explore the type of ANC counselling pregnant women received on obstetric danger signs and how this influenced their health literacy (knowledge of obstetric danger signs). MEDLINE (Ebsco), PubMed, PsycInfo (Ebsco), Cumulative Index to Nursing and Allied Health Literature (CINAHL) (Ebsco), Scopus, and Maternity and Infant Care (Ovid) databases were used to search for peer-reviewed research publications from LLMICs. Additional relevant research articles were accessed by looking at reference lists from the identified articles. The first author (TY) drafted the search strategy, and AD reviewed and approved the search strategy.

The search strategy was built using key terms and Medical Subject Heading (MeSH) terms focusing on pregnant women, ANC counselling, and maternal health literacy or

knowledge of obstetric danger signs (Appendix 3). The last date of literature searching was the 17th of March 2022.

The search included research articles published since 1990, a period when maternal health began to receive growing international attention from donors, United Nations (UN) agencies and governments. The Safe motherhood initiative was established in 1987 and, shortly afterwards, the Millennium Development Goals in 1990 (Cohen 1987).

As shown in Figure 3, the Preferred Reporting Items for Systematic review and Meta-Analyses (PRISMA) process was applied to identify and screen studies for appraisal and inclusion in the review (Moher et al. 2009). The search from six databases yielded 1,338 research articles. Additionally, one research article was identified by hand-searching reference lists of included research articles. The identified citations were collected in EndNoteX9.3.3™ software (The EndNote Team 2020) and exported in extensible markup language (*XML*) form to Covidence software (Veritas Health Innovation 2019). Using the Covidence software, 418 duplicates were removed, 920 research articles were screened by title and abstract, with 809 articles deemed ineligible for full-text review. A total of 112 research articles were subjected to full-text review, with 38 studies meeting inclusion criteria.

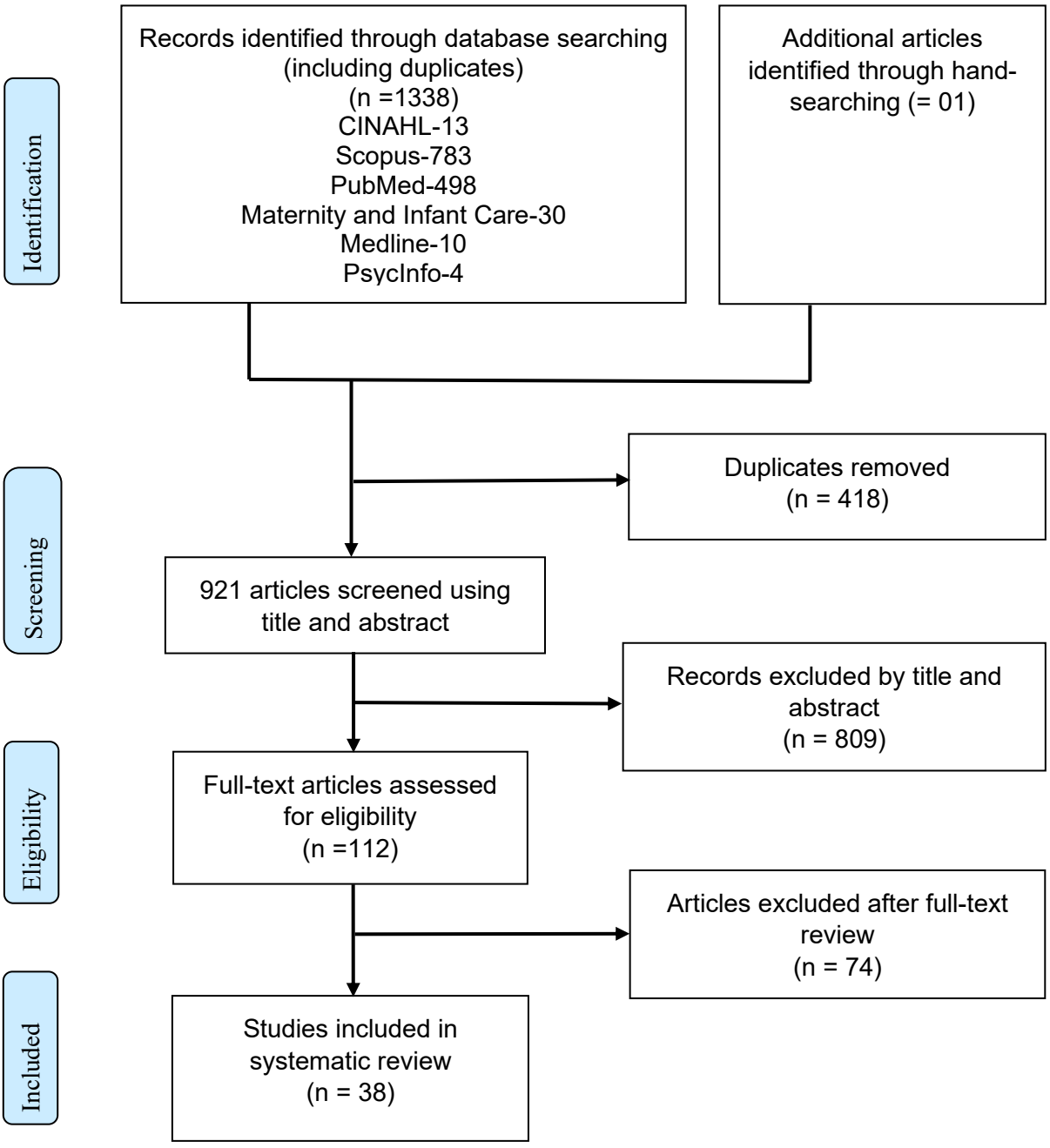


Figure 3 PRISMA flowchart

Source: PRISMA guideline (Moher et al. 2009).

Inclusion and exclusion criteria

Peer-reviewed quantitative and qualitative studies from LLMICs that documented maternal health literacy or knowledge of obstetric danger signs, BPCR and ANC counselling were included. Study protocols, commentaries, studies for which abstracts

are unavailable, non-journal citations such as book chapters and conference proceedings, discursive papers and non-peer-reviewed research articles were excluded. Studies based on interventions other than ANC counselling, such as community health education for non-pregnant women, were excluded. We used the World Bank classification of countries to identify LLMICs (The World Bank 2022).

Quality appraisal

The Joanna Briggs Institute (JBI) quality appraisal tools were used to evaluate the methodological quality of the included articles (JBI 2017). TY and AD performed quality appraisals independently, and AH participated in decision-making. A total of 39 research articles were appraised. One quasi-experimental study was excluded due to a very low methodological quality score (10%) (Triastin et al. 2021). Triastin et al. (2021) study did not specify how the outcome variable was measured nor the cause and effect. Eleven studies scored 100%, 20 studies scored between 75%-99.9%, and seven studies scored between 50% and 74.9% (Appendix 4)**.**

Data extraction and analysis

A template was used to frame data extraction, which included study author(s), publication year, study setting, study objective(s), study design(s), sampling technique(s) and sample size, and the results. Data on quantitative reports that measured knowledge of obstetric danger signs and/ or BPCR or maternal health literacy related to counselling during ANC visit(s) or contact(s) were extracted. Quantitative reports include proportions, percentages, and odds ratios of maternal health literacy or knowledge of obstetric danger signs against counselling during ANC. Qualitative data describing ANC counselling on obstetric danger signs, BPCR and its relationship with women's awareness or knowledge of obstetric danger signs were also extracted for content analysis (Appendix 5). Content analysis was applied to describe and quantify phenomena by summarising them into categories that were synthesised into themes (Elo and Kyngäs 2008). These a priori categories sought to determine the ANC counselling approaches in the included studies, the degree to which women received ANC counselling, and the

relationship between this ANC counselling and maternal health literacy or knowledge of obstetric danger signs.

Ethics consideration and Patient and Public Involvement

No patient data source was used in this study; instead, peer-reviewed research articles were accessed from academic research databases. Therefore, an ethics application was not required.

2.4. Results

Characteristics of the studies

The systematic review comprised 38 eligible peer-reviewed primary research studies. The studies were from 23 LLMICs and included 47,971 pregnant and postpartum women. Twenty-seven (71%) studies were from African countries (Adaji et al. 2019, Anastasi et al. 2015, Anya et al. 2008, Azeze et al. 2019, Bakar et al. 2019, Bayou and Gacho 2013, Brazier et al. 2014, Bintabara et al. 2017, Bintabara et al. 2015, Duysburgh et al. 2013, Eze et al. 2020, Gebre et al. 2015, Ijang et al. 2019, Jennings et al. 2010, Lakew et al. 2016, Lori et al. 2017, Lori et al. 2014, Mutiso et al. 2008, Mwilike et al. 2018, Nkamba et al. 2021, Pembe et al. 2009, Pembe et al. 2010, Salem et al. 2018, Sarker et al. 2010, Smeele et al. 2018, Sripad et al. 2019, Woldeamanuel et al. 2019). One study used data from three African countries (Burkina Faso, Ghana, and Tanzania) (Duysburgh et al. 2013). Eight (21%) studies were from South Asian countries (Akshaya and Shivalli 2017, Darmstadt et al. 2010, Karkee et al. 2014, Kusuma et al. 2018, Mullany et al. 2009, Nuraini and Parker 2005, Shukla et al. 2019, Thapa et al. 2019). One study (2.6%) used data from two African countries and a Caribbean country (Malawi, Senegal, and Haiti) (Assaf 2018). One study (2.6%) was from Central America (Guatemala) (Perreira et al. 2002), and another study (2.6%) was from Oceania (Papua New Guinea) (Vallely et al. 2019).

In terms of study designs, 24 (63%) studies were cross-sectional (Akshaya and Shivalli 2017, Anastasi et al. 2015, Anya et al. 2008, Assaf 2018, Azeze et al. 2019, Bayou and Gacho 2013, Brazier et al. 2014, Bintabara et al. 2017, Bintabara et al. 2015, Duysburgh et al. 2013, Gebre et al. 2015, Ijang et al. 2019, Kusuma et al. 2018, Lakew et al. 2016, Mutiso et al. 2008, Mwilike et al. 2018, Nkamba et al. 2021, Pembe et al. 2009, Pembe et al. 2010, Salem et al. 2018, Sarker et al. 2010, Smeele et al. 2018, Vallely et al. 2019, Woldeamanuel et al. 2019), four (10.5%) studies were cohort (Adaji et al. 2019, Karkee et al. 2014, Shukla et al. 2019, Lori et al. 2017), four (10.5%) studies were randomised controlled trials (RCT) (Darmstadt et al. 2010, Jennings et al. 2010, Mullany et al. 2009, Thapa et al. 2019), three (7.9%) studies were qualitative (Bakar et al. 2019, Lori et al. 2014, Sripad et al. 2019), and three (7.9%) studies were non-randomised quasi-experimental (Eze et al. 2020, Nuraini and Parker 2005, Perreira et al. 2002) (Appendix 5).

Approaches to ANC counselling on obstetric danger signs

The included studies revealed various approaches to counselling pregnant women on obstetric danger signs. In four studies, ANC counselling was delivered through GANC (Adaji et al. 2019, Nuraini and Parker 2005, Thapa et al. 2019, Lori et al. 2017). A facilitator's guide or a handbook was initially developed in Nigeria and Ghana to guide women's discussions in GANC. The facilitator's guide outlined various topics and a step-by-step procedure for leading group discussions. The ANC providers facilitated women's discussion of a healthy pregnancy, obstetric danger signs, emergency preparedness, nutrition during pregnancy, health facility birth, and childcare (Adaji et al. 2019, Lori et al. 2017). GANC was implemented in Ghana over the course of seven visits or sessions. Each session lasted up to an hour and focused on a specific topic. During the first visit, women were introduced to GANC and the topics of discussion during the first visit, and during the second visit, they discussed self-care and how to prevent problems during pregnancy. Self-care activities included nutrition, recognising and reporting danger signs, resting to avoid problems, sleeping under an insecticide-impregnated bed net, optimum fluid intake, and iron tablet intake to prevent anaemia during pregnancy.

Discussions about obstetric danger signs were held during the third visit, and discussions about BPCR were addressed during the fourth visit. From the fifth to the seventh visit, the emphasis was on discussing postpartum and newborn care (Lori et al. 2017). In group sessions, women were encouraged to share information, ideas, experiences, and personal feelings (Adaji et al. 2019). Women were counselled on obstetric danger signs using storytelling, peer support, demonstration, and teach-back techniques (Lori et al. 2017). Additionally, picture cards and visual images were utilised to stimulate and simplify discussions and enhance retention (Lori et al. 2017). The topics of discussion and the process of group sessions were not detailed in the studies from Nepal (Thapa et al. 2019) and Indonesia (Nuraini and Parker 2005).

Other studies described guides to direct counselling in individual ANC sessions. These comprised written materials outlining lists of danger signs and picture cards (Duysburgh et al. 2013, Jennings et al. 2010, Perreira et al. 2002) and educational calendars that could be kept in the client's billfold, a small case used to keep notes and reminders (Perreira et al. 2002). A guide, known as mother-child protection card containing seven obstetric danger signs, was used by auxiliary Nurse-Midwives in India (Akshaya and Shivalli 2017). Counselling guides were utilised in studies in Benin (Jennings et al. 2010) and Guatemala (Perreira et al. 2002) to facilitate ANC counselling and enhance women's understanding. The counselling guides in Benin were known as job aids provided to healthcare workers. Adapted from the national ANC guideline, the job aids consisted of cards with culturally appropriate educational images on one side and a list of key messages, including those related to obstetric danger signs on the other side (Jennings et al. 2010). The images on the card were designed to encourage interactions with pregnant women and enhance their understanding of the message under discussion. An observation checklist was used to evaluate the quality of ANC counselling in the intervention arm (using job aids). The checklist contained a list of topics (general pregnancy care, BPCR, danger signs, clean delivery and newborn care) that the ANC provider should address in counselling (Jennings et al. 2010). Similarly, in Guatemala, desktop flipcharts containing coloured pictures of indigenous women illustrating obstetric danger signs, obstetric complications, and the importance of preparedness for

timely health care-seeking were used to counsel women. The counselling sessions were organised according to "10 Golden Rules" of effective interpersonal communication (Perreira et al. 2002, p. 21). However, Perreira et al. (2002) did not elaborate on the 10 Golden Rules.

Three intervention strategies were described in one study to improve women's knowledge of obstetric danger signs. The three interventions included a radio campaign, clinic-based education, and education at women's groups. In clinic-based education, ANC providers counselled women on obstetric danger signs using visual aids such as flip charts and leaflets. Radio messages in three local languages (*Spanish*, *K'iche'* and *Mam*) were broadcast and implemented alongside a clinic-based intervention that continued over two years (Perreira et al. 2002). In the women's group, healthcare workers conducted seven discussion sessions about obstetric complications and their causes, preventive measures, and the importance of health care-seeking. The interventions addressed obstetric complications, including haemorrhage, swelling of body extremities, premature labour, premature rupture of membrane, history of caesarean section, foetal malpresentation, multiple gestations, prolonged labour, retained placenta, abdominal pain, fever, and foul-smelling discharge (Perreira et al. 2002).

An interventional study from Nigeria aimed at improving BPCR involved training of community health workers (CHWs) and pregnant women on danger signs and BPCR, as well as stakeholder engagement in maternal healthcare services. The trained CHWs went door to door, educating pregnant women on obstetric danger signs and BPCR and offering them with print materials containing information on obstetric danger signs. Following the intervention, 64.5% of women received information on obstetric danger signs from healthcare providers, 21% from radio and 7.3% from print materials (Eze et al. 2020).

Another study from Tanzania described counselling for women on obstetric danger signs during ANC visits, and healthcare workers shared their phone numbers with women so that women could call them for help if they experienced danger signs such as bleeding, swelling of extremities, or any problems (Bakar et al. 2019). Only one study described male partner involvement in ANC counselling (Mullany et al. 2009).

An RCT study in Bangladesh used home visits twice during pregnancy and four times during postpartum as interventions to provide obstetric danger signs counselling. During home visits by trained CHWs, women received ANC services, including counselling on obstetric danger signs and BPCR, the promotion of newborn care and a free delivery kit (Darmstadt et al. 2010).

The extent of counselling women received

The analysis of the findings from the cross-sectional studies included in the systematic review indicated that not all women in the studies were counselled on obstetric danger signs. A few women (13%) in India (Kusuma et al. 2018), less than a fifth (19.3%) of women in The Gambia (Anya et al. 2008), slightly more than one-third of women in Senegal (38%) (Assaf 2018) and the Democratic Republic of Congo (35%) (Nkamba et al. 2021), and slightly over half of the women in Cameroon (53%) (Ijang et al. 2019), Papua New Guinea (54%) (Vallely et al. 2019), Malawi (54%) and Haiti (51%) (Assaf 2018) were counselled on at least one obstetric danger sign. Two-thirds of women received counselling on obstetric danger signs in Rwanda (Smeele et al. 2018) and Ghana (Duysburgh et al. 2013). A higher number of women received counselling on at least one obstetric danger sign in Madagascar (71%) (Salem et al. 2018) and Kenya (72%) (Mutiso et al. 2008), ranging from 16% to 85% in six studies in Tanzania (Bintabara et al. 2015, Bintabara et al. 2017, Duysburgh et al. 2013, Pembe et al. 2009, Pembe et al. 2010, Mwilike et al. 2018). Less than one-third (30.6%) of women in The Gambia were informed about the benefits of birthing at a health facility (Anya et al. 2008). Two studies in Ethiopia described that 63% (Gebre et al. 2015) and 83% (Bayou and Gacho 2013) of women received ANC counselling on at least one obstetric danger sign.

In Benin, about half (51%) of pregnant women in the intervention arm (the use of job aids) and 36% of pregnant women in the control arm (without job aids) received counselling on the recommended ANC components (Jennings et al. 2010).

ANC counselling also varied across obstetric danger signs, with not every obstetric danger sign receiving equal attention during counselling. Two studies found that 5.4%, 30%, and 8.7% to 22.5% of women in Burkina Faso, Ghana, and Tanzania, respectively, were counselled on seven obstetric danger signs (Duysburgh et al. 2013, Pembe et al. 2010). In these studies, more time was given to explanations of vaginal bleeding and severe abdominal pain during counselling than other obstetric danger signs (Duysburgh et al. 2013, Pembe et al. 2010). In contrast, a study from India showed no difference in the percentage of counselling across six obstetric danger signs assessed in the study (10% to 11.4%) (Kusuma et al. 2018). The danger signs studied were severe headache with blurred vision, convulsions or loss of consciousness, prolonged labour, leakage through the vagina, high fever with or without abdominal pain, and decreased or absence of foetal movements (Kusuma et al. 2018).

Factors associated with ANC counselling on obstetric danger signs

Three studies investigated factors that could have an impact on the quality of ANC counselling, as measured by the provision of information on all obstetric danger signs (Anya et al. 2008, Assaf 2018, Duysburgh et al. 2013). These studies found associations between the information provided on obstetric danger signs and the profession and educational level of the ANC provider (Duysburgh et al. 2013). Studies also noted that less time spent on client-provider interaction could limit the amount of information provided on obstetric danger signs (Anya et al. 2008, Assaf 2018). An RCT and quasi-experimental studies indicated that ANC provider's training and ANC consultation guidelines increased ANC counselling provision on obstetric danger signs by 25% in Benin and 15% in Guatemala (Jennings et al. 2010, Perreira et al. 2002). One study from Burkina Faso found that women older than 30 years received less ANC counselling (on average, two danger signs) than younger women (on average, 2.7 danger signs) (Duysburgh et al. 2013).

A qualitative study from Tanzania found that pregnant women who went to ANC clinics as scheduled received adequate information on obstetric danger. On the contrary,

women who commenced the ANC service late in their pregnancies and attended fewer visits received less information on obstetric danger signs (Bakar et al. 2019). Another study, however, found no statistical difference in ANC counselling based on the number of ANC visits (Duysburgh et al. 2013).

Defining a woman's level of knowledge of obstetric danger signs

This review found that pregnant women's knowledge of obstetric danger signs was assessed contextually using a variety of approaches. Thapa et al. (2019) defined women's knowledge of obstetric danger signs using the Jhpiego safe motherhood guideline (Jhpiego 2004). Seven studies used cut-off values to classify women's knowledge of obstetric danger signs into two or three levels. Cut-off values included the median (Mullany et al. 2009), mean (Assaf 2018, Lakew et al. 2016), and any other values starting from one (Brazier et al. 2014, Mutiso et al. 2008, Jennings et al. 2010, Shukla et al. 2019). Brazier et al. (2014) measured knowledge of birth preparedness and knowledge of complication readiness. Knowledge of birth preparedness was assessed in terms of a woman's ability to identify a means of transport to a facility, a place of birth, pre-arranged funding for associated costs, and a skilled care provider. A score of "1" was assigned if a woman identified each birth preparedness indicator. Birth preparedness was dichotomised into "high" if a woman spontaneously mentioned two or more indicators and "low" if a woman spontaneously mentioned less than two indicators. Knowledge of complication readiness was assessed based on whether a woman agreed that every pregnancy was risky, mentioned at least three danger signs occurring during pregnancy and childbirth, mentioned at least three danger signs occurring during the postpartum period, and identified a blood donor if needed during birth. Each woman scored between 0 to 4, and a value equal to or greater than three was used to categorise a woman's knowledge of complication readiness as high or low.

A woman's knowledge of danger signs was rated high in a Nepalese study if her knowledge score exceeded the median value (Mullany et al. 2009). In India, a woman's ability to mention more than eight danger signs was one of seven components of the

BPCR index used to assess women's preparedness for birth (Shukla et al. 2019). Two studies considered a woman was knowledgeable if she could spontaneously recall at least two danger signs (Akshaya and Shivalli 2017, Gebre et al. 2015). Four studies regarded a woman as knowledgeable if she could mention at least three danger signs at any obstetric phase (Azeze et al. 2019, Ijang et al. 2019, Jennings et al. 2010, Mutiso et al. 2008). One study considered a woman knowledgeable if she could state at least three danger signs in each obstetric phase (Woldeamanuel et al. 2019). In Tanzania, women were considered knowledgeable if they could cite at least five danger signs during the three obstetric phases, including at least one danger from each phase (Bintabara et al. 2015, Bintabara et al. 2017). In research from Guinea, a woman's knowledge of obstetric danger signs was regarded as high if she could spontaneously recall at least three danger signs during pregnancy and childbirth and at least three danger signs during the postpartum period (Brazier et al. 2014). Three studies classified a woman as knowledgeable if she could spontaneously mention at least one danger sign (Kusuma et al. 2018, Salem et al. 2018, Vallely et al. 2019).

Research from Tanzania classified women's knowledge of obstetric danger signs into three levels, "not knowledgeable", "low knowledge", and "sufficient knowledge" (Mwilike et al. 2018). Accordingly, a woman was categorised as "not knowledgeable" if she could not mention any danger sign, or "low knowledge" if she could recognise one to three danger signs, or she was identified as having "sufficient knowledge" if she could cite at least four danger signs. Three studies did not classify women's knowledge but described the danger signs that women could describe (Adaji et al. 2019, Duysburgh et al. 2013, Pembe et al. 2010).

Women's knowledge of obstetric danger signs and the relationship with ANC counselling

All of the studies in the review demonstrated that the majority of women could not cite one or more obstetric danger signs of pregnancy, childbirth or the postpartum period. Only four women (1%) from Burkina Faso and Ghana who were able to state all seven danger signs listed in the study questionnaire (Duysburgh et al. 2013). The percentage

of women who did not know any danger sign in each obstetric phase varied across countries. Higher rates of women who did not know any obstetric danger signs during pregnancy, childbirth and the postpartum period were from studies in Tanzania (19% to 69%) (Bintabara et al. 2015, Bintabara et al. 2017, Duysburgh et al. 2013, Mwilike et al. 2018, Sarker et al. 2010) and Burkina Faso (58.2%) (Duysburgh et al. 2013). The percentage of women who could not describe any obstetric danger sign was 57% in The Gambia (Anya et al. 2008), 45% in Malawi, 43% in Haiti, and 35% in Senegal (Assaf 2018), 33% in Kenya (Mutiso et al. 2008), 32% in Uganda (Anastasi et al. 2015), 22% in Nigeria (Adaji et al. 2019), 22% in Ghana, 20% to 87% in India (Akshaya and Shivalli 2017, Kusuma et al. 2018), 19% in Madagascar (Salem et al. 2018), 15% in Rwanda (Smeele et al. 2018) and 13% in Cameroon (Ijang et al. 2019). More than two-thirds of women in the Democratic Republic of Congo knew at least one obstetric danger sign (Nkamba et al. 2021).

Some studies reported the percentage of women who knew at least two, three, four or five danger signs. The percentage of women who knew at least two danger signs ranged from 27% to 40.4% in Ethiopia (Bayou and Gacho 2013, Gebre et al. 2015), while it ranged from 15.4% to 31.7% in Rwanda that varied depending on obstetric phases (Smeele et al. 2018). About half of women in a study from the Democratic Republic of Congo knew at least two danger signs during pregnancy (Nkamba et al. 2021). Similarly, 9.3% to 56.1% of women in Ethiopia (Azeze et al. 2019, Woldeamanuel et al. 2019), 6.9% of women in Kenya (Mutiso et al. 2008), and 6.6% of women in Rwanda (Smeele et al. 2018) knew at least three danger signs. More than one-fourth of women in studies from Tanzania knew at least four danger signs (Bintabara et al. 2015, Bintabara et al. 2017).

Three studies found women had difficulty demonstrating the skills needed to decide and seek timely healthcare when obstetric emergencies arose (Salam and Sarfraz 2018). For example, women in Tanzania who recognised fever and headache danger signs did not seek healthcare when they encountered these symptoms and instead chose to take over-the-counter medications or do nothing (Mwilike et al. 2018). The provision of low counselling for women on obstetric danger signs and birth preparedness resulted in low

knowledge of birth preparedness. In turn, a lack of understanding of birth preparedness contributed to low health care-seeking practice (Brazier et al. 2014).

In a study from The Gambia, only a small percentage of women stated obstetric danger signs such as haemorrhage (14.8%), fever (12.9%), and other obstetric complications such as anaemia (28.9%), hypertension (24.6%) and puerperal sepsis (5%) due to poor client-provider interactions and short consultations. Only a small percentage (19.3%) of women were provided with information on what to do when obstetric danger signs appeared. Women with four or more pregnancies were better able to describe obstetric danger signs such as vaginal bleeding (Anya et al. 2008).

Vaginal bleeding or haemorrhage was the danger sign that most women were able to recall in many countries (Adaji et al. 2019, Assaf 2018, Azeze et al. 2019, Bintabara et al. 2017, Mutiso et al. 2008, Mwilike et al. 2018, Nkamba et al. 2021, Pembe et al. 2010, Smeele et al. 2018, Vallely et al. 2019, Woldeamanuel et al. 2019).

This review revealed that the following ANC interventions increased women's awareness of obstetric danger signs. These included GANC, the use of ANC guidelines, and home-to-home visits and counselling by trained CHWs, as well as the provision of printed materials to pregnant women (Adaji et al. 2019, Akshaya and Shivalli 2017, Jennings et al. 2010, Lori et al. 2017, Perreira et al. 2002).

Following GANC implementation in Nigeria, the mean knowledge score of obstetric danger signs increased from 31% to 47.8%, knowledge of excessive vaginal bleeding increased from 50.7% to 78.1%, and the percentage of women who could mention at least five danger signs increased from 1.4% to 13.3% (Adaji et al. 2019). Another study from Ghana (Lori et al. 2017) found that significantly more women in GANC than in individual ANC were able to practise the self-care behaviours needed to recognise and seek timely healthcare for obstetric complications during pregnancy. Self-care behaviours included the practice of healthcare behaviours that women had discussed with a midwife. Additionally, more women in GANC (38%) recalled being instructed to

watch for obstetric danger signs than women in individual ANC (18.3%). A greater percentage of women in GANC than in individual ANC also reported to be undertaking BPCR activities which included arranging transport (98% versus 83.1%), setting money aside (99% versus 80.7%), and decision making concerning the place to give birth (62% versus 33.7%) (Lori et al. 2017).

The use of ANC guidelines was another intervention that increased knowledge of obstetric danger signs (Akshaya and Shivalli 2017, Jennings et al. 2010, Perreira et al. 2002). Following the implementation of contextually designed counselling guidelines, the percentage of women who recognised at least one obstetric danger sign increased by 32%, from 66% to 98% in Guatemala (Perreira et al. 2002), and the overall knowledge of obstetric danger signs increased by 28.7% in Benin (Jennings et al. 2010), and by 29% in India (Akshaya and Shivalli 2017).

Two studies, one in Nigeria (Eze et al. 2020) and the other in Bangladesh (Darmstadt et al. 2010), showed that women's knowledge of obstetric danger signs increased after trained CHWs made home visits and counselled or educated women on obstetric danger signs and distributed print-material containing information on obstetric danger signs to pregnant women. A pre and post-intervention study in Nigeria found that household-level health education on obstetric danger signs, BPCR and how to seek healthcare in case of emergency delivered by trained CHWs significantly increased women's knowledge of obstetric danger signs from 3.96 to 4.31 (Eze et al. 2020). In Bangladesh, trained CHWs made two antenatal home visits and counselled pregnant women in the intervention group on BPCR and obstetric danger signs, while pregnant women in the control group received the usual care. The study found that women's knowledge score on obstetric danger signs was significantly higher in the intervention group (1.8) than in the control group (1.1) (Darmstadt et al. 2010).

One study from Nepal found that women's knowledge of obstetric danger signs increased when their partners participated in ANC counselling. The improvement of knowledge of obstetric danger signs at follow-up compared to baseline was higher among women who

received ANC counselling in couples than women who received counselling alone. On average, women's knowledge of obstetric danger signs increased by 0.61 points among those who received counselling with male partners and by 0.34 points among women who received ANC counselling with no male partner (Mullany et al. 2009).

The review also found that while women who were unaware of BPCR were more likely to opt for a home birth, women who received better ANC counselling on BPCR were up to five times more likely to use SBA during childbirth (Bayou and Gacho 2013, Brazier et al. 2014). This was due to women who received ANC counselling on BPCR having higher levels of birth preparedness knowledge (31%) as well as complication readiness knowledge (14%) (Brazier et al. 2014). Azeze et al. (2019) also found that women who were more aware of obstetric danger signs were more likely to be prepared for birth and complications, including preparing funds, arranging transportation, and identifying a health facility. A qualitative study from Tanzania, on the other hand, found that while some women agreed that knowing obstetric danger signs would help them prepare for birth and emergencies and seek timely medical care, others believed that obstetric danger signs such as convulsions and haemorrhage are due to witchcraft and evil spirits, and that traditional healers are the only people able to treat these conditions (Bakar et al. 2019).

2.5. Discussion

The systematic review sought to examine the extent to which ANC counselling contributes to women's awareness of obstetric danger signs or health literacy in LLMICs. The review demonstrated that not every woman in LLMICs receives ANC counselling on obstetric danger signs, and that even among those who do, not all danger signs are discussed. This suggests that ANC counselling in many LLMCs does not conform to the current WHO guideline, which recommends that every pregnant woman should receive counselling on all obstetric dangers signs during each ANC contact (WHO 2016b).

The findings showed that a variety of factors influenced ANC counselling on obstetric danger signs. Women with multiple ANC contacts are more likely to receive obstetric danger signs counselling than women with only one ANC contact (Bakar et al. 2019). This implies that women will have the opportunity to receive obstetric danger signs counselling if they visit with ANC multiple times. The recent WHO ANC guideline has also increased the recommended number of ANC contacts for each pregnant woman in a normal pregnancy to eight in order to improve a positive pregnancy experience (WHO 2016b).

Another factor influencing ANC counselling on obstetric danger signs is the educational level of the provider. The higher the educational level of ANC providers, the more likely the women will be counselled on obstetric danger signs (Duysburgh et al. 2013). Providing quality ANC that includes counselling as an integral part of the care and establishing a rapport between the client and care provider requires the acquisition of skills through training and education (Worsley et al. 2016). One study in the review noted that the absence of training on counselling skills for healthcare providers negatively impacted ANC counselling (Assaf 2018). In-service refresher training for healthcare providers at least once every 12 months can improve maternal and newborn healthcare quality (WHO 2016a). Quality improvement in maternal healthcare, including ANC, can also be strengthened by undertaking regular audits and providing supportive supervision (Biza et al. 2015, Manzi et al. 2018).

The duration of a woman's interaction with her ANC provider also influences her knowledge of obstetric danger signs. The shorter the time, the less counselling a woman receives (Anya et al. 2008, Assaf 2018), and therefore it is unlikely that all danger signs will be discussed in the consultation (Shukla et al. 2020). A shortage of ANC providers will also affect the time available to deliver ANC counselling to each woman in facilities with a high volume of care seekers. A study in Tanzania revealed that as a result of a staff shortage, patients waited long time to get the service and compromised the duration of client-provider communication (Sheffel et al. 2019).

The use of well-structured ANC guidelines, supported by descriptive and coloured images, contributed to comprehensive, interactive, and transparent discussions that addressed each obstetric danger sign (Jennings et al. 2010, Perreira et al. 2002, Thapa et al. 2019). An RCT study in Benin demonstrated that job aids, mainly graphic cards designed to facilitate communication between the ANC provider and client, and health worker training increased the mean proportion of recommended messages to pregnant women. These messages covered topics such as recognising danger signs, birth preparation, clean delivery, and newborn care (Jennings et al. 2010). Similarly, a quasi-experimental study in Guatemala revealed that using a counselling guide increased counselling on obstetric danger signs by 15% (Perreira et al. 2002). Another quasi-experimental study in Tanzania also showed that using job aids in ANC counselling increased the number of obstetric danger signs counselled for women by two (Oka et al. 2019). The findings suggest that every pregnant woman in LLMICs gets more counselling about obstetric danger signs when ANC guidelines are used. It has also been shown that ANC guidelines in high-income countries are important for making sure that all pregnant women get high-quality, evidence-based pregnancy care (Homer et al. 2018). The ANC counselling handbook helps the ANC provider improve his or her counselling and communication skills. This helps women understand obstetric danger signs, develop skills to practise PBCR, and seek timely treatment for complications (WHO 2013). To standardise the quality improvement in ANC, the WHO recommends that countries adapt the recent WHO ANC guideline to a local setting using a manual adaptation toolkit (Barreix et al. 2020). Thus, consistent use of ANC service delivery guidelines has twofold importance: ensuing service standardisation and quality improvement.

The use of ANC counselling guides combined with provider training (Jennings et al. 2010, Perreira et al. 2002), GANC (Adaji et al. 2019, Lori et al. 2017), home visits by trained ANC providers (Darmstadt et al. 2010, Eze et al. 2020) and educational materials such as leaflets can improve women's knowledge of obstetric danger signs (Perreira et al. 2002). GANC allows a pregnant woman to receive counselling in a group of eight to twelve women of the same gestational age (Rising 1998). Communication and sharing of ideas and experiences occur within the group when facilitated by the ANC provider. Women

in this counselling approach receive information on obstetric danger signs from their peers and the ANC provider(s). As a result, more danger signs can be described to women within the group, increasing women's ability to recognise danger signs (Adaji et al. 2019, Lori et al. 2017).

Despite the studies measured the knowledge of obstetric danger signs inconsistently across countries as opposed to Jhpiego safe motherhood guideline (Jhpiego 2004), they found a positive association between women's knowledge of obstetric danger signs and ANC counselling (Assaf 2018, Lori et al. 2017, Mullany et al. 2009, Mutiso et al. 2008). The more the danger signs were described to women, the more the women were able to recall and recognise danger signs (Mutiso et al. 2008, Assaf 2018). Women often recognised danger signs, which they had discussed with a care provider during ANC visit or contact (Lori et al. 2017, Mullany et al. 2009, Mutiso et al. 2008). For example, compared to other obstetric danger signs, vaginal bleeding was among the most discussed and frequently recognised danger signs (Pembe et al. 2010). A comparable finding was reported in a clinical trial study from Iran which found that antenatal counselling increased women's active participation in improving their physical health to prevent disease, including managing their weight and improving nutrition (Gharachourlo et al. 2018). Another study on women's knowledge of iron and folic acid supplementation found that women's knowledge of iron and folic acid supplementation increased after they received antenatal counselling on iron and folic acid supplementation (Kamau et al. 2018). Another important finding in this review is the contribution of including husbands in ANC counselling for improved maternal health literacy (Mullany et al. 2009). Mullany et al. (2009) demonstrated that maternal health literacy increased more when husbands were involved compared to when husbands were not involved. This might have helped women share pregnancy ideas with their husbands. The literature shows that involving men in maternal healthcare services increases communication and joint decision-making between couples, resulting in a more positive pregnancy experience (Tokhi et al. 2018).

This systematic review found that a woman's knowledge of obstetric danger signs is higher if a woman has a history of previous multiple pregnancies (Anya et al. 2008). Multiple lifetime pregnancies may have contributed to a woman's increased maternal healthcare service uptake, including ANC. Moreover, a woman's repeated exposure to ANC counselling messages on obstetric danger signs may heighten awareness and facilitate the desired behavioural change (Anya et al. 2008). Evidence shows that prior utilisation of maternal health services, such as ANC and facility birth, is associated with increased knowledge of obstetric danger signs (Geleto et al. 2019).

2.6. Strength and limitations of the review study

A rigorous search strategy and the use of various databases led to the identification of research studies, of which 38 were deemed eligible, which involved a range of study designs across 23 LLMICs. This helped in the identification of various ANC counselling approaches that improved maternal health literacy, which may help the ministry of health in LLMICs take into account country contexts in designing interventions to improve ANC counselling and increase maternal health literacy. The following are the limitations of this review study. The review did not include grey literature and studies published in languages other than English. As a result, the review may have missed useful studies that could have provided additional insight into ANC counselling and health literacy. Most of the included studies were not based on national data; therefore, caution should be taken interpreting the findings.

2.7. Conclusion

While the findings of this systematic review highlighted various approaches to ANC counselling and that ANC guidelines appear to affect the provision of antenatal counselling, which in turn affects women's health literacy, contextual differences across countries are apparent. Women's knowledge of obstetric danger signs can be increased through ANC counselling approaches that use ANC guidelines. These ANC counselling approaches need to be scaled up to reach more women and tailored to local contexts. Additionally, ongoing staff development for ANC providers increases women's reception

of counselling on obstetric danger signs, subsequently increasing women's ability to recognise these signs and seek timely care. LLMICs need to strengthen ANC counselling by ensuring the availability and use of country-specific guidelines that conform to the WHO ANC guidelines. More research, such as quantifying the influence of contextual factors on ANC counselling in countries with high maternal health burdens, such as Ethiopia, is also needed to inform policymakers on best practises. Finally, two research questions emerged from the findings of the systematic review. These included the need to more closely examine the relationship between ANC guideline availability and provider training on the quality of counselling on obstetric danger signs and how this counselling improves women's knowledge and decision on where to give birth.

Chapter 3 Methods

This chapter describes the research questions, study objectives and the research methods employed to answer the research questions. Two related studies were conducted, each answering a specific research question using a distinct data analysis method. For both studies, an overview of study design, study setting, study population and data source is provided here, while the details of data analysis for each study are found in the consecutive chapters.

The research objectives were specified based on the research questions identified through systematic review research.

The research questions were:

1. Do the guidelines for ANC at the facility-level and ANC providers' uptake of ANC related refresher training affect ANC counselling on obstetric danger signs in Ethiopia?
2. Does ANC counselling influence the place where women decide to give birth in Ethiopia, and does maternal health literacy play a role in this?

3.1. Research objectives

The studies aimed to examine the effect of the availability of national ANC guidelines and the ANC providers' uptake of training on the provision of ANC counselling, as well as the relationship between ANC counselling, maternal health literacy, and women's decision where to give childbirth in Ethiopia.

Study 1 has two specific objectives. These are identifying:

- The effect of the availability of national ANC guidelines at the facility level on the provision of antenatal counselling in Ethiopia, and
- The effect of ANC providers' uptake of in-service training in the last 24 months on the provision of antenatal counselling in Ethiopia.

Similarly, study 2 was undertaken to:

- Examine the influence of antenatal counselling on women's decision where to give birth in Ethiopia.
- Investigate whether maternal health literacy (knowledge of obstetric danger signs) mediates ANC counselling and women's decision on a place where to give birth in Ethiopia.

3.2. Study design, study setting, and data source

The research employed a cross-sectional study design in Ethiopia. Ethiopia is an SSA country located on the horn of Africa. Ethiopia is the second most populous country in Africa after Nigeria, with an estimated 109 million people in 2019 (The World Bank 2019). The country has 11 regional states. Of the 11 regional states, Sidama regional state (borkena 2020) and South West Ethiopia Peoples' regional state (Ethiopia News Agency 2021), are the two newly formed states that were previously part of the Southern Nations, Nationalities and People's (SNNP) regional state (FMOH 2015). The majority of the regional states are further divided into zones, while city and zonal administrations are divided into *woredas* (districts) and *kebeles*. Kebeles are the smallest administrative units encompassing at least 5,000 people (FMOH 2015).

Both research studies involved a secondary data analysis. The studies draw on the 2014 Ethiopia health provision assessment plus (ESPA+) data. The 2014 ESPA+ is the first nationally representative facility-based survey on maternal and child health, which also includes tuberculosis (TB), malaria, human immune-deficiency virus (HIV) and sexually transmitted infections (STIs). The survey was designed to assess the performance of health facilities rendering maternal, child, and reproductive health services and services on STIs, TB and malaria. The Ethiopian Public Health Institute (EPHI) conducted the survey with technical support from the World Bank, International Classification of Function Disability and Health and the Monitoring and Evaluation to Assess and Use Results Demographic and Health Surveys Project of the World Bank (EPHI et al. 2014).

The 2014 ESPA+ survey used four data collection instruments: facility inventory questionnaires, provider interview questionnaires, client exit interviews, and observation checklists of client-provider interactions. Facility inventory questionnaires were used to collect data on the availability of services, medicines, infrastructures, and supplies. Healthcare provider interview questionnaires were used to collect data on the service environment, practices, and the healthcare providers' perspectives (experiences and qualifications). Data on to what extent the provider applied the accepted standards of care were collected by observing service provision. The client exit interview was used to collect data on the quality of the client-provider interaction (EPHI et al. 2014).

The 2014 ESPA+ survey included a total sample of 1,327 health facilities in Ethiopia. A list of 23,102 health facilities was obtained from the Federal Ministry of Health during the survey period. The list included: 202 hospitals, 3,292 health centres, 15,618 health posts, and 3,990 private clinics (higher clinics, medium clinics, and lower clinics). The survey included all hospitals from the list and newly established hospitals, while representative samples from the remaining healthcare facilities were taken. It should be noted that the 2014 ESPA+ report did not indicate a specific sampling method. A total of 1,902 pregnant women who received ANC were included in the survey (EPHI et al. 2014).

3.3. Study population and sample size

In both research studies, the study population were pregnant women who received ANC from hospitals, health centres, lower clinics, medium clinics, and higher clinics. Figure 4 provides an overview of the sample size and selection process.

The sample size was determined after excluding pregnant women who did not meet the inclusion criteria. In both studies, 49 pregnant women who refused the client-exit interview, and 25 pregnant women who attended health posts, the lowest health facilities at the primary healthcare level staffed with health extension workers (Assefa et al. 2019) who are not skilled attendants, as defined by the WHO (WHO 2018), were

excluded. In addition, pregnant women with incomplete data on selected study variables were excluded, and this differed in each study depending on the study variables.

The first study examined the influence of the facility-level ANC guidelines and the ANC providers' uptake of refresher training on obstetric danger signs counselling for women. The study included 1,725 women in the analysis. Of the 1,828 pregnant women who attended health facilities and volunteered for the client-exit interview, excluding those who visited health posts, 103 were excluded. Those who were not included were two women who were not observed while receiving ANC counselling on obstetric danger signs and 101 women who had missing values in one or more study variables.

Study 2 investigated whether ANC counselling on obstetric danger signs affects women's decision on where to give birth and the mediating role of maternal health literacy. The analysis of this study included 1,006 pregnant women who met the inclusion criteria. Firstly, two pregnant women who were not observed while receiving ANC counselling on obstetric danger signs were excluded among pregnant women who received ANC in health facilities, excluding health posts, and participated in the client-exit interview. Secondly, one woman who had a missing value on women's decision on where to give birth was excluded. Thirdly, 776 women who were not asked whether they knew obstetric danger signs (knowledge of obstetric danger signs is a mediating variable in this study) were excluded. In the end, 43 women with missing values in the study variables were excluded.

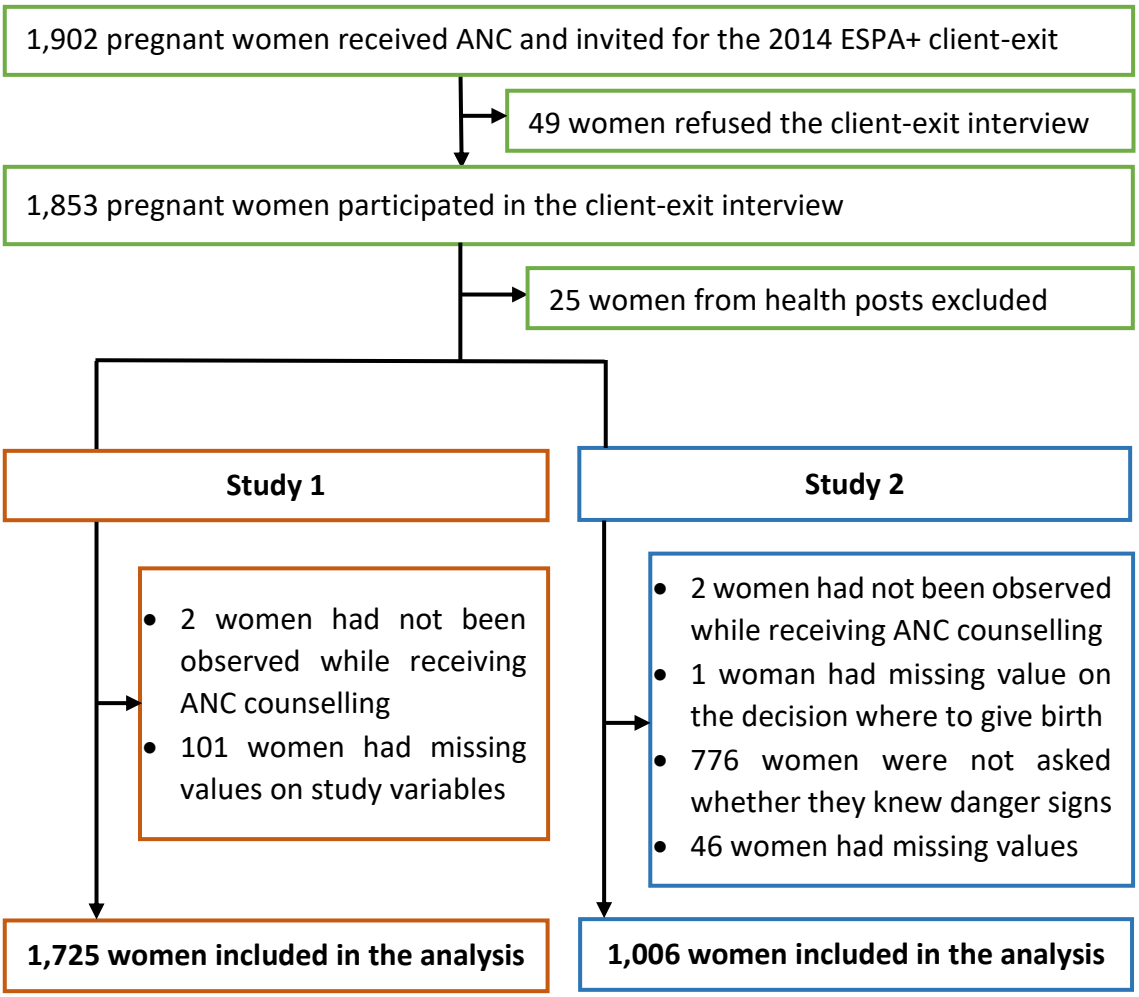


Figure 4 Sample size and selection process

3.4. Outcome variables

Counselling on obstetric danger signs: When a pregnant woman received information on seven obstetric danger signs and on any danger signs during pregnancy. This was measured using the 2014 ESPA+ observation checklist stating, "Record whether the provider counselled the client on the danger signs". The checklist included the following eight danger signs: vaginal bleeding, fever, blurred vision and severe headache, swollen face or hands, tiredness or breathlessness, reduced or absence of foetal movement, cough or difficulty breathing, and any other symptoms or problems the client thinks might be related to this pregnancy. Each obstetric danger received a score of 1 if a

woman was counselled about it, otherwise a score of 0. Summing the obstetric danger signs yielded a score ranging from 0 to 8, indicating the number of obstetric danger signs that a woman was counselled about. The value 0 indicates a woman received no counselling, and the value 8 indicates a woman received counselling on eight obstetric danger signs.

Women's decision on a place where to give birth: This was based on the 2014 ESPA+ client-exit interview questionnaire stating, "*Have you decided where you will go for the delivery of your baby*?". The response options for this question were: '*Yes, at this health facility*', '*Yes, at another health facility*', '*Yes, at home*', '*Yes, at traditional birth attendant's (TBAs) home*', '*Yes, other location*', and '*No/Do not know*'. This was dichotomised into 'at a health facility' and 'at a non-health facility'. At a health facility means if women responded as: 'Yes, at this health facility' and 'Yes, at another health facility'. At a non-health facility means if women responded as: 'Yes, at home', 'Yes, at traditional birth attendant's (TBAs) home', 'Yes, other location, and No/Do not know'.

3.5. Independent variables

Maternal health literacy or Knowledge of obstetric danger signs: This was measured by using the client-exit interview stating, "*Please tell me any signs of complications (danger signs) that you know of*". Obstetric danger signs recognised by women were summed to create a score ranging from 0 to 8. The value of 0 indicates a woman knew none of the obstetric danger signs, and the value of 8 indicates a woman knew eight obstetric danger signs.

National ANC guidelines: ANC guidelines are any country-context standardised guides on ANC aimed to aid the provider in ANC service provision. This was measured using the 2014 ESPA+ inventory 'Yes' 'No' question to a provider stating, "*Do you have the national ANC service guidelines available in this service area today?".*

ANC providers' receipt of ANC related refresher training: This was measured by 'Yes' 'No' question in the 2014 ESPA+, which asked a provider, "*As a provider of ANC services, have you personally received any training in ANC any time in the past 24 months?*".

Socio-demographic characteristics: included the women's age in years and school attendance.

Obstetric history: included gestational age (measured in weeks or classified into three trimesters), number of ANC visits or contacts for the current pregnancy, and number of pregnancies.

Health facility characteristics: included health facility type (hospitals, health centres, lower clinics, medium clinics, and higher clinics), managing authority (public and private), facility location (urban and rural), availability of health management information system (HMIS) and ANC guidelines, facility's reception of supervision at different levels (federal, regional, zonal and district levels), and presence of management meeting.

Healthcare provider characteristics: provider sex (male or female), profession, and reception of ANC related refresher training.

3.6. Data processing

Data processing was carried out using the statistical package for social sciences (SPSS) for windows version 27 (IBM Corp 2020). The 2014 ESPA+ has three datasets organised as facility inventory (which consisted of data on facility characteristics), client exit interview and observation (consisted of data on client characteristics and performance of ANC consultation), and provider dataset (consisted of data on the providers' characteristics). These datasets were merged by using facility identification. Data specific to ANC were extracted, whereas data related to child health and family planning

and variables of no importance in the current research studies were excluded before exporting the data into Stata for further analysis.

3.7. Data analysis

The data analyses were done using Stata software for windows, versions 16 IC and 17 BE (StataCorp 2021, StataCorp LLC 2020). Two types of statistical analysis methods were used, both involving descriptive and inferential statistic computations. These included propensity score matching (PSM) analysis and generalised structural equation modelling (GSEM) analysis.

Propensity score matching (PSM) analysis

The PSM method of data analysis was used in study 1 to investigate the effect of national ANC guidelines and the providers training on ANC counselling of women on obstetric danger signs. While counselling women on obstetric danger signs was an outcome variable, facility-level national ANC guidelines and providers' receipt of ANC related refresher training were treatment variables.

The 2014 ESPA+ data was non-experimental in its design. Estimating unbiased treatment effect using non-experimental data requires selecting study subjects with similar baseline characteristics and assigning them to treatment and control groups.

The PSM enables the creation of a sample of two groups (treatment and control) from such observational data by reducing the dimensionality of the covariates to a one-dimensional propensity score. It is used to estimate the difference in the outcome variable between the treatment and control groups that is not attributed to the confounders (Brookhart et al. 2006).

For study participants *i*, (*i*=1,…,N) being assigned to treatment (Z=1) or control (Z=0) given a vector of observed covariates x_i, the conditional probability of an individual's assignment to treatment 1 is expressed as:

$$e(xi) = Pr\ (Zi = 1|xi) \quad \text{(Rosenbaum and Rubin 1983).}$$

Logistic regression was used to calculate the propensity score as follows:

$$log\ \frac{e(xi)}{1 - e(xi)} = log\ \frac{Pr(Zi = 1|xi)}{1 - \Pr(zi = 1|xi)} = \alpha + \beta xi$$

Where:

$$e(xi) = \beta 0 + x1\beta 1 + x2\beta 2 + \cdots + xn\beta n$$

β0 is the intercept and β1, β2,…βn are the regression coefficients for x1, x2,…xn variables, respectively (Rosenbaum and Rubin 1983, Thavaneswaran and Lix 2008).

There are four types of propensity score methods (Austin 2011). These are matching on the propensity score, stratification or sub-classification, inverse probability of treatment weighting using the propensity score, and covariate/regression adjustment using the propensity score (Austin 2011).

1. Matching: The treatment and control subjects are matched based on the estimated propensity score. This method is used when there is a larger number of study participants in the control group than in the treatment group. It eliminates subjects who cannot be matched.
2. Stratification: Study participants are classified into homogenous subgroups (strata) with similar propensity scores using the estimated propensity score, and each subgroup (stratum) has the same number of study participants. The study participants who were treated and those who were not treated are then compared. The treatment effect in each stratum is estimated and then combined to get the overall treatment effect. Usually, five strata are used to avoid up to 90% of the covariate bias. When there are more covariates, there are more

strata, making this method cumbersome and challenging to compare treated and untreated groups.

3. Regression/covariate adjustment: The propensity score is included as a covariate in a regression model to adjust for estimating treatment effects. The treatment and the propensity scores are considered as independent variables. This method requires a substantial overlap between the treated and control groups.
4. Weighting: The weight of the treated study participant is equal to one divided by the calculated propensity score, expressed as:

$$wi = \frac{1}{e(xi)}$$

and the weight of the control study participant is the inverse of one minus the calculated propensity score, which is expressed as:

$$wi = \frac{1}{1 - e(xi)}$$

Weighting is unrealistic if the propensity score is close to zero or one.

Among the methods of adjustment described above (Austin 2011), matching has been considered as the most statistically efficient method of integrating propensity scores for observational studies (Rosenbaum and Rubin 1983). The current study applied a one-to-one with the nearest neighbourhood matching (Austin 2011).

In estimating the propensity score, variables that are more likely to be related to the outcome variable (provision of counselling on obstetric danger signs) but less likely to be related to the exposure variable (availability of national ANC guideline and ANC provider(s) who took a refreshment training on ANC in the last 24 months) were selected to increase the precision of the estimated effect of the exposure variable (Brookhart et al. 2006). Bergstra et al. (2019) has suggested that including variables that are only related to the exposure but unrelated to the outcome variable leads to imprecise estimation and should therefore not be included in a propensity score estimation. Identifying variables related to the exposure and outcome variables in this study was done based on the prior knowledge from the literature described in chapter two.

The PSM has two assumptions. The first assumption is that the distribution of the observed covariates in the treated group should overlap with that of the control group (Arpino and Mealli 2011, Dugoff et al. 2014). The second assumption is unconfoundedness, or that treatment status is independent of the outcomes of the observed covariates (Arpino and Mealli 2011, Dugoff et al. 2014). However, testing this assumption directly is difficult. Rosenbaum's sensitivity analysis method is an indirect approach to testing this assumption (Becker and Caliendo 2007, Rosenbaum 2002). In matched groups, the effect of the treatment is the estimated difference of outcome variable between the treatment and control groups that is not attributed to the confounders (Brookhart et al. 2006).

Table 1 Covariates included in PSM to estimate the effect of ANC guidelines and ANC providers' training on ANC counselling

Variables	Categories
1. Client related variables	
Age in years	[1] 15-20
NB: *Age was in the continuous form to estimate the effect of provider training on counselling*	[2] 21-25
	[3] 26-30
	[4] >=31
School attendance	[1] Yes [0] No
2. Obstetric history	
Trimester	[1] First trimester
NB: *It was in the continuous form to estimate the effect of provider training on counselling*	[2] Second trimester
	[3] Third trimester
ANC visit number	[1] First visit [0] Re-visit
Number of pregnancies	[1] First pregnancy
	[0] Not first pregnancy
3. Facility related variables	
Facility location	[1] Urban [0] Rural
Facility type	[1] Hospital or Health Centre [0] Clinic
Managing authority of the facility	[1] Government
	[0] Other than government
Zonal level supervision	[1] Yes [0] No
Health information system available	[1] Yes [0] No
4. ANC provider related variables	
Profession	[1] Nurse or Midwife [0] Others

Generalised structural equation modelling (GSEM)

The GSEM was employed to investigate the relationship between ANC counselling, maternal health literacy and women's decision on a place where to give birth. The GSEM is a statistical modelling approach that combines regression and path analysis to estimate each independent variable's direct and indirect effects on the outcome variable. It examines the causal relationship between variables by constructing a model consisting of variables connected to each other by arrows or paths and estimates the coefficient for each path (Lombardi et al. 2017, VanderWeele 2015). Sewall Wright (1920), a geneticist, introduced this method in the 1920s while examining the relative effects of inheritance and environment on the colour pattern of Guinea-Pigs. The GSEM allows examining a variable as both dependent and independent, in contrast to multiple regression, which only allows examining a variable as a dependent or independent at a time. In GSEM, two or more regressions are modelled simultaneously. As a result, a dependent variable in one regression model can be an independent variable in another model included in GSEM. In statistical language, such variables are referred to as indigenous and exogenous variables (Hasanzadeh et al. 2019, Stata 2017).

In examining the direct and indirect influence of ANC counselling of women on obstetric danger signs on women's decision where to give birth and the mediating role of maternal health literacy, two regressions were involved in the GSEM. The structural model, which included exogenous, endogenous, and outcome variables, was first built for the GSEM analysis, and then the path coefficients were estimated. Exogenous variables included women's characteristics, obstetric history, health facility characteristics, provider characteristics, and ANC counselling. Maternal health literacy was an endogenous variable, and women's decision on where to give birth was the outcome variable (Ensor et al. 2013, Jansen et al. 2018, Kindig et al. 2004, Owili et al. 2017, Wu et al. 2019).

3.8. Ethics

Initially, a research protocol describing the details of the study aims and data analysis was prepared. The protocol was then submitted to the Ethiopian Public Health Institute (EPHI) along with a letter asking permission to access the 2014 ESPA+ data. The EPHI reviewed the research protocol and granted a letter of approval (EPHI 6.13/895), dated 22 October 2020, to access the 2014 ESPA+ data. In addition, The UTS Human Research Ethics Committee reviewed the protocol and granted a low-risk ethics approval (ETH194127). No personal identification was accessed from the ESPA+ data. ESPA+ survey was conducted after obtaining informed consent from the person in charge in the facility for inventory questionnaire, from providers for provider interview questionnaire and observation, and from clients for client-interview and observation checklists.

In summary, chapter 3 provided an overview of the research questions, the study objectives, and the research methods used to answer the research questions. Details of the research methods used to answer each research question are included in the next two chapters (Chapters 4 and 5). The following chapter provides findings of an analysis of Ethiopian data examining the influence of ANC guidelines and providers' training on ANC counselling of women on obstetric danger signs.

Chapter 4 The effect of national antenatal care guidelines and provider training on obstetric danger sign counselling

This chapter presents the research findings on the effect of national ANC guidelines and ANC provider in-service training uptake on ANC counselling in Ethiopia. The evidence on the importance of ANC counselling to improve maternal health in LLMICs is presented in the background section. The extent to which national ANC guidelines and provider training can increase obstetric danger signs counselling is presented and discussed. This study has been published in BMC Reproductive Health journal.

Yeneabat, T., Hayen, A., Getachew, T. & Dawson, A. 2022, 'The effect of national antenatal care guidelines and provider training on obstetric danger sign counselling: a propensity score matching analysis of the 2014 Ethiopia service provision assessment plus survey', *Reproductive Health,* 19 (132). *10.1186/s12978-022-01442-6.*

4.1. Abstract

Background: Most pregnant women in low and lower-middle-income countries do not receive all components of antenatal care (ANC), including counselling on obstetric danger signs. Facility-level ANC guidelines and provider in-service training are major factors influencing ANC counselling. In Ethiopia, little is known about the extent to which guidelines and provider in-service training can increase the quality of ANC counselling.

Methods: We examined the effect of national ANC guidelines and ANC provider in-service training on obstetric danger sign counselling for pregnant women receiving ANC using the 2014 Ethiopian service provision assessment plus (ESPA+) survey data. We created two analysis samples by applying a propensity score matching method. The first sample consisted of women who received ANC at health facilities with guidelines matched with those who received ANC at health facilities without guidelines. The second sample consisted of women who received ANC from the providers who had undertaken in-service training in the last 24 months matched with women who received ANC from untrained providers. The outcome variable was the number of obstetric danger signs

described during ANC counselling, ranging from zero to eight. The covariates included women's socio-demographic characteristics, obstetric history, health facility characteristics, and ANC provider characteristics.

Results: We found that counselling women about obstetric danger signs during their ANC session varied according to the availability of ANC guidelines (61% to 70%) and provider training (62 % to 68%). After matching the study participants by the measured covariates, the availability of ANC guidelines at the facility level significantly increased the average number of obstetric danger signs women received during counselling by 24% (95% CI: 12% - 35%). Similarly, providing refresher training for ANC providers increased the average number of obstetric danger signs described during counselling by 37% (95% CI: 26% - 48%).

Conclusion: The findings suggest that the quality of ANC counselling in Ethiopia needs strengthening by ensuring that ANC guidelines are available at every health facility and that the providers receive regular ANC related in-service training.

Plain English Summary

Maternal death from preventable pregnancy-related complications remains a global health challenge. In 2017, there were 295,000 maternal deaths worldwide, and about two-thirds of these deaths were from Sub-Saharan Africa. Ethiopia is a Sub-Saharan African country with 401 maternal deaths per 100,000 live births in 2017, and this rate is higher than the target indicated in sustainable development goals. Most maternal deaths are due to obstetric complications and could have been averted through early detection and treatment. Providing antenatal care counselling about obstetric danger signs enhances women's awareness of obstetric complications and encourages women to seek treatment from a skilled care provider. However, most women from low-income settings, including Ethiopia, do not receive counselling about obstetric danger signs. Facility-level antenatal care guidelines and provider in-service training improve antenatal care counselling. In Ethiopia, little is known to what extent antenatal care

guidelines and provider training increase counselling on obstetric danger signs. The present study used the 2014 Ethiopian service provision assessment data and estimated the effect of antenatal care guidelines and provider training on counselling about obstetric danger signs. The analysis involved a propensity score matching method and included 1,725 pregnant women. The study found that antenatal care guidelines at health facilities and antenatal care provider in-service training significantly increase counselling on obstetric danger signs by 24% and 37%, respectively. The finding suggests improving the quality of antenatal care counselling in Ethiopia needs antenatal care guidelines at each antenatal care clinic and refresher training for the providers.

4.2. Background

Maternal death, the death of a woman while pregnant, during childbirth, or within 42 completed days of termination of pregnancy (WHO 1977), remains a global health challenge (WHO 2019b, 2021). It has a negative effect on infant and child survival, the well-being of the family and society, and the country's socio-economic development by increasing health costs and reducing productivity (Machiyama et al. 2017, Moucheraud et al. 2015, Zhou et al. 2016). As a result, improving maternal health and reducing maternal mortality are key to achieving sustainable development goals (SDGs). Sustainable development goal target 3 includes reducing the maternal mortality ratio to less than 70 per 100,000 live births by 2030 (UN 2017, WHO 2015a, 2019a).

Between 2000 and 2017, there was a 38% decline in the global maternal mortality ratio (MMR). In 2017 there were 295,000 maternal deaths, with an estimated 211 maternal deaths per 100,000 live births. This rate is higher than the SDG target. About 94% of these maternal deaths were from low-income countries. Sub-Saharan Africa (SSA) alone had 196,000 maternal deaths, accounting for nearly two-thirds of the global maternal deaths (UN 2017, WHO 2019b, 2021). Ethiopia is an SSA country where maternal deaths have remained very high, particularly between 2000 and 2011. There were 871, 673 and 676 maternal deaths per 100,000 live births in 2000, 2005 and 2011, respectively (CSA [Ethiopia] and ORC Macro 2001, CSA [Ethiopia] and ICF International 2012, CSA

[Ethiopia] and ORC Macro 2006). As a result, the Ethiopian Ministry of Health has prioritised maternal health. The Ministry of Health launched the health sector development program (HSTP) in 2015 that outlined strategies to provide quality healthcare (FMOH 2015). The main focus of the HSTP is to ensure universal health coverage by strengthening primary healthcare (FMOH 2015), including training and deploying community health extension workers (Assefa et al. 2019). As a result, the country has made remarkable progress in reducing MMR from 676 in 2011 to 412 in 2016 (CSA/Ethiopia and ICF 2017). A recent report indicated that MMR in Ethiopia was 401 in 2017 (WHO 2021), which has declined by slightly more than half compared to 871 in 2000 (CSA [Ethiopia] and ORC Macro 2001). However, the current MMR in Ethiopia is considerably high as it surpasses the SDGs target of no more than 140 maternal deaths per 100,000 live births, and interventions need to be scaled up to avert preventable maternal deaths (UN 2017, WHO 2015a).

Most maternal deaths are preventable through quality healthcare services, such as ANC (WHO 2021). For example, up to half of all maternal deaths can be prevented through ANC that provides comprehensive counselling on obstetric danger signs and facilitates the early detection and timely management of pregnancy-related complications and other pre-existing health problems (Assaf 2018, Kruk et al. 2018, Rosado et al. 2019, Sarker et al. 2010, WHO 2021). Improving pregnancy outcomes requires a pregnant woman to commence her first ANC contact at or before 16 weeks of gestation and to receive the recommended components of care, including ANC counselling on obstetric danger signs that enhance risk identification (Hodgins and D'Agostino 2014, Lattof et al. 2020, WHO 2016b). ANC counselling on obstetric danger signs enhances a woman's awareness of obstetric complications and encourages treatment-seeking from a skilled care provider during pregnancy, childbirth and postpartum (WHO 2007).

Studies showed that ANC counselling, an interaction between the ANC provider and a woman and her family involving the exchange of information providing support (WHO 2013), regarding pregnancy-related topics, such as obstetric danger signs, improves maternal health literacy about obstetric complications contributing to women's

decision to seek timely treatment (Yeneabat et al. 2022, Under review), skilled birth attendance (Soubeiga et al. 2014) and postpartum family planning (Adanikin et al. 2013, Tafere et al. 2018). An example of an interactive ANC counselling approach is group ANC (GANC), a method of pregnancy care that provides eight to 12 women the opportunity to share their pregnancy and childbirth life experiences and learn from peers and the care provider. GANC has been found to enhance a woman's awareness of obstetric danger signs (Lori et al. 2017, Patil et al. 2013, Patil et al. 2017). However, most women do not receive ANC counselling on obstetric danger signs (Duysburgh et al. 2013, Pembe et al. 2010, Phommachanh et al. 2019b, Sarker et al. 2010, Timša et al. 2015). ANC counselling in some low and lower-middle-income countries is as low as 13% (Yeneabat et al. 2022, Under review). In Ethiopia, only 45% of women who received ANC were counselled on obstetric danger signs (CSA/Ethiopia and ICF 2017).

Factors relating to a woman's demand for healthcare and the supply of health services can influence the quality of ANC counselling. Examples of demand-related factors include a woman's educational level (Okawa et al. 2019) and the number of ANC contacts she has (Anya et al. 2008, Duysburgh et al. 2013). Supply related factors are primarily human and material resources (Assaf 2018, Defar et al. 2020, Leslie et al. 2017, Phommachanh et al. 2019a, WHO 2007, 2016b). However, the lion's share of factors influencing quality ANC counselling are facility-level ANC guidelines and ANC provider uptake of in-service training (Jennings et al. 2010, Lori et al. 2017, Oka et al. 2019, Perreira et al. 2002).

The importance of ANC guidelines and provider in-service training in improving ANC counselling on obstetric danger has been reported in studies from Benin (Jennings et al. 2010), Guatemala (Perreira et al. 2002) and Tanzania (Oka et al. 2019). In Ethiopia, however, little is known to what extent guidelines and in-service training increase ANC counselling on obstetric danger signs. Therefore, the present study aimed to answer the research question "Does the availability of national ANC guidelines at the facility level and ANC in-service training in the last 24 months affect antenatal counselling on obstetric danger signs?". The study estimates the extent to which the availability of

facility-level national ANC service guidelines and trained ANC providers can increase ANC counselling on obstetric danger signs in Ethiopia.

4.3. Methods

Study design and data source

This is a cross-sectional study based on a secondary data analysis of the 2014 Ethiopian service provision assessment plus (ESPA+) survey data (EPHI et al. 2014). The 2014 ESPA+ was the first nationally representative facility-based survey on the performance of health facilities in Ethiopia. The 2014 ESPA+ survey utilised four data collection instruments: facility inventory questionnaires, provider interview questionnaires, client exit interviews, and observation checklists of client-provider interactions. Facility inventory questionnaires were used to collect data on the availability of services, medicines, infrastructures, and supplies. The provider interview questionnaires were used to collect data on the service environment and the healthcare provider's practices and perspectives (experiences and qualifications). Observation checklists were used to assess the extent to which the provider applied the accepted standards of care. The client exit interview questionnaires were used to collect data on the quality of client-provider interaction (EPHI et al. 2014).

Sample size and selection process

The 2014 ESPA+ survey data involved 1,902 women receiving ANC at 1,327 health facilities (EPHI et al. 2014). We excluded 177 women from the analysis for the following reasons (see Figure 5). Forty-nine women refused to participate in the client-exit interview. Twenty-five women attended health posts, the lowest health facilities at the primary healthcare level staffed with health extension workers (Assefa et al. 2019) who are not skilled attendants, as defined by the WHO (WHO 2018). Two women were not observed receiving ANC counselling on obstetric danger signs. One hundred one women had missing values in one or more study variables. Finally, we included 1,725 women in this analysis.

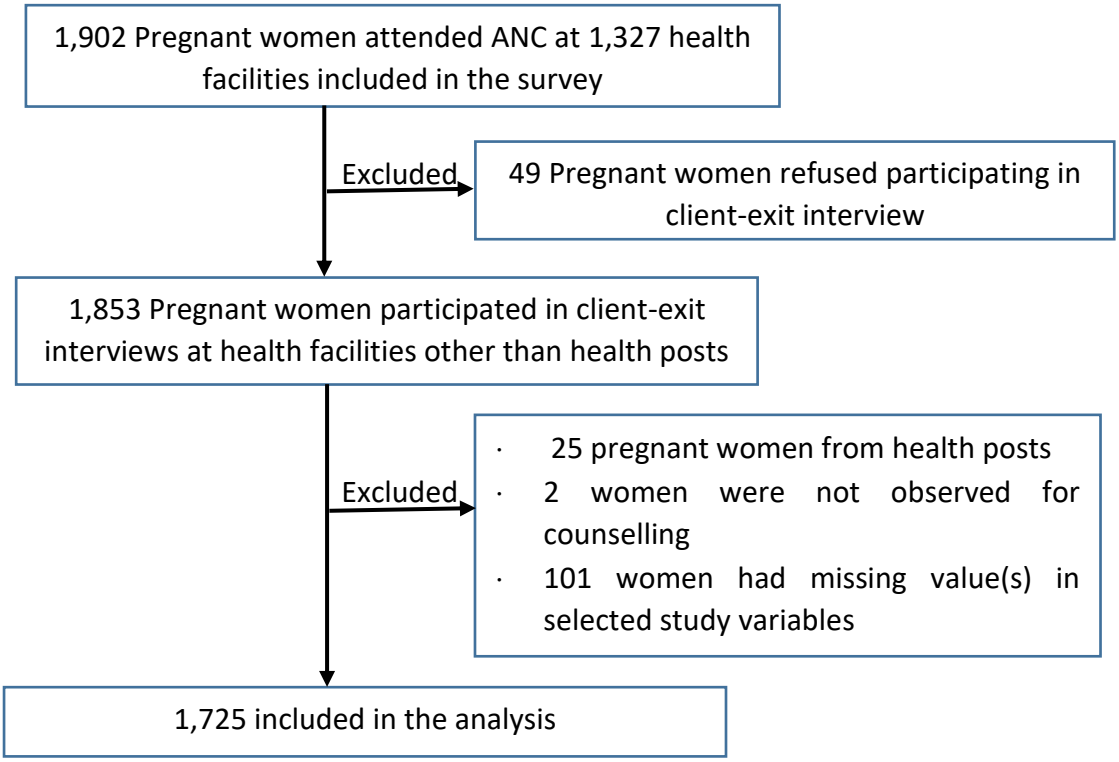


Figure 5 Sample selection process (unweighted sample)

Study variables

To illustrate the relationship between ANC guidelines and ANC provider training, quality counselling and its outcome, we constructed a conceptual framework (shown in Figure 6) based on a review of available literature (Villadsen et al. 2015, WHO 2016a). The improvement of ANC counselling in quantity and quality positively influences a woman's ability to recognise obstetric danger signs early and seek timely care (Assaf 2018, Lori et al. 2017). We defined quality ANC counselling in this study as the conversation an ANC provider has with a woman concerning problems that could arise during pregnancy, childbirth and the postpartum period, as recommended by WHO (WHO 2016b), and what the woman should do if she experiences these. This includes counselling each woman on obstetric danger signs, the importance of nutrition during pregnancy and following childbirth, childcare and breastfeeding, and family planning. While the quantity of ANC can be defined in terms of timing and the number of visits, it can vary depending on contextual differences (Rowe et al. 2020). For example, the 2016 WHO

ANC guideline recommends a minimum of eight ANC contacts (WHO 2016b), whereas the recommended minimum number of ANC visits in Ethiopia is four (FMOH 2015). It is beyond the scope of the present study to focus on the quantity of ANC. The present study only focuses on the relationship between ANC counselling and the availability of ANC guidelines and provider training. The relationship between ANC counselling, maternal health literacy and women's decision to give birth at a health facility is addressed in another study (the results not provided). Guidelines can be defined as "systematically developed statements to assist practitioner and patient decisions about appropriate healthcare for specific clinical circumstances" (IOM 1990, p. 8). ANC guidelines are protocols that included details on managing common problems during pregnancy.

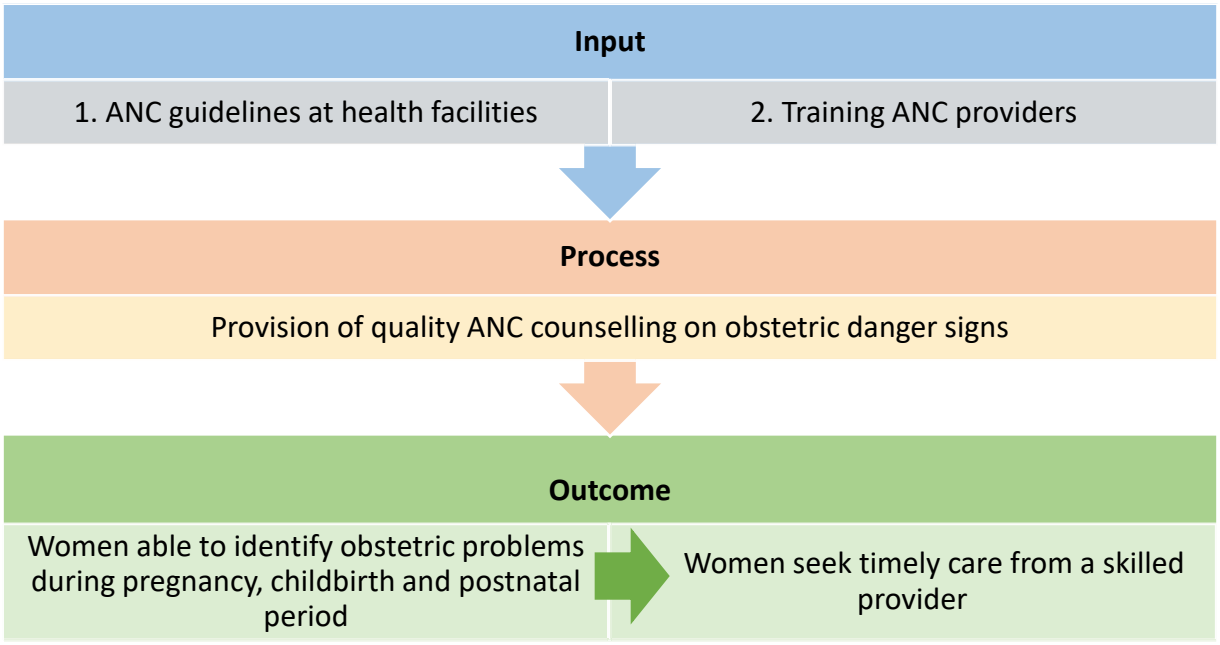


Figure 6 Conceptual framework of the relationship of national ANC guidelines and ANC provider uptake of training with quality ANC counselling and outcomes

Counselling on obstetric danger signs for pregnant women during ANC was an outcome variable measured using data from an observation checklist that recorded if the ANC provider counselled each pregnant woman on each obstetric danger. The 2014 ESPA+ survey observation checklist included seven obstetric danger signs (vaginal bleeding,

fever, blurred vision and severe headache, swollen hands and face, reduced or absence of foetal movement, difficulty breathing, and convulsion/ loss of consciousness). In addition, the checklist used the statement "*Any other symptoms or problems the client thinks might be related to this pregnancy*" to address if each pregnant woman received counselling on any other pregnancy-related problems. A score of "1" was assigned to each obstetric danger sign if a woman was counselled; otherwise ", 0". Thus, the counselling score ranges from 0 to 8. The score represents the number of obstetric danger signs counselled for a woman (EPHI et al. 2014). Facility-level availability of ANC guideline (defined as 1 if it was available, otherwise 0) and ANC providers' uptake of in-service/a refreshment training on ANC in the last 24 months preceding the 2014 ESPA+ survey (defined as 1 if ANC provider took training, otherwise 0) are treatment variables. The covariates included women's age, educational level, and obstetric history (gestational age, number of ANC visits a woman had, and the number of lifetime pregnancy); health facility characteristics (health facility type, managing authority, and location); and healthcare provider characteristics (gender and profession) (Shown in Table 1).

Statistical analysis

Given the non-experimental nature of the 2014 ESPA+ survey data, the analysis involved a propensity score matching (PSM) method (Rosenbaum and Rubin 1983). Introduced in the early 1980s, the propensity score matching method is an approach to analyse the effect of an intervention in observational studies. Its use in observational studies mimics a randomised controlled trial, creating a sample of units or study population that received the treatment and comparable on all observed characteristics with a sample of units that did not receive the treatment. Its purpose is to balance the distribution of observed baseline characteristics between the treated or exposed and untreated or unexposed group (Austin 2011, Rubin 2001), and therefore to reduce bias due to confounding. This method allowed us to construct treatment and control group of pregnant women who are matched by their observed baseline characteristics for each treatment variable (i.e., (1) national ANC guidelines and (2) ANC providers' in-service

training). Then we estimated the effect of each treatment variable on the outcome variable (number of obstetric danger signs addressed in counselling) (Rosenbaum and Rubin 1983, Rubin 2001).

Steps involved in estimating propensity scores and the treatment effect

We calculated propensity scores for each treatment variable using Stata user-written command (psmatch2) (Leuven and Sianesi 2003). We used the logit model for each treatment variable to identify the probability of the study participants receiving treatment conditional on the observed covariates (the propensity score) (Caliendo and Kopeinig 2008).

Firstly, we identified the covariates to estimate the propensity score. The covariates included in the propensity score model were grouped into four categories: women's socio-demographic characteristics, (2) obstetric history, (3) health facility characteristics, and ANC provider characteristics (Table 1). The selection of these covariates was based on their relationship with the outcome variable (counselling on obstetric danger signs) (Garrido et al. 2014). Including the covariates that are related to the outcome variable and those that may or may not be related to the exposure variable provides a precise estimation of effect size (Bergstra et al. 2019). For example, women's age and educational level influence women's reception of counselling but do not influence the availability of national ANC guideline at a health facility (Duysburgh et al. 2013). Likewise, some healthcare provider characteristics such as profession may affect the ANC provider's reception of training and the performance in counselling but do not influence the availability of ANC guidelines (Duysburgh et al. 2013, Pembe et al. 2010). On the other hand, the characteristics of the health facility, such as being a public or a private health facility, may be related to the availability of national ANC guidelines and staff training (Defar et al. 2020). We identified the covariates through a systematic review of literature on ANC counselling and maternal health literacy in low and lower-middle-income countries (Yeneabat et al. 2022, Under review). We iteratively included the covariates in the propensity score model until we achieved an acceptable level of

balance (Garrido et al. 2014, Austin 2011) and excluded variables that showed unsatisfactory balanced property and variables which could be affected by the treatment (Ali et al. 2019, Brookhart et al. 2006, Garrido et al. 2014).

Secondly, we calculated the standardised difference in proportions and means to assess whether propensity score matching has removed the differences in observed baseline characteristics between treated and control groups (Austin 2009). We chose a maximum of 10% standardised differences in the means and proportions as criteria to define covariates are balanced between the treated and control study participants (Garrido et al. 2014).

Lastly, to determine the effects of treatment variables on the outcome variable, we chose the nearest neighbour one-to-one matching without replacement. The caliper distance of the propensity scores between the treated and control groups was set to be 0.01 and 0.002 for national ANC guideline and ANC provider training, respectively. While there is no consensus on the value of caliper distance (Allan et al. 2020), we decided on the width of the caliper by observing that the kernel density plots between the treated and control study participants are closely similar after matching (see Figures 7 and 8) while retaining the optimum sample (West et al. 2014).

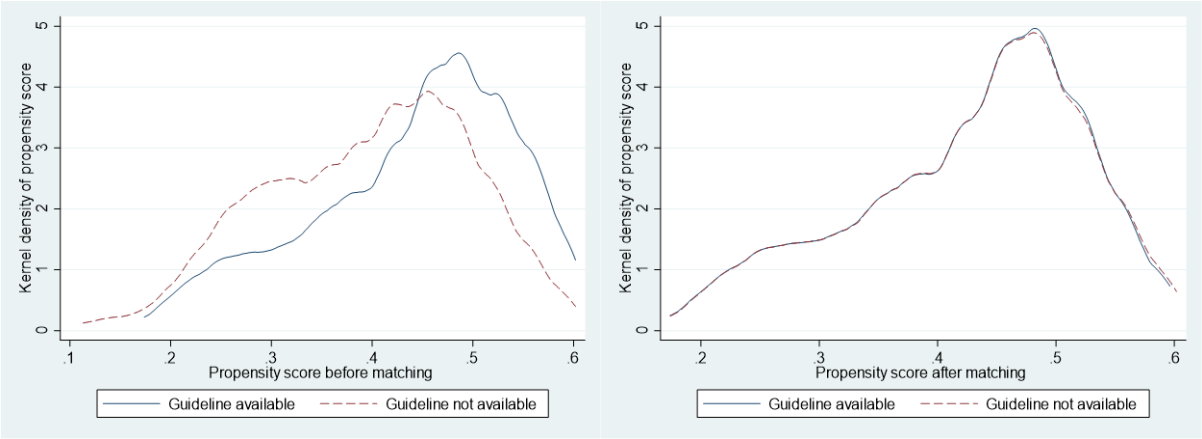


Figure 7 Kernel density of propensity score before and after matching for treatment ANC guideline

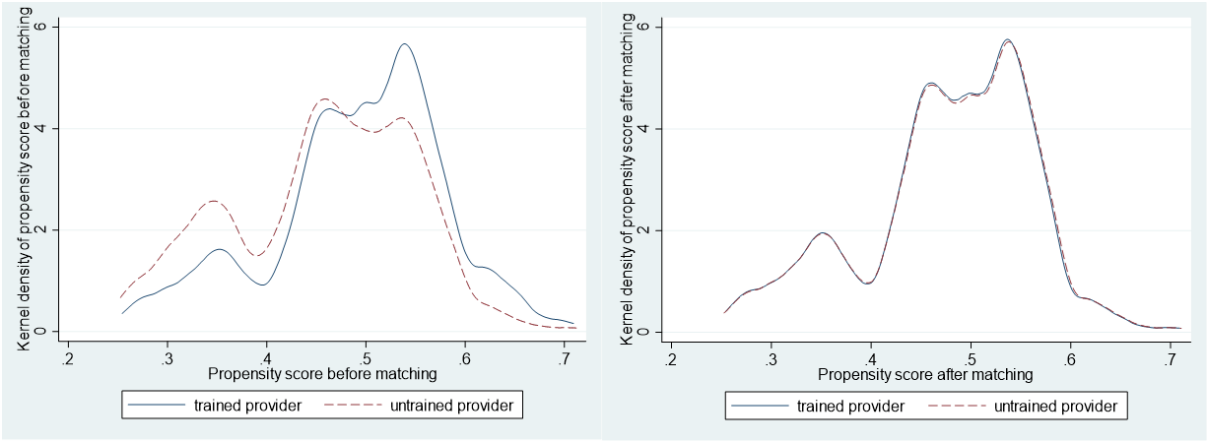


Figure 8 Kernel density of propensity score before and after matching for treatment providers' training

The smaller the width of the caliper, the closer the match between the treated and control groups despite an increased drop in the sample (Choi et al. 2019). The results are reported according to reporting guidelines on PSM (Yao et al. 2017).

4.4. Results

Of the 1,725 pregnant women included in the analysis, 713 (41.5%) attended ANC at health facilities with national ANC guidelines, and 815 (47.3%) received ANC service from

a provider who took ANC related in-service training in the last 24 months preceding the ESPA+ survey 2014.

National ANC guideline and ANC counselling

The nearest one-to-one matching without replacement yielded 1,274 samples comprised of 637 women who received ANC at health facilities with national ANC guidelines (treated) and 637 women who received ANC at health facilities with no national ANC guideline (control).

We found that the absolute value of the calculated standardised difference in means and proportions of each variable after matching is less than 10%, indicating the presence of a balanced match on the observed baseline characteristics between treated and control groups.

Table 2 shows that most study participants were aged between 21 to 25 years and were in the third trimester. About two-thirds of the study participants attended school. Slightly more than one-third were pregnant for the first time, about 58% were in the third trimester, and less than half of them attended ANC for the first time.

Table 2 Comparison of the standardised differences of baseline characteristics before and after matching for facility-level availability of the national ANC guideline

Variable	Unmatched / Matched	Per cent (%) Treated	Per cent (%) Control	Bias (%)	Reduced bias (%)	t-test t	t-test p
Age category in years:	Unmatched						
15-20		21.1	25.3	-10.0	88.9	-2.04	0.042
	Matched	23.5	24.0	-1.1		-0.20	0.844
21-25	Unmatched	33.0	31.0	4.3	-55.7	0.89	0.376
	Matched	34.5	31.4	6.7		1.19	0.234
26-30	Unmatched	34.1	30.2	8.4	0.1	1.73	0.085
	Matched	28.7	32.7	-8.3		-1.52	0.129
>=30	Unmatched	11.7	13.5	-5.2	26.9	-1.05	0.293
	Matched	13.2	11.9	3.8		0.68	0.499
Ever attended school	Unmatched	71.7	66.5	11.3	78.9	2.30	0.021
	Matched	69.5	68.4	2.4		0.42	0.672
Gestational age:							
First trimester	Unmatched	7.3	5.7	6.2	79.5	1.28	0.200
	Matched	5.7	5.3	1.3		0.25	0.806
Second trimester	Unmatched	35.7	37.2	-3.2	-50.6	-0.66	0.507
	Matched	35.3	37.7	-4.9		-0.87	0.383
Third trimester	Unmatched	57.1	57.0	0.1	-6040.7	0.01	0.989
	Matched	59.0	57.0	4.1		0.74	0.461
First-time pregnancy	Unmatched	33.7	33.9	-0.6	-698.4	-0.13	0.899
	Matched	36.6	34.2	5.0		0.88	0.380
ANC visit is first	Unmatched	44.3	47.1	-5.6	55.0	-1.15	0.252
	Matched	44.1	45.4	-2.5		-0.45	0.652
Facility is urban	Unmatched	83.4	70.7	30.4	97.5	6.12	0.000
	Matched	81.3	81.0	0.8		0.14	0.886
The facility owner is government	Unmatched	87.1	82.4	13.3	50.5	2.68	0.007
	Matched	85.9	88.2	-6.6		-1.25	0.211
Facility is hospital or health centre	Unmatched	97.1	95.6	7.6	55.8	1.53	0.127
	Matched	96.9	97.5	-3.4		-0.68	0.499
Facility is supervised at the zonal level	Unmatched	47.9	55.4	-15.3	85.6	-3.13	0.002
	Matched	53.2	52.1	2.2		0.39	0.695
ANC provider is Nurse or Midwife	Unmatched	87.1	83.8	9.6	95.3	1.94	0.052
	Matched	85.9	85.7	0.4		0.08	0.936
HMIS is available	Unmatched	97.2	93.5	17.8	95.8	3.52	0.000
	Matched	96.9	96.7	0.7		0.16	0.874

Figure 9 presents the frequency of counselling on each obstetric danger sign for pregnant women who received ANC at health facilities with national ANC guidelines compared to those who received ANC at health facilities without guidelines. The number of pregnant women who received ANC counselling on each obstetric danger sign differs by the facility-level availability of the national ANC guidelines. The frequency of

counselling on most obstetric danger signs was higher at health facilities with ANC guidelines than without guidelines. Vaginal bleeding was the most counselled obstetric danger sign in the treatment group (46.3%). In contrast, headache or blurred vision was the most counselled obstetric danger sign in the control group (39.1%). On the contrary, cough or difficulty breathing was the least counselled obstetric danger sign for pregnant women in the treatment (4.7%) and control (8.2%) groups. Thirty per cent of women in the treatment group and 38.2% of women in the control group did not receive counselling on any obstetric danger sign.

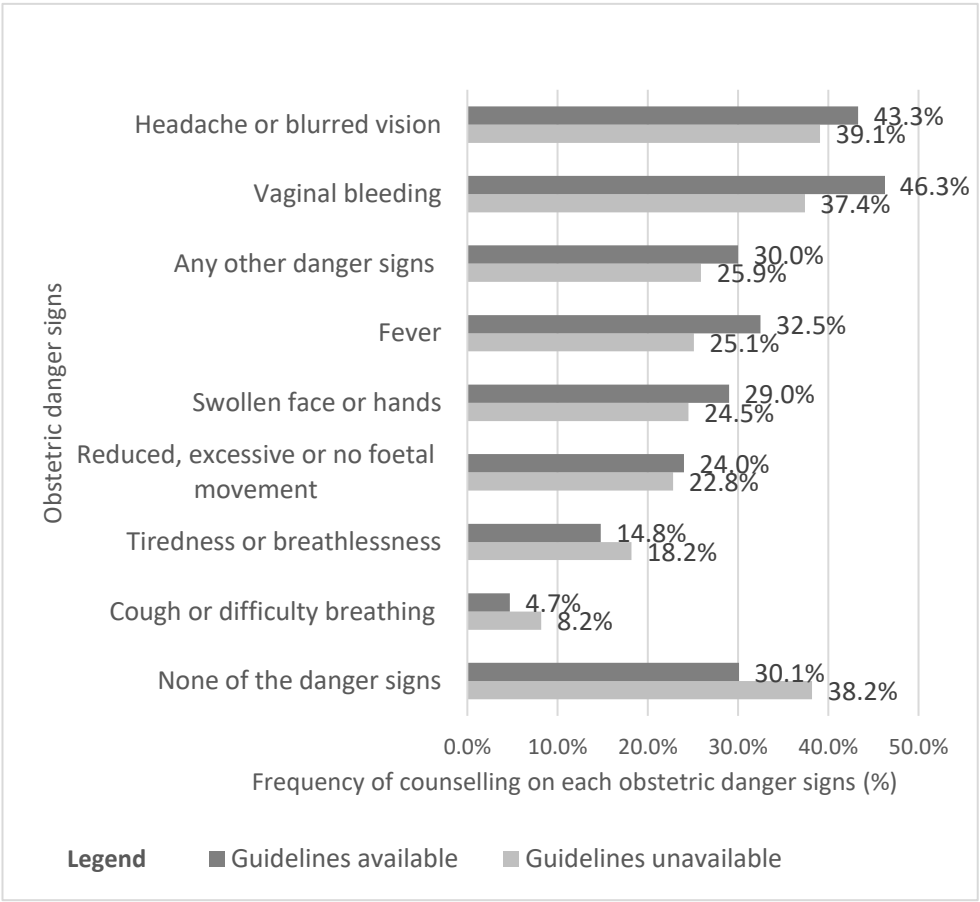


Figure 9 Comparison of counselling on each obstetric danger sign by facility-level availability of national ANC guidelines

After matching the study participants by the observed baseline characteristics, we found that facility-level ANC guidelines increased the average number of obstetric danger signs included in counselling women by 24% (95% CI: 12% - 35%) (Table 3). A Wilcoxon signed-

rank test for matched pairs (Siegel 1956) also indicated that the observed difference in obstetric danger sign counselling related to the availability of guidelines is statistically significant (z= -2.301, p=0.021).

Table 3 Average treatment effect of facility-level availability of national ANC guideline on ANC counselling on obstetric danger signs

Outcome variable	Sample	Treated	Control	Difference	S.E
The mean number of danger signs counselled	Unmatched	2.27	1.93	0.34	0.101
	ATT	2.25	2.01	0.24	0.117

ANC providers' uptake of training and ANC counselling

The second treatment variable in this study was the ANC provider's reception of ANC related in-service training in the last 24 months preceding the ESPA+ survey 2014. Matching yielded thirteen hundred and sixty-eight pregnant women, in which 684 women received ANC from trained providers, other 684 women received ANC from untrained providers.

Table 4 shows that the mean age of the study participants was 25 years. About 70% of the women had attended school. The average gestational age of the study participants was 27 weeks. One-third of the study participants were pregnant for the first time.

Table 4 Comparison of the standardised differences of baseline characteristics before and after matching for ANC providers' uptake of refresher training

Variable	Unmatched / Matched	Per cent (mean)		Bias (%)	Reduced bias (%)	t-test	
		Treated	Control			t	p
Age in years (mean)	Unmatched	25.2	25.4	-3.7		-0.77	0.439
	Matched	25.3	25.2	2.3	38.0	0.43	0.665
School attendance	Unmatched	68.5	68.9	-0.9		-0.19	0.846
	Matched	68.9	70.8	-4.1	-337.1	-0.77	0.444
Gestational age in weeks (mean)	Unmatched	27.5	27.1	4.7		0.97	0.335
	Matched	27.0	27.3	-3.7	20.1	-0.69	0.490
First-time pregnancy	Unmatched	37.3	30.6	14.3		2.97	0.003
	Matched	34.3	36.4	0.0	100.0	0.00	1.000
ANC visit is first	Unmatched	45.2	46.7	-3.1		-0.64	0.519
	Matched	48.0	46.1	3.8	-22.6	0.70	0.482
Facility is urban	Unmatched	82.6	70.0	29.9		6.16	0.000
	Matched	80.0	79.2	1.7	94.2	0.34	0.737
Facility owner is government	Unmatched	82.9	85.6	-7.3		-1.51	0.129
	Matched	86.0	84.2	4.8	34.0	0.91	0.363
Facility is hospital or health centre	Unmatched	95.2	97.1	-10.1		-2.10	0.036
	Matched	98.4	97.0	7.6	24.2	1.79	0.074
Facility is supervised at the zonal level	Unmatched	50.7	53.7	-6.1		-1.27	0.204
	Matched	53.1	50.3	5.6	9.3	1.03	0.304
ANC provider is Nurse or Midwife	Unmatched	83.8	86.3	-7.2		-1.50	0.134
	Matched	84.8	84.8	0.0	100.0	0.00	1.000

Figure 10 shows that headache or blurred vision was the most counselled obstetric danger sign for pregnant women in the treatment group (44.0%). In contrast, the most counselled obstetric danger sign for pregnant women in the control group was vaginal bleeding (37.6%). The least counselled obstetric danger sign was cough or difficulty breathing in both the treatment (7.8%) and control (5.6%) groups. Thirty-two point eight per cent of women in the treatment group and 37.7% of women in the control group did not receive counselling on any obstetric danger sign.

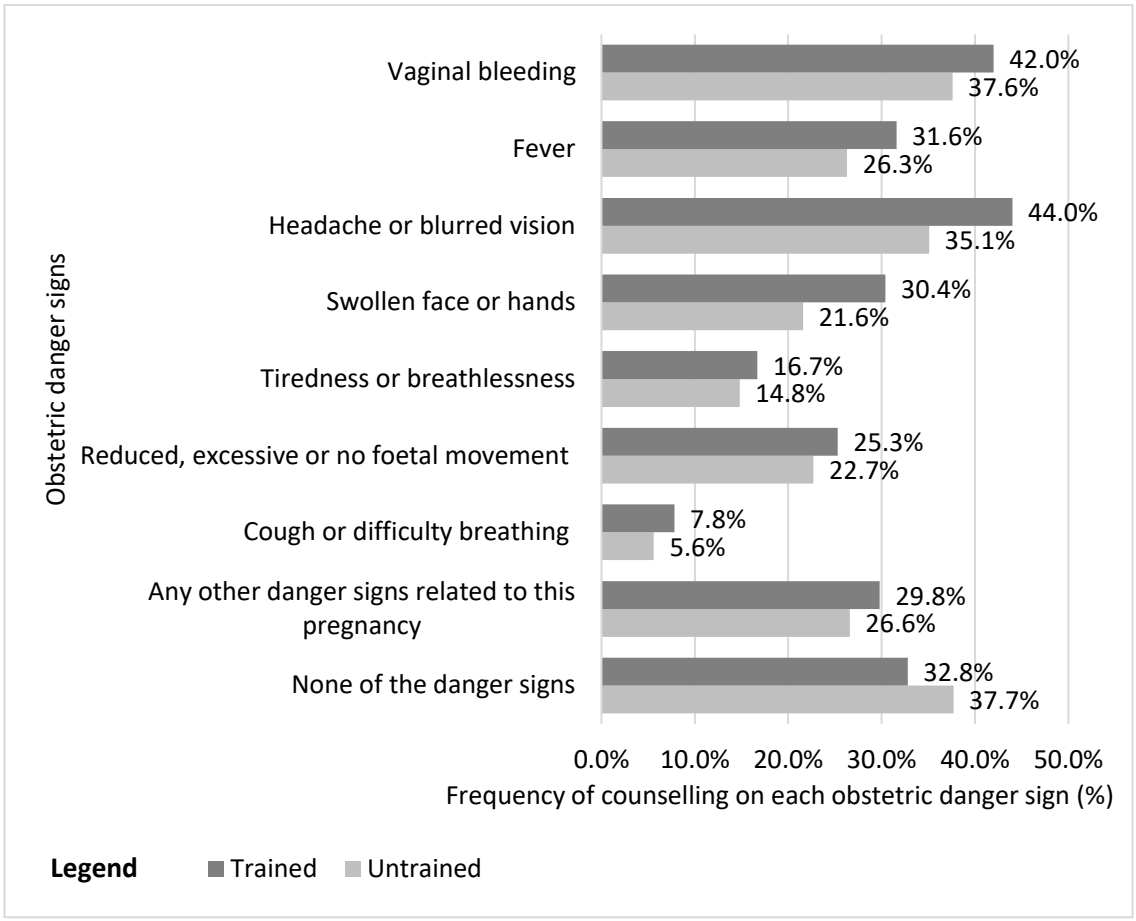


Figure 10 Comparison of counselling on each obstetric danger sign with by ANC providers' receipt of refresher training

Table 5 shows that ANC providers' uptake of ANC related in-service training in the last 24 months increased the mean number of obstetric danger signs included in counselling pregnant women by 37% (95% CI: 26% - 48%). This increment was statistically significant in the Wilcoxon signed-rank test for paired sample (z=-3.212, p=0.001).

Table 5 Average treatment effect of the ANC providers' uptake of ANC-related refresher training on ANC counselling on obstetric danger signs

Outcome variable	Sample	Treated	Control	Difference	S.E
The mean number of danger signs counselled	Unmatched	2.25	1.90	0.35	0.099
	ATT	2.27	1.90	0.37	0.112

4.5. Discussion

This PSM study using the ESPA+ 2014 data showed that the availability of national ANC guidelines at the facility level significantly increased the average number of obstetric danger signs discussed with pregnant women during ANC counselling by 24%. Similarly, providing ANC related in-service training for the ANC providers significantly increased the average number of obstetric danger signs discussed with women received during ANC counselling by 37%. While some women received no counselling on any danger signs, others received no counselling on a particular danger sign. Cough or difficulty breathing were found to be the least discussed danger signs. These danger signs are very relevant in the context of the current COVID-19 pandemic. A cough or difficulty breathing can signify both pregnancy-related complications and COVID-19 infection. Our study shows that a higher percentage of counselling sessions on most obstetric danger signs were at health facilities with guidelines and trained providers. The findings demonstrate the importance of the national ANC guidelines and in-service training for the ANC providers in counselling each pregnant woman on every obstetric danger sign.

The results are consistent with study findings from other countries that have shown an increase in counselling on obstetric danger signs due to guidelines or job aids and provider training (Jennings et al. 2010, Perreira et al. 2002, Oka et al. 2019). The use of ANC counselling job aids in Benin resulted in a 26% increase in counselling on obstetric danger signs (Jennings et al. 2010). Similarly, in Tanzania, more women in the intervention group involving ANC counselling job aids reported counselling reception on obstetric danger signs than women in control (no job aid intervention) (Oka et al. 2019). In Guatemala, there was a 15% increase in women who received counselling on obstetric danger signs following the use of counselling guidelines (Perreira et al. 2002).

ANC guidelines increase counselling on obstetric danger signs by enhancing provider-recipient communication for effective counselling on obstetric danger signs. This is attributed to the printed information on the ANC guidelines outlining clear instructions that support ANC providers approaching pregnant women and discussing pregnancy-

related topics (Rowe et al. 2018, WHO 2013). Guidelines also contain a list of pregnancy-related complications and danger signs to be discussed with a woman. Providers can discuss each of the danger signs with each pregnant woman based on the instructions in the guideline and let them know what to do if the danger signs occur (Duysburgh et al. 2013, Phommachanh et al. 2019a). ANC guidelines are also essential to reduce the time that the providers would typically spend thinking about the types of prenatal healthcare that should be provided to the expectant mother. As a result, this maximises the probability of counselling on each obstetric danger sign (Jennings et al. 2010, Perreira et al. 2002, Oka et al. 2019, Seyoum et al. 2021).

In the GANC model, ANC guidelines consist of a list of instructions on a range of pregnancy-related topics, including danger signs, that can be used to facilitate communication between the provider and recipients (Lori et al. 2017, Patil et al. 2013, Patil et al. 2017). The implementation of GANC involves developing country-context guidelines and training facilitators (the ANC providers) on how to use these guidelines to facilitate women's discussion in a group setting. The provider uses these guidelines to promote discussion that encourages women to share their experiences and learn from each other (Lori et al. 2017, Patil et al. 2013, Patil et al. 2017, Rising et al. 2004, Rising 1998). While this model may be useful to improve the ANC counselling on danger signs, implementing GANC might be challenging in the context of the coronavirus pandemic due to the increased risk of COVID-19 infection in a group setting (Larki et al. 2020). Thus, the traditional one-to-one ANC would be preferred to apply physical distancing in reducing COVID-19 transmission (Benski et al. 2020). One-to-one ANC counselling could be as effective as GANC in achieving successful counselling on obstetric danger signs if guidelines are in place for use by trained providers (Jennings et al. 2010, Perreira et al. 2002).

Another facility-level factor influencing ANC counselling that we examined in this study is ANC provider uptake of ANC related in-service training. Consistent with the findings of other studies (Jennings et al. 2010, Leslie et al. 2016, Vickers et al. 2007), our study findings showed that women have a 37% increased chance of receiving counselling on

obstetric danger signs if the providers had ANC related in-service training in the last 24 months.

Appropriate and acceptable care tailored to the pregnant woman's socio-cultural context requires providers to be clinically competent, motivated, and available (Gross et al. 2011, WHO et al. 2018). Training, mentoring, and supportive supervision are among the strategies that make the ANC provider capable and motivated (Goyet et al. 2019, Seyoum et al. 2021). Provider training includes pre-service training and in-service training. In-service training is a low-cost option to refresh provider knowledge and skills (de la Perrelle et al. 2020, Kurzawa et al. 2021), ensuring their competencies are up-to-date (Phommachanh et al. 2019a, Seyoum et al. 2021). Moreover, in-service ANC-related training is vital to address the emerging healthcare needs of pregnant women and to take their socio-cultural context into account (Bahri Khomami et al. 2021). With up-to-date knowledge and skills on ANC, providers can communicate effectively with pregnant women and understand their needs, beliefs, and values. These skills and understanding of the socio-cultural context of women enable providers to assess and identify problems and assist women in making informed decisions. Ethiopia is the home of people with multiple socio-cultural characteristics that play an important role in healthcare provision (Kaba et al. 2016). Provider in-service training helps the provider understand and respect these socio-cultural attributes of women to establish interactive communication (Heinonen 2021). Interactive provider-client communication that takes social and cultural norms into account gives pregnant women an extra opportunity to discuss a range of pregnancy-related topics, including how to recognise danger signs and how and where to seek treatment (Mian et al. 2018, WHO 2013). In-service training also increases providers' motivation (Momanyi et al. 2016) and confidence (Austin et al. 2015). A motivated and confident ANC provider makes informed clinical decisions (Thi Hoai Thu et al. 2015) and takes professional responsibility and accountability to provide the highest possible quality care (Farahani et al. 2013).

Other interventions that could improve the quality of ANC counselling include systematic quality improvements at the facility level (e.g., audits and feedback), support

to enhance quality infrastructure, and community participation (Goyet et al. 2019, Mian et al. 2018, Saaka et al. 2017). A study in Malawi found that providers felt happier and motivated, and patient satisfaction increased after implementing monthly supportive staff meetings. The monthly meetings involved sharing stories that involved identifying best practices and developing plans to implement these (Merriel et al. 2021). These facility-level quality improvement strategies could also be supported by community-based interventions (Rowe et al. 2018), such as implementing social and behavioural change communication. Involving community leaders, such as religious leaders, in disseminating health messages regarding pregnancy, childbirth, postnatal and newborn care, has been shown to increase women's knowledge of obstetric danger signs and maternal healthcare service reception (Perreira et al. 2002, Saaka et al. 2017).

Strength and Limitations

Applying the PSM method in an observational data (the 2014 ESPA+ survey data) enabled us to estimate the unconfounded treatment effects of ANC guidelines and provider in-service training on the provision of counselling on obstetric danger signs. However, this study has some limitations. The PSM method only adjusts for measured covariates. Therefore, this study does not guarantee the elimination of bias due to unmeasured covariates. The PSM also excluded unmatched samples that may be systematically different from the matched samples, which could affect the representativeness of the study population. We acknowledge the findings in this study may or may not directly represent the current ANC counselling practice in Ethiopia because the 2014 ESPA+ survey was undertaken seven years ago as of 2021. Thus, care should be taken to interpret the results. However, as the 2014 ESPA+ survey is a national representative data, the findings of this study are comprehensive to provide policymakers with quality insights to improve ANC quality. Additionally, the providers' uptake of in-service training was self-reported, which might have been affected by the recall and social desirability biases. Similarly, this study did not examine whether ANC providers were given ANC guidelines along with the training and whether they used the guidelines consistently during ANC counselling.

4.6. Conclusion and recommendations

We found that counselling pregnant women about obstetric danger signs during their ANC contacts is not universally practised. Nearly one in three women do not receive counselling on any obstetric danger sign. The availability of facility-level national ANC guidelines and in-service training for the ANC providers are positively and significantly associated with the number of obstetric danger signs discussed with women during ANC counselling. Decision-makers need to prioritise funding and policy to build supportive environments to ensure each health facility has guidelines and continuous in-service training programs are available for every ANC provider. Further research is required to understand whether ANC guidelines are consistently used during ANC service provision and examine whether this is associated with the quality of ANC counselling.

In summary, chapter 4 has presented the findings on how facility-level ANC guidelines and providers' training can contribute to increasing ANC counselling of pregnant women on obstetric danger signs for a positive pregnancy experience in the Ethiopian context and discussed the findings with existing literature. The following chapter presents and discusses the findings of study 2 that employed mediation analysis and examined how quality ANC counselling can contribute to increased facility birth for a positive pregnancy experience by employing a mediation analysis.

Chapter 5 Antenatal care counselling on obstetric danger signs and place of birth

This chapter presents the findings from the second study that involved an analysis of the 2014 ESPA+ data, to investigate the relationship between ANC counselling and a woman's decision where to give birth, as well as the mediating role of maternal health literacy. The manuscript has been prepared to submit to a peer-reviewed journal.

5.1. Abstract

Background: While skilled care during and after pregnancy is key to avoiding preventable maternal deaths, many births in Ethiopia occur outside health facilities. Research shows the importance of ANC counselling on obstetric danger signs to increase facility birth. It is unknown, however, if ANC counselling increases the number of births that take place in healthcare facilities. Therefore, this study estimated the direct and indirect effect of ANC counselling on a woman's decision to give birth at a health facility and the mediating role of maternal health literacy.

Methods: The 2014 ESPA+ data was analysed, and 1,006 eligible pregnant women were included. Firstly, descriptive and bivariable regression analyses were performed. Then, to examine the mediating role of maternal health literacy, structural equation modelling with multivariable regression and path analysis was conducted. The independent variables were reported using the beta coefficient and odds ratio with a 95% CI.

Results: The mean age of the women in the study was 25.3 ± 4.9 years. Three-quarters of the women had attended school. Most women (93%) decided to give birth at a health facility. On average, counselling addressed 2.5 ± 2.2 obstetric danger signs, and women knew an average of 1.9 ± 1.1 obstetric danger signs. Mediated by maternal health literacy, ANC counselling on obstetric danger signs indirectly increased women's decision to give birth at a health facility by 4% [Adjusted odds ratio (AOR)= 1.04, 95% CI (1.004 – 1.08)]. While ANC counselling significantly increased maternal health literacy (β=0.09), it had no significant direct and total effect on women's decision to give birth

at a health facility. Likewise, women's school attendance had a statistically significant direct, indirect, and total effect on their decision to give birth at a health facility. Women who had attended school were more likely to decide to give birth in a health facility [AOR= 5.49, 95% CI (1.92 – 15.65)], with maternal health literacy mediating about 20% of this effect.

Discussion: Women are more likely to make an appropriate and informed decision about where to give birth if they are well informed about obstetric complications and the benefits of facility birth. A lack of access to information on obstetric danger signs and the importance of facility birth hinders the care-seeking behaviour of women.

Conclusion: Including the recommended obstetric danger signs in ANC counselling, as well as school education, increases maternal health literacy, which in turn encourages women to give birth with a skilled attendant at a health facility. Improving the quality of ANC counselling through regular provider training and ANC guidelines can increase maternal health literacy and facility birth.

5.2. Background

The WHO has called on countries to expedite progress to meet the sustainable development goal (SDG) target of reducing maternal death by reaching 90% coverage in maternal healthcare services. Maternal healthcare services include FP, ANC, facility childbirth, and PNC (WHO and UNFPA 2021). It is critical that women receive these healthcare services to detect and manage obstetric complications early and avoid preventable maternal deaths. However, a substantial proportion of women in low-income setting do not receive these maternal healthcare services (WHO 2021).

Ethiopia has a three-tiered healthcare delivery system structured into primary, secondary, and tertiary healthcare levels and connected to each other by a referral system. The system covers a wide range of services, including health promotion, disease prevention, curative, rehabilitative and palliative care. Improving maternal health is one of the top priorities in the Ethiopian HSTP (FMOH 2015). The country has undertaken various initiatives to reduce maternal morbidity and mortality, such as expanding healthcare facilities, deploying trained providers, and delivering free maternal healthcare services in all public health facilities (FMOH 2015). Every pregnant woman is encouraged to receive ANC and give birth at a health facility. Despite these efforts, about one in two births (53%) in Ethiopia occur outside a health facility where childbirth is unlikely to be assisted by skilled personnel (EPHI and ICF 2019).

Several factors have been reported to influence maternal healthcare uptake (Afulani and Moyer 2016, Okedo-Alex et al. 2019, Tekelab et al. 2019). Women who did not use health facilities during childbirth had lower levels of education (Ahmed et al. 2018, Doctor et al. 2018, Gabrysch et al. 2019), lived in rural areas (Ayele et al. 2019, Dankwah et al. 2019), and belonged to lower wealth quintiles (Exavery et al. 2014, Doctor et al. 2018, Gabrysch et al. 2019, Tegegne et al. 2020). Others may not seek healthcare from a skilled provider due to cultural and religious reasons as well as fear of medical interventions (Abed Saeedi et al. 2013, Ahmad Tajuddin et al. 2020). For example, Kifle et al., (2017) reported that Muslim women may not find male providers acceptable.

Women who face difficulties accessing a health facility due to distance and a lack of transport may be forced to give birth outside of a health facility (Ayele et al. 2019, Choulagai et al. 2013, Gabrysch et al. 2019, Tegegne et al. 2020, Wallace et al. 2018).

The influence of these socio-economic and contextual factors on women's healthcare use during childbirth could be mediated by the extent to which women understand the risks associated with pregnancy and childbirth (Budhathoki et al. 2017, Stormacq et al. 2018). Socio-economically disadvantaged women, such as those with low education and income, may lack knowledge regarding obstetric complications and the importance of healthcare service uptake. Women do not seek skilled care at all (Sk et al. 2019) or they arrive at health facilities late (Ayenew et al. 2021) if they cannot recognise signs of obstetric complications or lack maternal health literacy (Adjiwanou and Legrand 2013, Jennings et al. 2010, Siyoum et al. 2018, Soubeiga et al. 2014, Yoseph et al. 2020). Women with improved maternal health literacy, on the other hand, are more likely to seek timely care (Adjiwanou and Legrand 2013, August et al. 2016, Lori et al. 2017, Moyo et al. 2018, Mwilike et al. 2018, Nikiéma et al. 2009) because they are more aware of the risks of delayed care and lack of receiving care during and following pregnancy (Lupattelli et al. 2014).

Providing quality ANC counselling could encourage women to use maternal healthcare services, such as giving birth in a health facility, both directly and indirectly. An indirect influence of ANC on SBA utilisation could be through enhancing maternal health literacy. The results of the systematic review presented in chapter two showed that ANC counselling for women on obstetric danger signs could increase maternal health literacy or knowledge of obstetric danger signs (Yeneabat et al. 2022, Under review). Providing counselling to women on obstetric danger signs during ANC could also directly increase women's uptake of SBA through positive reinforcement. Effective ANC counselling can engender a supportive client-provider relationship, increasing women's trust in healthcare providers and decreasing their fear of interventions, which in turn encourages them to seek skilled care (Abed Saeedi et al. 2013, Ahmad Tajuddin et al. 2020). Moreover, counselling on obstetric danger signs ensures women receive quality

ANC, which also increases women's perceived quality of care. A higher perceived healthcare quality may lead to more facility births (Afulani and Moyer 2016).

Despite a substantial number of research studies in Ethiopia that show that ANC counselling can contribute to improving maternal healthcare uptake (Ayele et al. 2019, Geleto et al. 2019), no studies have explored the relationship between ANC counselling, maternal health literacy and women's decision to give birth at a health facility. This study seeks to determine the extent to which ANC counselling on obstetric danger signs influences a woman's decision to give birth at a health facility and the mediating role of maternal health literacy. Estimating the mediating effect of maternal health literacy on facility birth will provide evidence to strengthen ANC counselling to enhance maternal health literacy and increase women's decision to seek skilled birth attendance.

5.3. Methods

Study design and setting

This is a cross-sectional study that involved a secondary data analysis using the 2014 ESPA+ data. The 2014 ESPA+ is a national facility-based survey that assessed the performance of health facilities rendering maternal, child, and reproductive health services and other infectious diseases such as sexually transmitted infections, tuberculosis, and malaria. The 2014 ESPA+ report is available online alongside a detailed description of data collection instruments and methods (EPHI et al. 2014).

To explain the relationship between ANC counselling, maternal health literacy, and women's decision on where to give birth, a conceptual framework (Figure 11) was constructed. The framework consisted of women's characteristics and their obstetric history, health facility characteristics, provider characteristics, and ANC counselling as exogenous variables; maternal health literacy as an endogenous variable and women's decision where to give birth as the main outcome variable (Ensor et al. 2013, Jansen et al. 2018, Kindig et al. 2004, Owili et al. 2017, Wu et al. 2019).

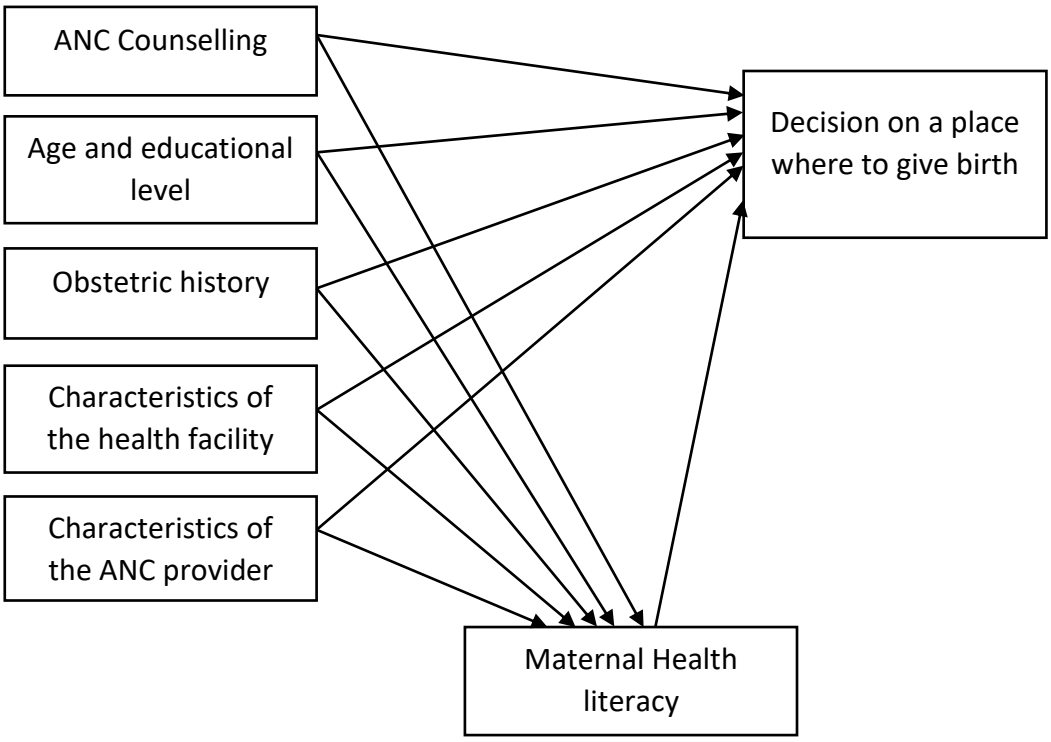


Figure 11 Conceptual framework illustrating how women's decision where to give birth is related to ANC counselling and maternal health literacy

Sample size and selection process

The current study included data from 1,006 pregnant women who met the inclusion criteria among 1,902 pregnant women included in the 2014 ESPA+ survey (Figure 12). Eight hundred and ninety-six pregnant women were excluded from the analysis step-by-step for several reasons. First, 49 pregnant women were excluded as they refused the client-exit interview. Second, 25 pregnant women who received ANC at health posts were excluded as these health facilities do not meet the definition of skilled care. In Ethiopia, health posts are staffed with health extension workers who completed at least tenth grade and undertook one-year of training required to deliver health promotion and health education (Assefa et al. 2019). Third, two pregnant women who were not observed while receiving ANC counselling on obstetric danger signs were excluded. Fourth, one woman was excluded because of a missing value on the outcome variable. Fifth, 776 women were excluded as they were not asked whether or not they knew

obstetric danger signs. Finally, 43 women were excluded because of missing values in the study variables.

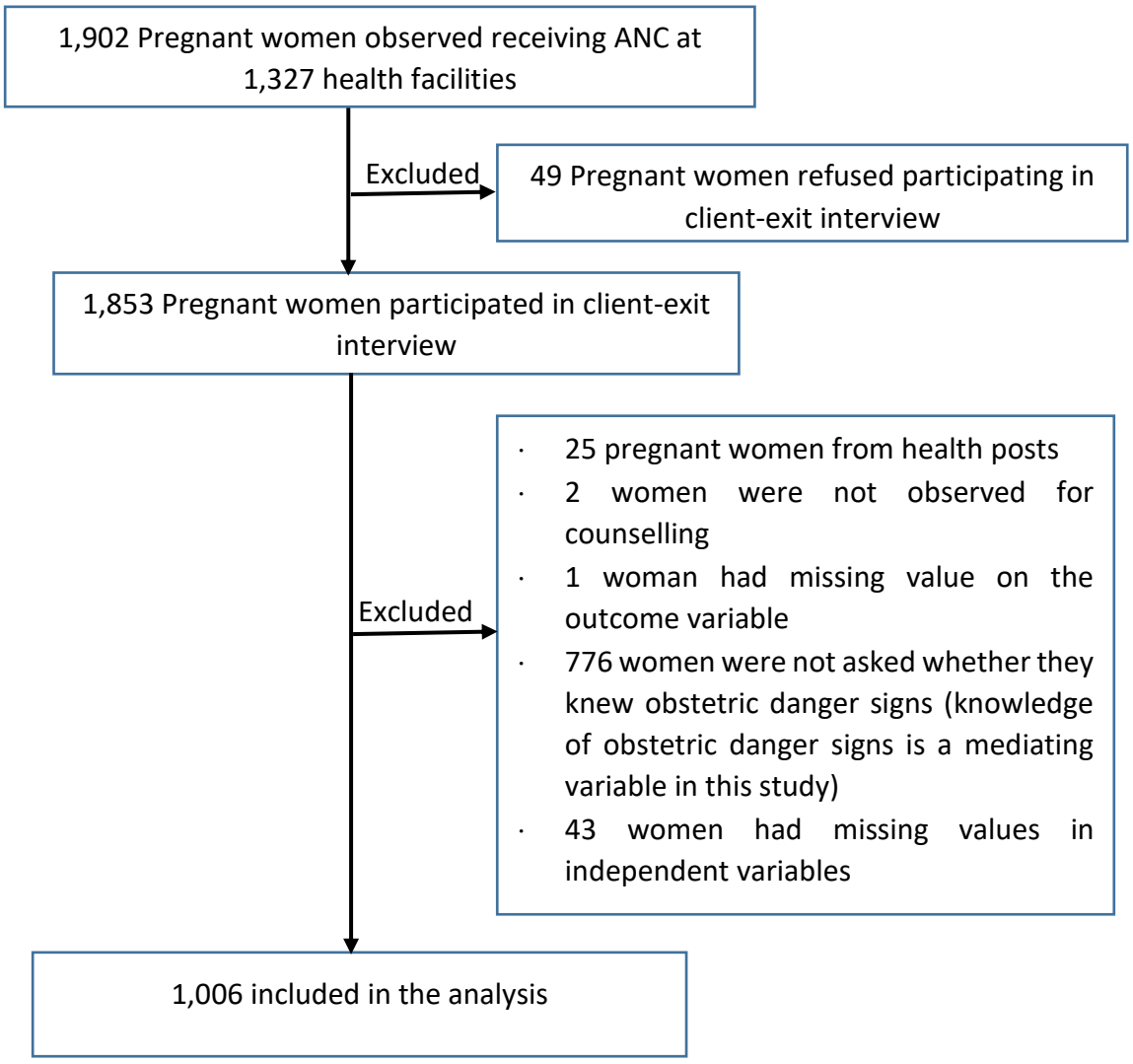


Figure 12 Sample selection process (using unweighted sample)

Variables and measurement

Outcome variable

A woman's decision concerning the place where she will give birth was an outcome variable. This was measured by using women's responses to the 2014 ESPA+ survey client-exit interview question, "Have you decided where you will go for the delivery of your baby?" The response options for this question are: (1). Yes, at this health facility; (2). Yes, at another health facility; (3). Yes, at home; (4). Yes, at a traditional birth attendant's (TBA's) home; (5). Other location; (6). No/Do not know. These responses were re-coded into two categories for analysis: at health facility (coded as 1) and not at health facility (coded as 0). The category at health facility includes a woman's response to either 'Yes, at this health facility' or 'Yes, at another health facility'. The category 'not at health facility' refers to a woman response to one of the following: 'Yes, at home', 'Yes, at a traditional birth attendants' home', 'Other location', 'No/Do not know'.

Exposure variable

The exposure variable was ANC counselling for women on obstetric danger signs. This was measured by using the number of obstetric danger signs the ANC provider discussed with each pregnant woman. An observation checklist was used to collect data on whether or not the ANC provider counselled each pregnant woman on the following obstetric danger signs: (1) Vaginal bleeding. (2) Fever. (3) Headache or blurred vision. (4) Swollen face or hands. (5) Tiredness or breathlessness. (6) Reduced or absence of or excess of foetal movement. (7) Cough or difficulty breathing. (8) Any other symptoms or problems the client thinks might be related to this pregnancy. (9) None of the above. Each obstetric danger sign scored 1 if a woman was counselled; otherwise, 0. A composite score ranging from zero to eight was calculated by summing the number of obstetric danger signs that women were counselled. A score of 0 denotes a woman received no counselling on any obstetric danger sign whereas 8 denotes a woman received counselling on eight obstetric danger signs.

Mediating variable

The mediating variable was maternal health literacy or knowledge of obstetric danger signs. This was measured using the client-exit interview questionnaire that asked each pregnant woman whether she knew the following obstetric danger signs: (1) Vaginal bleeding. (2) Fever. (3) Swollen face or hand. (4) Tiredness or breathlessness. (5) Headache or blurred vision. (6) Seizures/convulsions. (7) Reduced or no foetal movement. (8) Other. (9) Do not know any. Each danger sign was assigned a score of 1 if mentioned by a woman and a score of 0 otherwise. A score of knowledge of danger signs was obtained by adding the danger signs that a pregnant woman was able to state in the client-exit interview. The score ranged from 0 to 8. A score of 0 represents a situation where a woman could not state any of the obstetric danger signs, and 8 represents a woman who was able to list eight danger signs.

Covariates or confounding variables

The covariates or confounding variables were summarized into three categories. The first category consisted of women's characteristics and obstetric history, including age in years, school attendance recoded as 'Yes' and 'No', number of ANC visits, gestational age in weeks, and number of pregnancies recoded as 'First' and 'Not first'. The second category comprised facility characteristics, such as facility location recoded as 'Urban' and 'Rural', facility type recoded as 'Hospital' and 'Others', managing authority recoded as 'Governmental' and 'Non-governmental', availability of ANC guidelines recoded as 'Yes' and 'No', presence of supervision from federal level 'Yes' and 'No', presence of supervision from regional level 'Yes' and 'No', presence of supervision from zonal level 'Yes' and 'No', presence of supervision from district level 'Yes' and 'No', availability of health management information system (HMIS) 'Yes' and 'No', and presence of routine management meetings at the facility level 'Yes' and 'No'. The third category included the ANC provider's characteristics, including sex, profession, and receipt of ANC-related in-service training.

Statistical Analysis

Data analysis was carried out by using STATA 17.0 software (StataCorp 2021). First, descriptive statistics such as percentage, mean and standard deviation were used to describe the study population. Second, a bivariable regression analysis was performed for the outcome and mediating variables. While the outcome variable was regressed on the exposure, confounding, and mediating variables using logistic regression analysis, the mediating variable was regressed on the exposure and cofounding variables using linear regression analysis. Third, logistic regression and linear regression models were fitted simultaneously in GSEM for mediation analysis to explain how ANC counselling might affect women's decision to give birth at a health facility and to investigate the mediating role of maternal health literacy (Lee et al. 2019, VanderWeele 2015).

In mediation analysis, there should be no unmeasured independent-outcome confounders, no unmeasured mediator-outcome confounders, and no unmeasured independent-mediator confounders (Lee et al. 2019, VanderWeele 2016). Bivariable regression analysis was used to assess these confounders, and the corresponding level of significance (p-value) was referred to identify the confounders to be included in the mediation analysis. Variables that had a p-value of less than 0.25 in the bivariable regression results were included in the mediation analysis. Chowdhury and Turin (2020) suggested to include the variables in the model if their p-values in the bivariable regression analysis is less than 0.25 and if the variables are thought to be clinically important. ANC counselling and maternal health literacy or knowledge of danger signs were included in the GSEM irrespective of their p-values in the bivariable regression. This analysis also included the interaction of women's school attendance with knowledge of danger signs in the mediation model to increase power in testing for the overall effect of the exposure variable on the outcome (VanderWeele 2015), given the assertion that there is a positive association between women's educational level and their knowledge of danger signs (Bililign and Mulatu 2017, Geleto et al. 2019).

In addition, the assumptions of logistic regression and linear regression analyses were verified, as the mediation model in the present study consisted of simultaneously

modelled logistic regression and linear regression analyses. In logistic regression, Pearson's correlation was used to check for the absence of a strong correlation among continuous independent variables. The absence of extreme outliers in continuous variables was examined by studentised residuals (Stoltzfus 2011). Regarding the assumptions of linear regression, normality in the distribution of the residuals was checked by running the kernel density plot for the predicted residuals. The absence of multicollinearity was checked by running the variance inflation factor (VIF). Homoskedasticity was checked by plotting the residuals over the fitted (predicted) values (Belsley et al. 2004).

5.4. Results

Descriptive results

Table 6 displays the descriptive statistics of the 1,006 pregnant women included in the study. The mean age of the pregnant women studied was 25.3 ± 4.9 years. About three-quarters of the women had attended school. The average gestational age was 27.6 ± 8.1 weeks. Nearly three in five (58.4%) women had received ANC for the first time. Thirty-five per cent of women were pregnant for the first time. About nine in ten (93%) women had decided to go to a health facility for childbirth in their current pregnancy. While observation data revealed that women were counselled on an average of 2.5 ± 2.2 obstetric danger signs, client-exit interview data showed that women could recall 1.9 ± 1.1 obstetric danger signs.

Most women visited the ANC clinic at urban health facilities (78%) and non-governmental health facilities (83%). The health facilities received supervision from federal level (54%), regional level (84%), zonal level (51%), and *woreda* or district level (45.3%). Most health facilities had routine management meeting (98%), HMIS (96%), and ANC guidelines (56%). Eighty-six per cent of women received the ANC from a nurse or midwife, and the remaining received it from other professionals such as public health officers and general practitioners.

Table 6 Frequency distribution of study participants by study variables (n=1006)

Variables	Variable category*	Number (mean if continuous)	Per cent (%)
Age in years (mean ± SD)	-	25.3 ± 4.9	-
Ever attended school	Yes	745	74.1
	No	261	25.9
Gestational age in weeks	-	27.6 ± 8.1	-
Number of ANC visits	First visit	587	58.4
	Re-visit	419	41.6
Number of pregnancies	First pregnancy	352	35.0
	Not first pregnancy	654	65.0
Decision where to give birth	At health facility	935	92.9
	Not at health facility	71	7.1
Facility location	Urban	782	77.7
	Rural	224	22.3
Facility type	Hospital	431	42.8
	Non-hospital	575	57.2
Facility sector	Government/Public	174	17.3
	Non-government	832	82.7
Facility received supervision from the federal level	Yes	539	53.6
	No	467	46.4
Facility receive supervision from the region level	Yes	841	83.6
	No	165	16.4
Facility received supervision from the zonal level	Yes	517	51.4
	No	489	48.6
Facility received supervision from the woreda/district level	Yes	456	45.3
	No	550	54.7
Presence of routine management meeting	Yes	986	98.0
	No	20	2.0
Presence of health management information system (HMIS)	Yes	963	95.7
	No	43	4.3
ANC guidelines present	Yes	567	56.4
	No	439	43.6
ANC providers' sex	Male	344	34.2
	Female	662	65.8
ANC providers' profession	Nurse or Midwife	860	85.5
	Other	146	14.5
ANC providers received training	Yes	499	49.6
	No	507	50.4
ANC counselling (mean± SD)	-	2.5 ± 2.2	-
Knowledge of danger signs (mean± SD)	-	1.9 ± 1.1	-

* *Continuous variables are expressed using mean and standard deviation*

Bivariable regression of women's decision where to give birth

Table 7 portrays the results of the bivariable regression examining the women's decision where to give birth. Women's decision where to give birth was significantly influenced by their age and educational status, gestational age, the number of ANC visits or contacts, facility type, facility location, whether or not the facility received supervision from the district level, and women's knowledge of obstetric danger signs.

The odds of a woman's decision to give birth at a health facility decreased by 5% as her age increased by one year [Crude Odds Ratio (COR) = 0.95, 95% CI (0.91 – 0.99)]. Women who had attended school were three times more likely to decide to give birth at a health facility [COR = 3.25, 95% CI (1.99 – 5.29)]. An increase of one week in gestational age was associated with a 3% increase in the odds of women's decision to give birth at a health facility [COR = 1.03, 95% CI (1.01 – 1.06)]. Compared to women who had a single ANC visit, women who had multiple ANC visits during their current pregnancy were 67% more likely to give birth at a health facility [COR = 1.67, 95% CI (1.03 – 2.72)]. Receiving ANC at urban health facilities as opposed to rural health facilities increased the likelihood of a woman planning to give birth at a health facility by 75% [OR= 1.75, 95% CI (1.04 – 2.95)]. Similarly, women who attend ANC in a hospital rather than a place that was not a hospital were three times more likely to give birth at a health facility [OR= 3.22, 95% CI (1.92 – 5.42)]. A one-unit increase in maternal health literacy (knowledge of obstetric danger signs) increased the odds of deciding to give birth at a health facility by 30% [OR= 1.29, 95% CI (1.02 – 1.63)].

Women's decision to give birth at a health facility had no statistically significant association with gravidity, the health facility managing authority, facility supervision at the federal, regional, and zonal levels, the presence of routine management meetings, HMIS, and ANC guidelines, the ANC provider's sex, and the provider's receipt of ANC related training.

Table 7 Bivariable regression of women's decision on the place of birth on each independent variable (n=1006)

Variables	Variable category	Decided to give birth at a health facility		COR (95% CI)	P Value
		Yes	No		
Age in years (mean ± SD)	-	-	-	0.95 (0.91 – 0.99)	0.04
Ever attended school	Yes	710	35	3.25 (1.99 – 5.29)	0.00
	No	225	36	1	
Gestational age in weeks	-	-	-	1.03 (1.01 – 1.06)	0.02
Number of ANC visits	First visit	381	38	1	0.04
	Re-visit	554	33	1.67 (1.03 – 2.72)	
Number of pregnancies	First pregnancy	329	23	1	0.63
	Not first pregnancy	606	48	0.88 (0.53 – 1.48)	
Facility location	Urban	734	48	1.75 (1.04 – 2.95)	0.04
	Rural	201	23	1	
Facility type	Hospital	553	22	3.22 (1.92 – 5.42)	0.00
	Non-hospital	382	49	1	
Facility sector (facility owner)	Government/Public	769	63	0.59 (0.28 – 1.25)	0.17
	Non-government	166	8	1	
Facility received supervision from the federal level	Yes	508	31	1.54 (0.94 – 2.50)	0.08
	No	427	40	1	
Facility received supervision from the regional level	Yes	781	60	0.93 (0.48 – 1.81)	0.83
	No	154	11	1	
Facility received supervision from the zonal level	Yes	481	36	1.03 (0.64 – 1.67)	0.90
	No	454	35	1	
Facility received supervision from the district level	Yes	415	41	0.58 (0.36 – 0.95)	0.03
	No	520	30	1	
Facility had routine management meeting	Yes	916	70	0.69 (0.09 – 5.22)	0.72
	No	19	1	1	

Table 7 continued

Variables	Variable category	Decided to give birth at a health facility		COR (95% CI)	P Value
		Yes	No		
Presence of HMIS	Yes	894	69	0.63 (0.14 – 2.67)	0.53
	No	41	2	1	
ANC guidelines present	Yes	408	31	0.99 (0.61 – 1.62)	0.99
	No	527	40	1	
ANC providers' sex	Male	320	24	1	0.94
	Female	615	47	0.98 (0.59 – 1.63)	
ANC providers' profession	Nurse or Midwife	795	65	0.52 (0.22 – 1.23)	0.14
	Other*	140	6	1	
ANC providers received training	Yes	468	31	1.29 (0.79 – 2.10)	0.30
	No	467	40	1	
ANC counselling	-	-	-	0.94 (0.85 – 1.05)	0.30
Knowledge of danger signs	-	-	-	1.29 (1.02 – 1.63)	0.03

** Includes General practitioner, public health officer, gynaecologist*

Maternal health literacy or knowledge of obstetric danger signs

Of the 1006 women included in this analysis, 9.24% could not recall any obstetric danger sign, 64% knew two obstetric danger signs, and 27% knew three or more obstetric danger signs.

Table 8 shows the bivariable regression of maternal health literacy (knowledge of obstetric danger signs) on ANC counselling and the covariates. Maternal health literacy was positively associated with ANC counselling on obstetric danger signs (β=0.09), women's school attendance (β= 0.41), ANC at urban health facilities (β= 0.32) and receipt of ANC from male ANC providers (β= 0.22). On the other hand, maternal health literacy was negatively associated with ANC uptake at district-level facilities (β= -0.04). This analysis revealed no statistically significant relationship between maternal health literacy and the following variables: women's age, gestational age, gravidity, facility ownership, facility type, facility-level availability of routine management meetings, HMIS, and ANC guidelines, the providers' profession and receipt of ANC related training, and the facility supervision from the federal, regional, and zonal levels.

Table 8 Bivariable regression of women's knowledge of danger signs on each independent variable

Variables	Maternal health literacy or knowledge of obstetric danger signs		
	β coefficient	95% CI	P value
Age in years	0.004	-0.01 – 0.02	0.59
Had attended school	0.41	0.26 – 0.56	0.00
Gestational age in weeks	-5.13e-07	-0.01 – 0.01	1.0
Number of ANC visits	0.14	-0.002 – 0.27	0.05
Pregnant for more than once	-0.11	-0.25 – 0.03	0.14
Urban Facility location	0.32	0.16 – 0.48	0.00
Facility was a hospital	0.12	-0.02 – 0.25	0.09
Government facility	0.11	-0.07 – 0.29	0.24
Facility received supervision from the federal level	0.05	-0.09 – 0.18	0.51
Facility received supervision form the regional level	0.09	-0.09 – 0.27	0.34
Facility received supervision from the zonal level	-0.04	-0.18 – 0.09	0.54
Facility received supervision from the district level	-0.14	-0.28 – -0.01	0.04
Facility had routine management meeting	-0.10	-0.58 – 0.39	0.69
Facility had HMIS	0.05	-0.29 – 0.38	0.79
Facility had ANC guidelines	-0.05	-0.19 – 0.08	0.45
Male provider sex	0.22	0.08 – 0.36	0.00
Nurse or Midwife provider	-0.05	-0.24 – 0.15	0.63
Provider received training	-0.06	-0.19 – 0.08	0.41
ANC counselling score	0.09	0.06 – 0.12	0.00

Multivariable regression and mediation analysis

Table 9 depicts the multivariable regression results showing the relationship between ANC counselling, maternal health literacy, and the women's decision to give birth at a health facility. Of the variables included in the multivariable regression, only women's school attendance had a significant association both with maternal health literacy and with women's decision to give birth at a health facility. Women who had attended school had a 39% increase in maternal health literacy [β=0.39, 95% CI (0.23 – 0.56)] and were more likely to decide to give birth at a health facility [Adjusted Odds Ratio (AOR)=4.62, 95% CI (1.75 – 12.19)]. Additionally, maternal health literacy was positively associated with women's decision to give birth at a health facility [AOR= 1.55, 95% CI (1.07 – 2.23)].

There was a statistically significant ($p<0.05$) increase in maternal health literacy when women had two or more ANC contacts [β= 0.15, 95% CI (0.02 – 0.29)], received their ANC service at urban health facilities [β= 0.23, 95% CI (0.05 – 0.40)], received their ANC service at government health facilities [β= 0.29, 95% CI (0.11 – 0.48)], and received ANC counselling on more danger signs [β= 0.09, 95% CI (0.06 – 0.12)]. None of these variables, except maternal health literacy and women's school attendance, were significantly associated with a woman's decision to give birth at a health facility.

Table 9 Multivariable regression analysis for maternal health literacy and women's decision to give birth at a health facility

Variables	Variable category (not applicable for non-categorical variables)	Maternal health literacy (mediator)		Women's decision to give birth at a health facility (outcome variable)	
		β coefficient (95% CI)	P value	AOR (95% CI)	P value
Age in years	-	-	-	0.97 (0.93 – 1.02)	0.27
Ever attended school	Yes	0.39 (0.23 – 0.56)	0.000	4.62 (1.75 – 12.19)	0.002
	No			1	
Gestational age in weeks	-	-	-	1.02 (0.98 – 1.06)	0.24
Number of ANC visits	First visit	0.15 (0.02 – 0.29)	0.03	1.29 (0.73 – 2.29)	0.38
	Re-visit			1	
Facility location	Urban	0.23 (0.05 – 0.40)	0.01	1.10 (0.59 – 2.05)	0.77
	Rural			1	
Facility type	Hospital	-0.07 (-0.22 – 0.09)	0.42	2.83 (1.49 – 5.38)	0.001
	Non-hospital			1	
Facility sector	Government/Public	0.29 (0.11 – 0.48)	0.002	1.05 (0.41 – 2.67)	0.92
	Non-government			1	
Facility received supervision from the federal level	Yes	-	-	0.98 (0.57 – 1.69)	0.94
	No			1	
Facility received supervision from the district level	Yes	-0.05 (-0.20 – 0.10)	0.53	1.15 (0.62 – 2.11)	0.66
	No			1	
ANC providers' profession	Nurse or Midwife	-	-	0.92 (0.32 – 2.65)	0.88
	Other			1	
ANC counselling	-	0.09 (0.06 – 0.12)	0.000	0.94 (0.84 – 1.05)	0.27
Knowledge of danger signs	-	-	-	1.55 (1.07 – 2.23)	0.02
Interaction of educational level and knowledge of danger signs	-	-	-	0.64 (0.40 – 1.03)	0.07

The mediating role of maternal health literacy on women's decision to give birth at a health facility

Table 10 displays the direct, indirect, and total effect of ANC counselling on obstetric danger signs and a woman's educational status on her decision to give birth at a health facility. While ANC counselling on obstetric danger signs had no direct effect on women's decision to give birth at a health facility, it indirectly increased women's decision to give birth at a health facility by 4% [AOR= 1.04, 95% CI (1.004 – 1.08)]. This indirect effect of ANC counselling on women's decision to give birth at a health facility was mediated by maternal health literacy. However, ANC counselling on obstetric danger signs had no statically significant overall effect on women's decision to give birth at a health facility [AOR=0.98, 95% CI (0.87 – 1.09)].

Similarly, women's school attendance had a statistically significant direct, indirect, and total effect on women's decision to give birth at a health facility. School attendance increased the likelihood of women's decision to give birth at a health facility by more than five times [AOR= 5.49, 95% CI (1.92 – 15.65)], with maternal health literacy mediating about 20% of this effect.

Table 10 Direct, indirect, and total effect of antenatal care counselling and women's educational status on women's decision to give birth at a health facility

Variables	Direct effect AOR (95% CI), P	Indirect effect AOR (95% CI), P	Total effect AOR (95% CI), P
ANC counselling on obstetric danger signs	0.94 (0.84 – 1.05), P>0.05	1.04 (1.004 – 1.08), P<0.05	0.98 (0.87 – 1.09), P>0.5
School attendance	4.62 (1.75 – 12.19) P<0.01	1.19 (1.01 – 1.39) P<0.05	5.49 (1.92 – 15.65) P<0.01

5.5. Discussion

This study examined the influence of ANC counselling on obstetric danger signs on a woman's decision where to give birth and the mediating role of maternal health literacy. The study found that 93% of the women in the study decided to give birth at a health facility, and the remaining 7% opted to give birth in non-healthcare settings or had not decided where to give birth. Non-healthcare settings included a home, a traditional birth attendant's home, and other locations. The rate of women's decision to give birth at a health facility in the current study is higher than the findings from a study from Northern Ethiopia, where 74% of women intended to give birth in a healthcare settings (Ayana et al. 2021). The use of a single item question, "*Have you decided where you will go for the delivery of your baby?*" to measure the outcome variable in the current study might have accounted for a greater rate compared to the finding from the study by Ayana et al. (2021) that used three items on a 5-point Likert scale to measure women's intention to give birth at health facility. Unlike Ayana et al. (2021) study that employed a community-based cross-sectional study design and collected data from women who may have no exposure to healthcare facilities and might lack information on obstetric danger signs, the present study was facility-based cross-sectional and collected data from women who received ANC counselling on obstetric danger signs that positively contributed to women's decision to give birth at a health facility by increasing maternal health literacy. The higher percentage of women deciding to give birth at a health facility supports the findings from other research, which demonstrated that an effective client-provider relationship could positively reinforce women's healthcare utilisation (Abed Saeedi et al. 2013, Ahmad Tajuddin et al. 2020).

The GSEM analysis showed that ANC counselling for women on obstetric danger signs indirectly increased the likelihood of a woman deciding to give birth at a health facility. This indirect effect of ANC counselling on a woman's decision to give birth at a health facility was linked to maternal health literacy. Multivariable linear regression analysis revealed that maternal health literacy is significantly related to the following variables: ANC counselling where the provider explained an increased number of danger signs,

women's school attendance, women who received more than one ANC, and women who received ANC at urban and public facilities. Multivariable logistic regression analysis, on the other hand, showed that women with higher levels of maternal health literacy were more likely to decide to give birth at a health facility. This finding implies that the more information women obtain on obstetric danger signs through counselling during multiple ANC contacts and school attendance, the more likely they are to be aware of obstetric complications and seek skilled care during childbirth. The findings support findings of previous research studies that demonstrated that a woman's choice of where to give birth is influenced by her understanding of and ability to recognise signs of obstetric complications (Abebe et al. 2012, Ameyaw et al. 2020, Asefa et al. 2019, Boah et al. 2018, Hinton et al. 2018, Iftikhar ul Husnain et al. 2018, Sukirman et al. 2020).

The present study findings reinforce and support the WHO's recommendation that providing quality ANC counselling is key to improving a positive pregnancy experience (WHO 2016b). ANC counselling that covers all the obstetric danger signs encourages women to make informed choices and improves health-seeking behaviour by increasing health literacy. Pregnant women are more likely to make an appropriate choice about where to give birth if they are well informed about obstetric complications and the best available and safest options for childbirth services (Asresie and Dagnew 2019, Horiuchi et al. 2020). On the contrary, women who are less informed about signs of obstetric complications are less likely to understand the risks and consequences of homebirth. As a result, they do not seek skilled birth care, perceiving homebirth as a normal phenomenon as practised by previous generations. Previous studies have found that women perceived the risk of giving birth at home without a qualified provider to be the same as that of giving birth at a healthcare facility. Women also believed birth complications are inevitable no matter where the childbirth occurs (Abed Saeedi et al. 2013, Ahmed et al. 2018, Cofie et al. 2015). Homebirth is also a primary preference for women with a previous history of successful homebirth who are not aware that obstetric complications can occur at any time, irrespective of a prior birth outcome (Cofie et al. 2015).

ANC counselling also allows women to become familiar with medical care and helps to psychologically prepare women for birth that positively reinforces the use of healthcare services that becomes routine over time (Adjiwanou and Legrand 2013). Women may learn more about obstetric complications and the importance of early treatment through repeated exposure to healthcare services and interacting with the providers. On the contrary, the fear of the risks of medical interventions such as caesarean section may lead to women avoiding a facility birth (Abed Saeedi et al. 2013, Gardiner et al. 2021). Women may choose to give birth at home if they believe that emotional and family support is only available in this context and not permitted in health facilities (Solnes Miltenburg et al. 2022). Women may think it is unsafe to give birth at a health facility and continue to give birth at home, particularly if they have experienced emotional trauma or abuse in a health facility (Jackson et al. 2020).

The research also found that school attendance and women's decision to give birth at a health facility had statistically significant direct and indirect relationships. Women who had attended school were more likely than those who had not attended school to decide to give birth at a health facility. The study findings echo those of other studies showing that the rate of facility birth is significantly higher among educated women than women with no formal education (Afulani and Moyer 2016, Doctor et al. 2018). The direct effect of school attendance on a woman's decision to give birth at a health facility may be partly explained by the fact that educated women have higher reading skills and can access and understand health-related information from written materials (Smith-Greenaway 2013). As the current Ethiopian general education curriculum addresses a wide range of topics, such as health, population, and the environment (FDRE Ministry of Education 2009), women who attended school compared to non-educated women may be more exposed to health information and therefore may have more knowledge concerning self-care and the need to seek healthcare. In countries with greater gender equity and female education, women are more likely to be empowered to make appropriate health decisions (Sipsma et al. 2013). Tequame and Tirivayi's (2015) study based on the 2011 Ethiopian demographic and health survey data found that education increased women's decision-making on their health by 58%. The indirect effect of school

attendance on women's decision to give birth at a health facility could also be due to the difference in the range of the quality of ANC women receive that varies according to their socio-demographic characteristics. Evidence shows that educated and wealthier women are more likely to receive all recommended components of ANC (Bayou et al. 2016, Islam and Masud 2018).

Strength and limitations

This study provides useful insights into how quality ANC counselling might increase the rate of facility birth by using nationally representative data. Mediation analysis in this study helped to examine the contribution of ANC counselling and the role of maternal health literacy by buffering the influence of socio-economic factors on SBA at birth. Nevertheless, this study is not without limitations. The age of the data is one of the possible limitations as healthcare quality improvement is an ongoing process. The Ethiopian ministry of health has continuously implemented various interventions to improve maternal health, such as training and deploying healthcare providers and increasing the accessibility of health facilities. There might be a social desirability bias as the outcome variable was measured using the client-exit interview. Women may also change their decision to give birth at a health facility. There is a possibility that women who decided to give birth at health facilities could later give birth outside health facilities due to perceived low quality of care or socio-cultural reasons (Gabrysch and Campbell 2009). Hence, the rate of women's decision to give birth at health facilities in the current study might be higher than the actual number of births at health facilities.

5.6. Conclusion

This study has enhanced our understanding of the influence of ANC counselling on obstetric danger signs and a woman's subsequent decision to give birth at a health facility. The findings demonstrate that maternal health literacy plays an important role in where women give birth. Maternal health literacy is influenced by the extent to which women received ANC counselling on obstetric danger signs and whether or not they

attended school. Strengthening counselling on obstetric danger signs during ANC is needed to improve a woman's understanding of the risks associated with pregnancy and childbirth, thereby supporting women to make informed care-seeking decisions.

Summary

The overall findings of my study showed that ANC counselling on obstetric danger signs is a key to a positive pregnancy experience. Counselling for women on obstetric danger signs was not aligned with the WHO recommendations of quality care. Implementing ANC models such as GANC that consider the local context by designing guidelines and training providers improves the quality of ANC counselling. Quality counselling on obstetric danger signs resulted in increased maternal health literacy, increasing the likelihood of SBA uptake. These findings and their implications are discussed in the next chapter.

Chapter 6 Discussion

My research investigated the provision of obstetric danger sign counselling to pregnant women, its relationship with maternal health literacy, and how this influences a pregnant woman's decision where to give birth. This chapter discusses the four main findings of my research study, particularly how each result relates to each other and the implication for policy and practice in Ethiopia and beyond.

Antenatal care counselling of women on obstetric danger signs in LLMICs requires strengthening

The findings from the systematic review from LLMICs demonstrated considerable gaps in ANC counselling women on obstetric danger signs. While it is recommended that every pregnant woman attending ANC should receive ANC counselling on each obstetric danger sign, 13-85% of pregnant women in LLMICs lacked counselling on obstetric danger signs, which varied across countries. The number of obstetric danger signs that were included in the counselling women received also varied greatly, with some women receiving more than others. Likewise, some obstetric danger signs, such as vaginal bleeding, received more attention than others, such as cough or difficulty breathing. The analysis of Ethiopian data also revealed that only two in three women received counselling on at least one obstetric danger sign. The obstetric danger signs discussed most often were vaginal bleeding and headache or blurred vision.

Consistent with the findings of a scoping review study demonstrating the existence of disparities in the delivery of ANC contents in high-income countries (Soares Goncalves et al. 2022), the observed differences in ANC counselling in the current study were related to factors such as existing ANC delivery models, capacity building interventions, pregnant women's socio-demographic characteristics, and also providers' characteristics such as educational level. These variations may also result from ineffective client-provider interaction. Poor point-of-care interactions do not create an environment where pregnant women from diverse cultural and socioeconomic backgrounds can openly communicate with their providers. Ineffective client-provider

interactions may also occur due to a lack of resources and funding to support ANC services at the facility level, or the provider may lack the knowledge and skills required to deliver the service (Downe et al. 2019b).

Although not explored in my research, as the findings are based on 2014 data, contemporary challenges in Ethiopia, such as conflict and the COVID-19 pandemic, may exacerbate inadequate ANC counselling. Violent conflicts and war are increasingly public health challenges in many countries such as Afghanistan, Nigeria, Syria, and South Sudan (Singh et al. 2021, Wagner et al. 2019). Like other countries (Singh et al. 2021), Ethiopia has experienced violent armed conflict that has disrupted healthcare delivery and put the lives of civilians, particularly women and children at risk. Previous studies have shown that conflict and wars negatively impact maternal health and contribute an increase in the MMR (Jawad et al. 2021, Namasivayam et al. 2017, Wise et al. 2021). According to Jawad et al.'s (2021) study, based on data for 181 countries from 2000 to 2019, minor conflicts and war resulted in an additional 300,000 maternal deaths worldwide. In the following section, I discuss how contextual factors influence the quality of ANC counselling in LLMICs and strategies that may support the workforce to deliver quality care.

ANC guidelines and provider training are necessary to increase ANC counselling on obstetric danger signs

My systematic review revealed that ANC counselling on obstetric danger signs in LLMICs was of good quality when tailored ANC guidelines or job aids were used. Findings from the Ethiopian national data, presented in chapter 4, also showed that keeping other observed covariates constant, the availability of ANC guidelines at the facility increased the average number of obstetric danger signs that women received during counselling by up to 24%. This suggests that ANC guidelines assisted the providers to deliver quality ANC counselling for pregnant women. ANC guidelines could improve the quality of ANC counselling for pregnant women on obstetric danger signs in several ways as discussed below.

First, ANC guidelines give providers concise instructions on how to initiate an interactive conversation with pregnant women. Like other healthcare procedures, effective communication between the provider and the recipient is critical to engage and involve patients and families in the health care, educate and support, and provide care tailored to the individual's needs. For example, in a study from Ghana, Lori et al. (2016) found that using a facilitator's guide consisting of picture cards in ANC enhanced information sharing between the provider and pregnant women as well as among other pregnant women. Additionally, effective communication serves as a link between information and health literacy or understanding (Nair et al. 2014). Guidelines provide prompts that enable providers to greet and introduce themselves to women and systematically ask questions. For example, Rowe et al. (2002) demonstrated that the ANC providers who utilised structured checklists that supported them to ask pregnant women as many questions as necessary to explore if they experienced any danger signs. In addition, such structured approaches enhance the interaction and provide women with the opportunity to ask their providers any questions. On the contrary, a lack of guidelines, as shown in a study from the Lao People's Democratic Republic, results in poor client-provider communication and negatively influences the quality of ANC counselling (Phommachanh et al. 2019a). This suggests that guidelines in ANC are necessary to promote dynamic, respectful, and engaging client-provider communication that ensures the exploration and discussion of pregnancy and childbirth-related topics.

Second, ANC guidelines help providers use their time more effectively, which is important considering that the more time a provider spends with a woman, the more likely she is to receive quality ANC. The findings of my systematic review study revealed that the shorter time for client-provider engagement was associated with less counselling on obstetric danger signs. The duration of client-provider interaction during ANC can determine the amount of information delivered to each pregnant woman. For example, due to time constraints, ANC providers in Lao People's Democratic Republic could not provide sufficient information to women (Phommachanh et al. 2019a). In their systematic review of high-income countries, Origlia et al. (2017) found that short ANC consultations did not create a conducive environment for women to ask questions. This

might occur in healthcare settings with greater demand and fewer providers, leaving providers with limited time to think about what type of care each pregnant woman requires (Phommachanh et al. 2019a). In these situations, ANC guidelines contribute to improving the quality and efficiency of ANC by supporting ANC providers to engage in interactive, comprehensive and transparent discussions enabling them to identify what services to provide and how they should be delivered (Jennings et al. 2010, Perreira et al. 2002, Thapa et al. 2019).

Third, ANC guidelines can ensure consistency of care across and within healthcare facilities (Woolf et al. 1999). Guidelines can minimise socio-demographic disparities in the quality of ANC counselling and standardise service provision by encouraging the providers to adhere to the recommended care components (Kebede et al. 2021a). This contributes to the application of evidence-based practice and enables providers to learn from their experience (Amoakoh-Coleman et al. 2016).

Another factor that enables the delivery of quality ANC counselling is on-the-job or in-service training for ANC providers. The importance of an adequate number of well-trained and motivated skilled providers in quality maternal healthcare has received growing attention as a strategy to reduce MMR in LLMICs (Miller et al. 2016). The findings of the systematic review study showed considerable improvement in ANC counselling in LLMICs where providers received on-the-job training. Similarly, an analysis of Ethiopian data showed that ANC-related refresher training for providers significantly increased obstetric danger signs counselling for pregnant women by 37%. The findings support the WHO's quality of care framework for maternal and newborn health, suggesting that competent and motivated providers are required to provide good quality care (Tunçalp et al. 2015).

Human Resources for Health (HRH) interventions that integrate education (both in-service and pre-service) with other components such as policy, finance, partnership, and leadership result in providers' increased motivation and satisfaction for work that subsequently improve the quality of the care women receive (Lassi et al. 2016). Other

studies have showed that workforce capacity building through training, coaching, mentoring, and supervision improves the quality of maternal healthcare services (Negero et al. 2021). Goyet et al. (2019) demonstrated that in-service training in Asian and African countries improved providers' confidence, competence, motivation and willingness to treat pregnant women with dignity and respect. Despite the lack of evidence on how frequently it should be done, literature shows that frequent training, as opposed to one-time training, is more important for keeping providers' skills and knowledge up to date, and it is cost effective in terms of saving lives(Willcox et al. 2017). Ongoing professional training helps every provider gain the knowledge and skills necessary to provide care that meets the diverse healthcare needs of every pregnant woman (Sommer Albert et al. 2020). Moreover, training encourages the providers to adhere to the available guidelines and protocols (Seyoum et al. 2021). This suggests that the quality of ANC counselling relies heavily on providers' knowledge and skills, which must be continuously improved.

ANC counselling on obstetric danger signs is necessary to improve maternal health literacy

A high level of maternal health literacy is essential to enhance the early detection and treatment of obstetric complications and increase a positive pregnancy experience. However, my study findings showed that 13 to 87% of pregnant women in LLMICs lacked maternal health literacy on obstetric danger signs. The review showed that multiple factors influence maternal health literacy, including a woman's socioeconomic status and obstetric history, as well as other contextual factors such as how the ANC was delivered. Discussing each of those factors is beyond the scope of the present study, given that this research focused on understanding the relationship between ANC counselling, maternal health literacy and women's decision on where to give birth. The findings presented in Chapter 2 showed that ANC counselling, using various approaches, improved maternal health literacy. These approaches included GANC, clinic-based ANC education, and home visits by trained ANC providers. ANC guidelines were used, and providers received training to implement these approaches that involved using contextually developed guidelines to enhance care delivery. These approaches increase

opportunities for women to receive counselling on obstetric danger signs and improve maternal health literacy.

Similarly, my analysis of the Ethiopian data showed that maternal health literacy was slightly increased (β=0.09) for every danger sign included in ANC counselling, suggesting that counselling every woman on each obstetric danger sign is beneficial to enhancing their health literacy.

Maternal health literacy and quality ANC counselling can support women to make informed decisions and give birth at a health facility

The analysis of the 2014 ESPA+ showed for every danger sign counselling women received, there was a 4% increase in the number of women who decided to give birth at a health facility. The increase in health facility birth in my study was due to the indirect influence of ANC counselling on maternal health literacy. However, my study found no statistically significant direct effect of ANC counselling on a woman's decision on where to give birth.

Given that a woman's decisions regarding her health and healthcare choices are influenced by her skills, attitudes, knowledge, and socio-economic background (Hinton et al. 2018, Horiuchi et al. 2020, Sukirman et al. 2020), my study findings show that ANC counselling is a critical intervention that can reduce health inequity by improving maternal health literacy. Home birth is common among women with low maternal health literacy and those who perceive home birth as safe or more appropriate than facility birth (Bililign and Mulatu 2017, Pembe et al. 2009). For example, Asefa et al. (2019) found that home birth was sixfold more among women who did not perceive the risks associated with home birth.

Empowering women to make decisions that benefit their health requires women to be well-informed and aware of obstetric complications and the risk of not receiving care from skilled providers. Women's decisions regarding their health are governed by the

interplay between their understanding of the risks of delayed or lack of receiving skilled care and the diverse cultural, spiritual, and social aspects rooted in their lives. For instance, women's intention to continue using ANC depends on their experience of how the care is provided, including whether or not providers' communication is understandable, the type of care they received is socioculturally acceptable, and the privacy is maintained (Downe et al. 2019a). ANC counselling contributes to improved maternal health outcomes by increasing health literacy. Health care counselling also enhances the health outcomes of those experiencing other health challenges such as chronic diseases. For example, Lee et al. (2012) found that tailored counselling improved the health outcomes of cardiovascular patients through improving health literacy. Similarly, Taggart et al. (2012) demonstrated that counselling supported patients to change their behaviour and stop smoking.

Implications of the research

While pregnancy and childbirth carry risks if proactive self-care management and health decisions are not made to detect and manage pregnancy and childbirth complications early, my study, which is based on the IOM health literacy framework, showed that improved maternal health literacy provides pregnant women with a pathway for a positive pregnancy experience. Improving maternal health literacy and encouraging women to seek skilled care is critical to the timely detection and treatment of complications. Improving maternal health literacy necessitates that every woman has access to information and understands obstetric complications during and after pregnancy. In addition, investing in the capacity building of the health workforce through continuous training and supporting their performance with guidelines helps to ensure quality maternal healthcare for a positive pregnancy experience.

How could women's access to health information during pregnancy be expanded?

As depicted in the IOM's health literacy framework (Figure 1), there are numerous interventions that Ministries of Health and the health sector in LLMICs may consider to ensure that every pregnant woman receives quality ANC. This includes supporting a woman to make an informed decision concerning where and how to seek care during pregnancy and childbirth.

In addition to ensuring the availability of ANC guidelines, there is a need to ensure that each health facility is staffed with an appropriate number of healthcare providers. In case of chronic staff shortages, particularly in a fragile context such as the current situation in Ethiopia, effective training and task sharing among healthcare providers may assist services to deliver ANC (Jennings et al. 2011, Nair et al. 2014). In such conditions, delegating ANC counselling tasks to trained lay nurse-midwife auxiliaries may increase women's opportunity to receive ANC counselling on obstetric danger signs (Pembe et al. 2010).

Strategies to improve women's empowerment and efforts to improve maternal health care are necessary. While women's empowerment is a multi-dimensional concept and can be measured using various indicators (Khatiwada et al. 2020), in healthcare, it is focused on enabling women to take an active role in their care and supporting their ability to make informed decisions. Evidence suggests that women who are empowered to practice self-care and make informed decisions throughout their pregnancy and childbirth are more likely to seek healthcare, particularly in a resource-limited setting. Self-care, defined in Chapter 2, is the ability of a woman to assume responsibility for health promotion and disease prevention. This includes a woman's ability to choose nutritious foods, take adequate rest and exercise, and maintain general and personal hygiene (WHO 2019c).

Empowering women to practice self-care is important to improve women's health and wellbeing, particularly in settings where there are difficulties accessing skilled care services due to a lack of resources and infrastructure (Shahil Feroz 2022), or disease outbreaks (Shidhaye et al. 2020), and in humanitarian crises (Dawson et al. 2022). Abbas et al. (2020) demonstrated that women in Afghanistan who received counselling that on the self-administration of misoprostol if they could not reach a facility, or there is no skilled health provider present at a home birth safely used this medication. Among the 1,884 women who delivered at home, 98.7% reported self-use of misoprostol for postpartum haemorrhage prevention and 4.4% or 82 among 1,884 women were diagnosed with postpartum haemorrhage and administered treatment (Abbas et al. 2020).

Women can be empowered to improve maternal decision-making by enhancing their access to education (Sado et al. 2014, Shimamoto and Gipson 2019) and through opportunities to learn together in groups. A meta-analysis of women's groups in Bangladesh, India, Malawi, and Nepal that aimed to increase appropriate ANC and intrapartum care-seeking and appropriate home prevention and care practices for mothers and newborns indicated positive findings (Prost et al. 2013). Exposure to women's groups was associated with a 23% non-significant reduction in maternal mortality and a 20% reduction in neonatal mortality. Women's groups were found to not only be a cost-effective intervention but could save an estimated 283,000 newborn infants and 36,600 mothers per year if implemented in rural areas of 74 countries (Prost et al. 2013).

In Ethiopia, the Women's Health Development Army, which has been operational since 2011, is a promising primary healthcare intervention that promotes women's empowerment and participation in healthcare (FMOH 2015). This initiative involves teams of trained community volunteers delivering health promotion activities in collaboration with health extension workers at the village level. The Women's Health Development Army encourages women in communities to meet in groups, discuss existing health problems and challenges and identify solutions to improve healthcare

uptake. It involves forming a team of five women who are neighbours and selecting one woman to lead the group. A CHW supports and supervises women in the group to actively participate in their health care activities. By doing this, CHWs can deliver primary healthcare services to a greater number of women simultaneously, hence increasing their efficiency. This resulted in increased maternal healthcare uptake, such as ANC and facility birth in Ethiopia (Yitbarek et al. 2019). There are also studies from other countries that show the improvements in maternal and child health as a result of healthcare interventions involving women's groups (Hazra et al. 2020). For example, the community-level integration of microfinance with a health literacy program in India helped women to receive health messages, communicate with each other and share knowledge in the group resulting in increased maternal health literacy and facility birth (Ahmad et al. 2021, Saha et al. 2015). Scaling up such women empowerment strategies into other LLMICs could strengthen primary healthcare services and tailor them to improve maternal health. However, the implementation should consider local socio-cultural contexts, which may necessitate situational analysis and stakeholder engagement to identify what may or may not work in a particular setting (Ploeg et al. 2019).

Increasing women's access to education is a major factor in improving maternal health. Studies conducted in Nepal (Khatiwada et al. 2020) and SSA (Doctor et al. 2018) showed that the likelihood of facility birth was significantly higher among educated women than those without formal education. My study finding presented in Chapter 4 also demonstrated that women's school attendance significantly increased women's decision to give birth at a health facility. This positive contribution of educational status to increase facility birth rate is due to the positive effect of school attainment on maternal health literacy.

Exploring mobile health (mHealth) options that allow women to receive health information during pregnancy and childbirth could also help women have a positive pregnancy experience (Masoi and Kibusi 2019, Wagnew et al. 2018). The use of mHealth initiatives, such as mobile short message service and voice remainders, is gaining

popularity for its contribution to health promotion and disease prevention by increasing access to health information (Feroz et al. 2017, Rono et al. 2021). Mobile short message service and voice reminders can be used to educate women about pregnancy and childbirth, thereby improving their awareness of obstetric complications and birth preparedness. Health information delivered to women via mobile short message service helps them recognise the importance of healthcare uptake during pregnancy and childbirth. Additionally, women could be alerted via mobile short message service about upcoming ANC appointments and their expected date of delivery, reminding them to be prepared for facility birth. For example, in Tanzania, women who received health information via mobile short message service had greater knowledge of danger signs, birth preparedness and complication readiness than those who did not receive the intervention (Masoi and Kibusi 2019). The finding from a systematic review and meta-analysis study in LLMICS also showed that mobile short message services increased the likelihood of ANC and SBA uptake (Wagnew et al. 2018). However, implementing mHealth options requires more research, particularly regarding their feasibility in resource-constrained environments where mobile phone coverage is challenging. A Nigerian study has found that women without mobile phone access had less odds of receiving maternal healthcare indicating that multiple strategies are required to improve maternal health literacy and skilled care uptake (Jennings et al. 2015).

Delivering health information about pregnancy and childbirth in an engaging and entertaining manner, also referred to as entertainment education or edutainment (Firdausia et al. 2021, Jhons Hopkins Bloomberg 2008), may capture women's attention, provide easily digestible messages, and enable women to interpret these messages to inform their decision making. Edutainment involves using drama, film, singing (Jhons Hopkins Bloomberg 2008) and community radio programs (Day 2019) to deliver health messages that align with social norms to elicit the audiences' interest in receiving health information to promote behaviour change. Because of its power to stimulate multisensory learning, entertainment education may capture women's attention and improve their health knowledge and skills (Williams and Swierad 2019). For instance, Sharma et al. (2018) found that singing health messages concerning the importance of

ANC and SBA during childbirth that take into account the local cultural and linguistic contexts successfully raised women's awareness of the importance of timely care during pregnancy and childbirth in Nepal. Similarly, Firdausia et al. (2021) found that edutainment education involving image use and games in Indonesia resulted in increased women's self-care behaviour. While Sharma et al. (2018) and Firdausia et al. (2021) reported the effect of intervention by measuring the differences in change from baseline between intervention and control groups, they did not examine women's experience with the intervention and how it helped to increase women's knowledge and self-care regarding pregnancy and childbirth. The contribution of such intervention to increasing women's knowledge and healthcare uptake could be due to women's emotional connection to characters portrayed in an entertainment education approach (Williams and Swierad 2019).

How could healthcare providers be supported to improve the quality of maternal healthcare?

Improving the quality of maternal healthcare for a positive pregnancy experience also hinges on the availability of a competent, trained, and motivated health workforce. In-service training is crucial to help caregivers develop the necessary knowledge, skills, and attitudes to provide individualised health care. The finding from my study shows that the ANC providers with in-service training provided more danger signs counselling than those without. Rowe et al. (2018), in a systematic review that included 337 citations from LLMICs, also found that provider training resulted in a 2.4% increase in the performance of the caregivers in delivering healthcare service. Continuous on-the-job training and mentoring of caregivers can increase their performance by enhancing their competencies and motivation; and supporting this strategy with practice guidelines and supplies can build a strong healthcare system capable of responding to crisis situations and disease outbreaks (Kruk et al. 2015, Tran et al. 2021). For example, a three to four-day in-service training aimed at updating providers' competencies on safe abortion care in crisis-affected areas of Uganda, Nigeria and the Democratic Republic of Congo found increased providers' confidence to deliver safe abortion services, ability to counsel care-

seekers and understand of human rights and legal laws concerning safe abortion care. This study also found that care providers were more interested in receiving in-service training and suggested that the providers could benefit from the training if it involved practical sessions (Tran et al. 2021). Alongside in-service training, preparing guidelines and ensuring their availability at every maternal health clinic can strengthen providers' ability to deliver the intended quality maternal health care. A lack of guidelines and other necessary supplies, such as medication or equipment is one of the barriers to quality maternal healthcare (Nair et al. 2014). Therefore, healthcare providers must be provided with opportunities to continuously update their knowledge and skills, be supplied with guidelines, and supported by mentoring and supervision. Realising this requires political commitment, strong leadership, collaboration, and partnership, and allocating the necessary budget (Lassi et al. 2016).

Strength of the study

My study is the first to provide evidence on the barriers and facilitators of quality ANC counselling in Ethiopia and LLMICs in general, and the relationship of ANC counselling with maternal health literacy and how this influences women's use of SBA during childbirth in Ethiopia. My study carefully scrutinised the available data to explore a range of approaches to ANC counselling that resulted in improvements in the quality of ANC counselling, taking into account the socio-cultural and other context-related factors. My study is based on nationally representative data (the 2014 ESPA+); therefore, the findings are generalisable to all pregnant women attending ANC clinics in all regional states of Ethiopia.

Study limitations

My research has important limitations which should be considered in interpreting my findings. The first limitation is related to the search strategy in the systematic review that explored the relationship between ANC counselling on obstetric danger signs and maternal health literacy in LLMICs. The search was restricted to peer-reviewed research

articles that reported counselling as part of ANC only. This may have excluded other healthcare interventions that might have discussed maternal health literacy. For instance, studies on mobile message alert system in Tanzania (Masoi and Kibusi 2019) and integration of microfinance with health literacy programs Ahmed et al. (2021) that raised maternal health literacy were not included in the review. Thus, more research on maternal health literacy intervention strategies is warranted to assist policy makers to explore feasible options to improve maternal health in LLMICs.

The second limitation is related to the use of secondary data. Study 1 and 2 were based on the 2014 ESPA+ data analysis and the findings may not represent the current situation in terms of ANC and SBA uptake in Ethiopia, given that the Ethiopian Ministry of Health continuously undertakes quality improvement interventions, such as expanding healthcare facilities, deploying more healthcare providers, and training nurses and midwives on Basic Emergency Obstetric and Newborn Care. Additionally, it is unclear whether the current conflict in some parts of Ethiopia and COVID-19 have undermined maternal healthcare delivery system in the country. Gesesew et al. (2021) study claims that the recent war in Ethiopia contributed healthcare crisis. However, the study has been criticised for methodological flaws and unsubstantiated claims and inflammatory statements (Masebo et al. 2022). Studies from other countries across the world also showed that the COVID-19 pandemic significantly affected the quality of maternal healthcare due to the various measures taken to curb the spread of the infection, such as physical distancing that resulted in reduced emotional and physical support to women seeking healthcare (Asefa et al. 2022). Nevertheless, there is a lack of up-to-date research that evaluated the extent to which training and facility-level ANC guidelines can contribute to enhancing the quality of ANC counselling.

The third limitation of my research is there might be a social desirability and recall bias related to that data on providers' uptake of in-service training was based on providers' self-report. Mostly in-service training in Ethiopia is financially supported by non-governmental organisations and trainees are paid a per diem fee. This per diem fee could be viewed as an incentive, and providers may have reported they did not receive

training, thinking of additional training and associated payment. While my research explored the contribution of ANC guidelines to quality ANC counselling, it did not examine whether the guidelines were simple and easy for the providers to consistently use to deliver ANC services. In this regard, Tessema et al. (2019) argue that consistent use of guidelines in family planning services can be influenced by many factors, such as the provider's familiarity with the guidelines, comprehensiveness of the guidelines, and whether the guidelines are translated into the local language. Though my research estimated unconfounded effect of ANC guidelines and providers' training on ANC counselling in Ethiopia, it did not look into what other factors can influence ANC counselling.

Chapter 7 Conclusion

My research study demonstrates that providing quality ANC counselling to every woman receiving ANC is a turning point in the expectation that every woman who receives ANC will give birth at a health facility, contributing to a positive pregnancy experience and accelerating progress towards the SDGs target of reducing MMR to less than 70 per 100,000 live births. However, ANC counselling has not been consistently provided to every pregnant woman in LLMICs. This inconsistent and poor-quality ANC counselling has resulted in a low level of maternal health literacy. Women need quality ANC counselling to be more aware of obstetric danger signs, understand the importance of seeking timely treatment for any obstetric complications, and give birth at a health facility assisted by an SBA. Women with a low level of maternal health literacy are less likely to give birth assisted by a skilled provider. Interventions improving ANC counselling quality can steer the pregnancy experience to be positive. For instance, using country-context guidelines and ensuring every provider receives on-the-job training continuously (usually every 1 to 2 years) have resulted in quality ANC counselling.

Recommendations

The following recommendations are suggested based on the key findings of this research.

1. Recommendations to the Ministry of Health of Ethiopia (also other LLMICs)

Sufficient funding must be allocated to ANC and, context-specific ANC guidelines development that consider socio-cultural aspects, as well as the current COVID-19 situation is necessary. These ANC guidelines should be made available at each health facility and implemented. The Ministry of Health in Ethiopia should increase opportunities for continuous on-the-job training for every ANC provider. Additionally, training should be aligned with the socio-cultural needs of healthcare beneficiaries. The Ministry of Health in Ethiopia should also consider implementing GANC and assess its feasibility and effectiveness. Jhpiego has registered a protocol for a clinical trial in 2021 aimed at investigating the acceptability, feasibility, and effectiveness of GANC in Ethiopia (Jhpiego 2021). Yet, no evidence of the implementation of this GANC intervention is currently available.

2. Recommendations to healthcare providers and managers

Every ANC provider assigned to deliver ANC and health service managers must ensure that the clinic where the provider works is as convenient as possible to encourage every pregnant woman to feel relaxed and free to engage in open discussions about her care. Managers should also ensure that the number of providers is adequate so that the providers can deliver the service without being overburdened. If the guideline is available, the providers must always use it during each ANC consultation. Preparing leaflets that contain health messages about obstetric danger signs and providing them to every woman may allow women to get more health information. Facility audits and performance management are necessary to evaluate the delivery of quality care.

3. Recommendations to pregnant women and family

Every pregnant woman in Ethiopia is encouraged to have at least four ANC contacts (the recent WHO guideline recommends eight contacts) because increased ANC contacts improve women's awareness of obstetric danger signs. The involvement of husbands in ANC might be beneficial for joint decision-making regarding pregnancy and childbirth care.

4. Recommendations to collaborators

Non-governmental organisations whose missions are improving maternal health must expand their support to address in-service training for the providers and to develop and distribute guidelines.

5. Recommendations to researchers

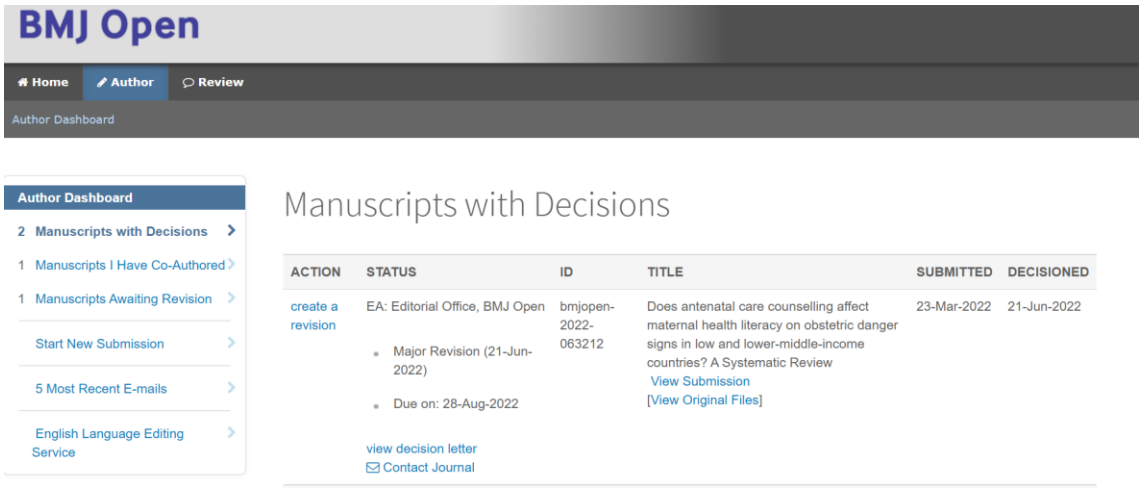
More research is needed to determine whether the available ANC guidelines are consistently followed. Additionally, further research is need to:

- Comprehensively examine what other factors and how they can influence ANC counselling,
- Understand the contribution of maternal health literacy to improved pregnancy outcomes.

Future research should also investigate if guidelines and provider training contribute to providing resilient maternal healthcare in crisis conditions, such as war and the COVID-19 pandemic.

Appendices

Appendix 1 Manuscript submitted to the journal (the latest status Major Revision)



Appendix 2 List of key terms and MeSH terms (based on PICO) for systematic review

"P" refers to the patient (pregnant woman), "C" refers to the control (no intervention), "I" refers to the intervention (counselling on obstetric danger signs), "O" refers to an outcome which is improved maternal health literacy (knowledge of obstetric danger signs).	
Key terms	**MeSH terms**
Patient- Pregnancy	
pregnant	**Pregnancy**
Gestation	
fertility	
Obstetrics	
Expectant mother	
Mother-to-be	
Maternity	
Maternal	
Parturient	
Before delivery	
Childbearing	
Gravidity	
Intervention- Counselling	
Antenatal counselling /antenatal counseling	**Prenatal education**
Prenatal counselling/ prenatal counseling	**Prenatal care**
Advice on healthy pregnancy	
Antenatal message	
Antenatal discussion	
Antenatal information	
Outcome- Knowledge	
Maternal health literacy	Health knowledge, attitudes, practice
Knowledge	Health literacy
Obstetric danger signs	
Obstetric danger signs	Pregnancy complications
Pregnancy complications	
Prenatal complications	
Antenatal complications	
Obstetric warning signs	
Obstetric emergency signs	

Appendix 3 Sample search strategy from PubMed (Searched on 11 March 2022 at 4:20 pm AEST—Australian Eastern Standard Time)

Search	Query	Number of items identified
	(((((((((((((((pregnant[Title/Abstract] OR Gestation[Title/Abstract]) OR fertility[Title/Abstract]) OR Obstetrics[Title/Abstract]) OR Expectant mother[Title/Abstract]) OR Mother-to-be[Title/Abstract]) OR Maternity[Title/Abstract]) OR Maternal[Title/Abstract]) OR Parturient[Title/Abstract]) OR delivery[Title/Abstract]) OR Childbearing[Title/Abstract]) OR Gravidity[Title/Abstract]) OR "pregnancy"[MeSH Terms]) AND (((((((((((((Antenatal counselling[Title/Abstract] OR antenatal counseling[Title/Abstract]) OR Prenatal counselling[Title/Abstract]) OR prenatal counseling[Title/Abstract]) OR (Advice[All Fields] AND healthy pregnancy[Title/Abstract])) OR (Antenatal[All Fields] AND message[Title/Abstract])) OR (Antenatal[All Fields] AND discussion[Title/Abstract])) OR Antenatal information[Title/Abstract]) OR "prenatal education"[MeSH Terms]) OR "prenatal care"[MeSH Terms]) OR counselling[Title/Abstract]) OR counseling[Title/Abstract]) OR "counseling"[MeSH Terms]) OR "counseling"[MeSH Terms])) AND (((knowledge[Title/Abstract] OR Maternal health literacy[Title/Abstract]) OR "health knowledge, attitudes, practice"[MeSH Terms]) OR "health literacy"[MeSH Terms])) AND ((((((Obstetric danger signs[Title/Abstract] OR Pregnancy complications[Title/Abstract]) OR Prenatal complications[Title/Abstract]) OR Antenatal complications[Title/Abstract]) OR (Obstetric[All Fields] AND warning signs[Title/Abstract])) OR (Obstetric[All Fields] AND emergency signs[Title/Abstract])) OR "pregnancy complications"[MeSH Terms])) AND ((("afghanistan"[MeSH Terms] OR "afghanistan"[All Fields]) OR ("benin"[MeSH Terms] OR "benin"[All Fields])) OR ("burkina faso"[MeSH Terms] OR ("burkina"[All Fields] AND "faso"[All Fields]) OR "burkina faso"[All Fields])) OR ("burundi"[MeSH Terms] OR "burundi"[All Fields])) OR ("central african republic"[MeSH Terms] OR ("central"[All Fields] AND "african"[All Fields] AND "republic"[All Fields]) OR "central african republic"[All Fields])) OR ("chad"[MeSH Terms] OR "chad"[All Fields])) OR (Democratic[All Fields] AND Republic[All Fields] AND ("congo"[MeSH Terms] OR "congo"[All Fields]))) OR ("eritrea"[MeSH Terms] OR "eritrea"[All Fields])) OR ("ethiopia"[MeSH Terms] OR "ethiopia"[All Fields])) OR ("gambia"[MeSH Terms] OR "gambia"[All Fields])) OR ("guinea"[MeSH Terms] OR "guinea"[All Fields])) OR ("guinea-bissau"[MeSH Terms] OR "guinea-bissau"[All Fields] OR ("guinea"[All Fields] AND "bissau"[All Fields]) OR "guinea	498 NB: The search is limited to: 1. English language 2. Published between 1990 and March 11/ 2022 3. The study is among human being 4. Abstract available

Sample search continued

Search	Query	Number of items identified
	bissau"[All Fields])) OR ("haiti"[MeSH Terms] OR "haiti"[All Fields])) OR ("democratic people's republic of korea"[MeSH Terms] OR ("democratic"[All Fields] AND "people's"[All Fields] AND "republic"[All Fields] AND "korea"[All Fields]) OR "democratic people's republic of korea"[All Fields])) OR ("liberia"[MeSH Terms] OR "liberia"[All Fields])) OR ("madagascar"[MeSH Terms] OR "madagascar"[All Fields])) OR ("malawi"[MeSH Terms] OR "malawi"[All Fields])) OR ("mali"[MeSH Terms] OR "mali"[All Fields])) OR ("mozambique"[MeSH Terms] OR "mozambique"[All Fields])) OR ("nepal"[MeSH Terms] OR "nepal"[All Fields])) OR ("niger"[MeSH Terms] OR "niger"[All Fields])) OR ("rwanda"[MeSH Terms] OR "rwanda"[All Fields])) OR ("sierra leone"[MeSH Terms] OR ("sierra"[All Fields] AND "leone"[All Fields]) OR "sierra leone"[All Fields])) OR ("somalia"[MeSH Terms] OR "somalia"[All Fields])) OR ("south sudan"[MeSH Terms] OR ("south"[All Fields] AND "sudan"[All Fields]) OR "south sudan"[All Fields])) OR ("mesocricetus"[MeSH Terms] OR "mesocricetus"[All Fields] OR "syrian"[All Fields])) OR ("tajikistan"[MeSH Terms] OR "tajikistan"[All Fields])) OR ("tanzania"[MeSH Terms] OR "tanzania"[All Fields])) OR ("togo"[MeSH Terms] OR "togo"[All Fields])) OR ("uganda"[MeSH Terms] OR "uganda"[All Fields])) OR ("yemen"[MeSH Terms] OR "yemen"[All Fields])) OR ("angola"[MeSH Terms] OR "angola"[All Fields])) OR ("bangladesh"[MeSH Terms] OR "bangladesh"[All Fields])) OR ("bhutan"[MeSH Terms] OR "bhutan"[All Fields])) OR ("bolivia"[MeSH Terms] OR "bolivia"[All Fields])) OR ("cabo verde"[MeSH Terms] OR ("cabo"[All Fields] AND "verde"[All Fields]) OR "cabo verde"[All Fields])) OR ("cambodia"[MeSH Terms] OR "cambodia"[All Fields])) OR ("cameroon"[MeSH Terms] OR "cameroon"[All Fields])) OR ("comoros"[MeSH Terms] OR "comoros"[All Fields])) OR (("congo"[MeSH Terms] OR "congo"[All Fields]) AND Rep.[All Fields])) OR ("cote d'ivoire"[MeSH Terms] OR ("cote"[All Fields] AND "d'ivoire"[All Fields]) OR "cote d'ivoire"[All Fields])) OR ("djibouti"[MeSH Terms] OR "djibouti"[All Fields])) OR ("egypt"[MeSH Terms] OR "egypt"[All Fields])) OR ("el salvador"[MeSH Terms] OR ("el"[All Fields] AND "salvador"[All Fields]) OR "el salvador"[All Fields])) OR ("eswatini"[MeSH Terms] OR "eswatini"[All Fields])) OR ("ghana"[MeSH Terms] OR "ghana"[All Fields])) OR ("honduras"[MeSH Terms] OR "honduras"[All Fields])) OR ("india"[MeSH Terms] OR "india"[All Fields])) OR ("indonesia"[MeSH Terms] OR "indonesia"[All Fields])) OR ("kenya"[MeSH Terms] OR	

Sample search continued

Search	Query	Number of items identified
	"kenya"[All Fields])) OR ("micronesia"[MeSH Terms] OR "micronesia"[All Fields] OR "kiribati"[All Fields])) OR ("kyrgyzstan"[MeSH Terms] OR "kyrgyzstan"[All Fields] OR ("kyrgyz"[All Fields] AND "republic"[All Fields]) OR "kyrgyz republic"[All Fields])) OR (Lao[All Fields] AND PDR[All Fields])) OR ("lesotho"[MeSH Terms] OR "lesotho"[All Fields])) OR ("mauritania"[MeSH Terms] OR "mauritania"[All Fields])) OR ("micronesia"[MeSH Terms] OR "micronesia"[All Fields])) OR ("moldova"[MeSH Terms] OR "moldova"[All Fields])) OR ("mongolia"[MeSH Terms] OR "mongolia"[All Fields])) OR ("morocco"[MeSH Terms] OR "morocco"[All Fields])) OR ("myanmar"[MeSH Terms] OR "myanmar"[All Fields])) OR ("nicaragua"[MeSH Terms] OR "nicaragua"[All Fields])) OR ("nigeria"[MeSH Terms] OR "nigeria"[All Fields])) OR ("pakistan"[MeSH Terms] OR "pakistan"[All Fields])) OR ("papua new guinea"[MeSH Terms] OR ("papua"[All Fields] AND "new"[All Fields] AND "guinea"[All Fields]) OR "papua new guinea"[All Fields])) OR ("philippines"[MeSH Terms] OR "philippines"[All Fields])) OR ("sao tome and principe"[MeSH Terms] OR ("sao"[All Fields] AND "tome"[All Fields] AND "principe"[All Fields]) OR "sao tome and principe"[All Fields])) OR ("senegal"[MeSH Terms] OR "senegal"[All Fields])) OR ("melanesia"[MeSH Terms] OR "melanesia"[All Fields] OR ("solomon"[All Fields] AND "islands"[All Fields]) OR "solomon islands"[All Fields])) OR ("sudan"[MeSH Terms] OR "sudan"[All Fields])) OR ("timor-leste"[MeSH Terms] OR "timor-leste"[All Fields] OR ("timor"[All Fields] AND "leste"[All Fields]) OR "timor leste"[All Fields])) OR ("tunisia"[MeSH Terms] OR "tunisia"[All Fields])) OR ("ukraine"[MeSH Terms] OR "ukraine"[All Fields])) OR ("uzbekistan"[MeSH Terms] OR "uzbekistan"[All Fields])) OR ("vanuatu"[MeSH Terms] OR "vanuatu"[All Fields])) OR ("vietnam"[MeSH Terms] OR "vietnam"[All Fields])) OR (("middle east"[MeSH Terms] OR ("middle"[All Fields] AND "east"[All Fields]) OR "middle east"[All Fields] OR ("west"[All Fields] AND "bank"[All Fields]) OR "west bank"[All Fields]) AND Gaza[All Fields])) OR ("zambia"[MeSH Terms] OR "zambia"[All Fields])) OR ("zimbabwe"[MeSH Terms] OR "zimbabwe"[All Fields])) AND ("1990/01/01"[PDAT] : "2022/03/11"[PDAT]) AND ("humans"[MeSH Terms] AND English[lang])	

Appendix 4 Methodological quality appraisal of the research articles included in the systematic review, using the JBI checklists

1. Methodological quality appraisal, cross-sectional studies

Journal article	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	100%
(Akshaya and Shivalli 2017)	Y	Y	Y	Y	N	N	Y	Y	75
(Anastasi et al. 2015)	Y	Y	Y	Y	Y	Y	Y	Y	100
(Anya et al. 2008)	Y	Y	Y	Y	U	U	Y	Y	75
(Assaf 2018)	NA	Y	Y	Y	Y	Y	Y	Y	100
(Azeze et al. 2019)	N	Y	Y	Y	Y	Y	Y	Y	87.5
(Bayou and Gacho 2013)	N	Y	Y	Y	Y	Y	Y	Y	87.5
(Bintabara et al. 2015)	Y	Y	Y	Y	Y	Y	Y	Y	100
(Bintabara et al. 2017)	Y	Y	Y	Y	Y	Y	Y	Y	100
(Brazier et al. 2014)	N	Y	Y	Y	Y	Y	Y	Y	87.5
(Duysburgh et al. 2013)	Y	Y	Y	Y	Y	Y	Y	Y	100
(Gebre et al. 2015)	Y	Y	Y	Y	Y	Y	Y	Y	100
(Ijang et al. 2019)	Y	Y	Y	Y	Y	Y	Y	Y	100
(Kusuma et al. 2018)	N	Y	Y	Y	Y	Y	Y	Y	87.5
(Lakew et al. 2016)	N	Y	Y	Y	Y	Y	Y	Y	87.5
(Mutiso et al. 2008)	N	Y	U	Y	N	N	Y	Y	50
(Mwilike et al. 2018)	Y	Y	Y	Y	N	N	Y	Y	75
(Nkamba et al. 2021)	Y	Y	Y	Y	Y	N	Y	Y	87.5
(Pembe et al. 2009)	N	Y	U	Y	Y	Y	Y	Y	75
(Pembe et al. 2010)	N	Y	Y	Y	Y	Y	Y	Y	87.5
(Salem et al. 2018)	Y	Y	Y	Y	Y	Y	Y	Y	100
(Sarker et al. 2010)	N	Y	Y	Y	N	N	Y	Y	62.5
(Smeele et al. 2018)	U	Y	Y	Y	Y	Y	Y	Y	87.5
(Vallely et al. 2019)	N	Y	Y	Y	N	N	Y	N	50
(Woldeamanuel et al. 2019)	Y	Y	Y	Y	Y	Y	Y	Y	100

Q1: Were the criteria for inclusion in the sample clearly defined? Q2: Were the study subjects and the setting described in detail? Q3: Was the exposure measured in a valid and reliable way? Q4: Were objective, standard criteria used for measurement of the condition? Q5: Were confounding factors identified? Q6: Were strategies to deal with confounding factors stated? Q7: Were the outcomes measured in a valid and reliable way? Q8: Was appropriate statistical analysis used?

2. Methodological quality appraisal, RCT studies

Journal article	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	100%
(Darmstadt et al. 2010)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
(Jennings et al. 2010)	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	84.6
(Mullany et al. 2009)	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	84.6
(Thapa et al. 2019)	N	N	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	61.5

Q1: Was true randomization used for assignment of participants to treatment groups?, Q2: Was allocation to treatment groups concealed?, Q3: Were treatment groups similar at the baseline?, Q4: Were participants blind to treatment assignment?, Q5: Were those delivering treatment blind to treatment assignment?, Q6: Were outcomes assessors blind to treatment assignment?, Q7: Were treatment groups treated identically other than the intervention of interest?, Q8: Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed? Q9: Were participants analyzed in the groups to which they were randomized?, Q10: Were outcomes measured in the same way for treatment groups?, Q11: Were outcomes measured in a reliable way?, Q12: Was appropriate statistical analysis used?, Q13: Was the trial design appropriate, and any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and analysis of the trial?

3. Methodological quality appraisal, quasi-experimental studies

Journal article	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	100%
(Eze et al. 2020)	Y	Y	Y	NA	Y	U	Y	Y	U	75
(Nuraini and Parker 2005)	Y	Y	Y	Y	Y	Y	Y	Y	Y	100
(Perreira et al. 2002)	Y	U	NA	N	N	Y	Y	Y	Y	62.5

Q1: Is it clear in the study what is the 'cause' and what is the 'effect' (i.e. there is no confusion about which variable comes first)?, Q2: Were the participants included in any comparisons similar?, Q3: Were the participants included in any comparisons receiving

similar treatment/care, other than the exposure or intervention of interest?, Q4: Was there a control group?, Q5: Were there multiple measurements of the outcome both pre and post the intervention/exposure?, Q6: Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed? Q7: Were the outcomes of participants included in any comparisons measured in the same way? Q8: Were outcomes measured in a reliable way?, Q9: Was appropriate statistical analysis used?

4. Methodological quality appraisal, qualitative studies

Journal article	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	100%
(Bakar et al. 2019)	U	Y	Y	Y	Y	N	N	Y	N	Y	60
(Lori et al. 2014)	U	Y	Y	Y	Y	Y	Y	Y	Y	Y	90
(Sripad et al. 2019)	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	80

Q1: Is there congruity between the stated philosophical perspective and the research methodology?, Q2: Is there congruity between the research methodology and the research question or objectives?, Q3: Is there congruity between the research methodology and the methods used to collect data?, Q4: Is there congruity between the research methodology and the representation and analysis of data?, Q5: Is there congruity between the research methodology and the interpretation of results?, Q6: Is there a statement locating the researcher culturally or theoretically?, Q7: Is the influence of the researcher on the research, and vice-versa, addressed?, Q8: Are participants, and their voices, adequately represented?, Q9: Is the research ethical according to current criteria or, for recent studies, and is there evidence of ethical approval by an appropriate body?, Q10: Do the conclusions drawn in the research report flow from the analysis, or interpretation, of the data?

5. Methodological quality appraisal, Cohort studies

Journal article	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	100%
(Adaji et al. 2019)	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	81.82
(Karkee et al. 2014)	Y	N	Y	Y	Y	Y	Y	U	U	U	Y	63.64
(Lori et al. 2017)	Y	Y	Y	Y	Y	Y	Y	Y	Y	NA	Y	90.9
(Shukla et al. 2019)	Y	N	Y	Y	Y	Y	Y	Y	Y	NA	Y	81.82

Q1: Were the two groups similar and recruited from the same population?, Q2: Were the exposures measured similarly to assign people to both exposed and unexposed groups?, Q3: Was the exposure measured in a valid and reliable way?, Q4: Were confounding factors identified?, Q5: Were strategies to deal with confounding factors stated?, Q6: Were the groups/participants free of the outcome at the start of the study (or at the moment of exposure)?, Q7: Were the outcomes measured in a valid and reliable way?, Q8: Was the follow up time reported and sufficient to be long enough for outcomes to occur?, Q9: Was follow up complete, and if not, were the reasons to loss to follow up described and explored?, Q10: Were strategies to address incomplete follow up utilized?, Q11: Was appropriate statistical analysis used?

Appendix 5 Summary of the studies included in the systematic review

Citation and country	Aim	Study design	Population and number of participants	Measure of knowledge of obstetric danger signs	Counselling on danger signs offered	Knowledge of obstetric danger signs
(Adaji et al. 2019) Nigeria	Assessed the women's experience of group antenatal care (GANC).	Prospective observational study	161 pregnant women attending ANC	Measured knowledge of obstetric danger signs based on women's ability to recall eight danger signs at the time of entry to the GANC and one week after pregnancy.	A handbook consisting of eight topics of discussion was developed to guide each session. Topics were: (1) knowing your body, (2) common discomforts of pregnancy, (3) hygiene, (4) nutrition during pregnancy, (5) danger signs of pregnancy and childbirth, (6) preparations for an emergency, (7) breastfeeding, and (8) baby care. Each session lasted for 3 hours, and the intervention duration was one year.	Of the 138 women included in the analysis, 50.7% knew about excessive bleeding at the point of entry, and 78.1% out of 105 women knew at post-childbirth. The mean knowledge score significantly increased from 31% to 47.8%. Women who could mention at least 5 out of 8 danger signs increased from 2 to 14.
(Akshaya and Shivalli 2017) India	Assessed the Birth preparedness and complication readiness (BPCR) practice and associated factors.	A facility-based cross-sectional study. Data were collected through exit client interviews of women attending ANC.	184 women involved in the study (60 pregnant with gestational age of more than 28 weeks and, 124 women have given birth in the last six months from the date of data collection).	Reported women knowledgeable when they could recall at least two danger signs in each phase or a minimum of 6 danger signs in three phases.	Women had information about BPCR. The finding showed that a healthcare provider informed two-thirds (62%) of women about BPCR. Women were provided the mother-child protection card that consisted of a list of danger signs.	Nearly 80% of women knew at least one danger sign. 53.8% of women knew at least two danger signs in each phase (6 danger signs). Awareness of at least six obstetric danger signs was significantly higher (64.9%) among those who received information/counselling on

Citation and country	Aim	Study design	Population and number of participants	Measure of knowledge of obstetric danger signs	Counselling on danger signs offered	Knowledge of obstetric danger signs
						BPCR than those who did not (35.7%).
(Anastasi et al. 2015) Uganda	Assessed the gap between ANC and SBA at birth.	Cross-section study (community-based mixed-study of quantitative and qualitative).	Quantitative: Pregnant women Qualitative: traditional birth attendants (TBA), women, men, health workers, and policymakers. In the quantitative section, 139 women were included, but fewer women were dropped out due to missing data variables. In the qualitative section, semi-structured interview with 36 women, ten health workers, ten policy workers and Focus Group Discussions with ten women, 20 men, and 20 TBA were conducted.	Knowledge of danger signs during pregnancy was not reported. Knowledge during childbirth was reported as the percentage of women who knew any danger signs (one, two, three or more danger signs).	73.6% of women were informed about the need for birthing at a health facility. The consultation took individual perceptions of the risk of birth (self and baby, including danger signs) into account.	32.4% did not know any danger signs. 36.62% of women knew one danger sign. 8.45% of women knew two danger signs. 22.54% of women knew three or more danger signs. 58.2% of women gave birth at a health facility to their last child. Those who received advice at their ANC visit had higher odds of using facility birth AOR=2.83.

Citation and country	Aim	Study design	Population and number of participants	Measure of knowledge of obstetric danger signs	Counselling on danger signs offered	Knowledge of obstetric danger signs
(Anya et al. 2008) The Gambia	Assessed the provision of information to ANC visiting women. Determined the experience of pregnant women with antenatal Information Education and Communication (IEC). Determined the level of awareness of pregnant women on obstetric danger signs and compared this between urban and rural women.	Facility-based cross-sectional study. Client exit interview and document review were done.	457 pregnant women attending ANC were involved. A mix of quota and systematic random sampling was used.	The study reported each obstetric danger sign that women were able to mention.	The study indicated that there was a client-provider interaction that lasted 3 to 10 minutes. The topics addressed in antenatal counselling were diet and nutrition (35.4%), how to get health facility (31.1%), benefits of birthing at a health facility (30.6%), care of a baby (30.4%), STIs and HIV/AIDS (30%), family planning (23.6%), place of birth (22.8%) and what to do if there is an obstetric emergency such as vaginal bleeding and seizure (19.3%). There was poor client-provider communication. Clients reported: being told progress of pregnancy (25.4%), being asked the ANC provider questions (12.8%) having understood answers given by the provider (94.8%) being asked to return for another visit (69.5%)	Less than 40% of women recalled being informed about the importance of nutrition during pregnancy, care of the baby, place where to give birth, and family planning. Women were able to mention danger signs for: Anaemia 28.9% Hypertension 24.6% Haemorrhage 14.8% Fever 12.9% Puerperal sepsis 5% Abdominal pain 43.3% Provision of information on what to do during an emergency was recalled by fewer women (31.1%).

Citation and country	Aim	Study design	Population and number of participants	Measure of knowledge of obstetric danger signs	Counselling on danger signs offered	Knowledge of obstetric danger signs
(Assaf 2018) Haiti, Malawi and Senegal	Assessed the level of agreement between counselling and knowledge of obstetric danger signs.	Cross-sectional study using service provision assessment (SPA) dataset. Client exit interview and observation were used	4899 ANC attending pregnant women were involved in the analysis.	Measured obstetric danger signs during pregnancy (vaginal bleeding, fever, swollen face or hands, tiredness or breathlessness, headache or blurred vision, cough or difficulty of breathing, and reduced or no foetal movement). The primary outcome variable was the number of danger signs reported by the women in the exit interview. Compared the number of danger signs counselled with the number of danger signs that the client could mention during the exit interview. Reported the mean number of obstetric danger signs known by the women.	Direct observation of health care provider during ANC consultation indicated 51% of women in Haiti, 54% of women in Malawi and 38%of women in Senegal were provided with counselling on obstetric danger signs. The average duration of ANC consultations in the three countries was less than 20 min.	More than half of women in each country mentioned at least one danger sign (65.1% in Senegal, 55.1% in Malawi, and 57.4% in Haiti), but no woman knew all the seven danger signs. Vaginal bleeding was the most known danger sign in the three countries (30% in Haiti and 45% in Malawi and Senegal). Provision of counselling on obstetric danger signs was significantly associated with women's knowledge of obstetric danger signs in Senegal and Malawi but insignificant in Haiti. The mean number of obstetric danger signs mentioned was 1.1 in Haiti, 1.6 in Malawi, and 1.7 in Senegal. In Haiti and Malawi, there was a significant agreement between the mean number of obstetric danger signs

Citation and country	Aim	Study design	Population and number of participants	Measure of knowledge of obstetric danger signs	Counselling on danger signs offered	Knowledge of obstetric danger signs
						known and the number of danger signs addressed in counselling, but insignificant in Senegal.
(Azeze et al. 2019) Ethiopia	Assessed the BPCR.	Community-based cross-sectional study.	495 pregnant and postpartum women who gave birth in the last 12 months preceding the survey were selected by systematic sampling that involved a multi-stage sampling technique.	Reported knowledge of danger signs by considering women who were able to mention at least three danger signs.	Did not report counselling on obstetric danger signs. Instead, the status of counselling on the components of BPCR such as arranging funds, planning where to go in case of emergencies, arranging blood donors, identifying SBA, identifying a place of birth, arranging transportation was reported. Counselling on: Place where to go in case of emergency 33.9%, Blood donor 18.6%, Identify SBA 31.7%, Saving funds 32.3%, Place of birth 80.8%, Arrange transportation 57%,	9.3% of women knew at least three danger signs. Counselling to identify a place of birth increased birth preparedness by 60%, and counselling on preparing blood donors increased BPCR by 90%. Association of Knowledge of obstetric danger signs with BPCR was insignificant.
(Bakar et al. 2019) Tanzania	Explored awareness of obstetric danger signs.	Community based exploratory qualitative study.	108 reproductive age group women who were pregnant were involved from purposively selected	The study used the explorative approach and reported women's awareness of each of the obstetric danger signs.	The study reported that the only source of information on obstetric danger signs for pregnant women was healthcare providers during ANC.	Most women (unquantified) knew danger signs during pregnancy such as vaginal bleeding, body swelling and acknowledged that knowing danger signs in advance

Citation and country	Aim	Study design	Population and number of participants	Measure of knowledge of obstetric danger signs	Counselling on danger signs offered	Knowledge of obstetric danger signs
			high populous areas.		Women reported that some healthcare workers provided them with phone numbers for further communication if they experience problems such as bleeding. Most women received health information on danger signs during ANC. Some continued consulting traditional healers for medical care and advice on danger signs. This resulted in delays to seek professional medical care.	would help for emergency preparedness. Women mentioned that if they routinely attended the scheduled ANC visits, they would get health education on obstetric danger signs, birth preparedness and skilled birth service uptake. However, the late commencement of ANC could not help women to receive important health education. Some women agreed on the importance of early care seeking when obstetric danger signs occur. Contrarily, others believed danger signs are due to witchcraft, and in this case, traditional healers are the persons from whom the care is sought. Some focus group discussants also believed that a woman should not expose her pregnancy early

Citation and country	Aim	Study design	Population and number of participants	Measure of knowledge of obstetric danger signs	Counselling on danger signs offered	Knowledge of obstetric danger signs
						to avoid evil eyes that cause maternal death.
(Bayou and Gacho 2013) Ethiopia	Assessed the women's utilisation of clean and safe delivery (birth) services of health extension programs.	Community-based cross-sectional study.	226 women were selected by multi-stage sampling among those who gave birth in the last 12 months before the data collection.	The components of danger signs during pregnancy and assessed were: severe vaginal bleeding, swollen face/hands, blurred vision, and dichotomised into knowing at least two danger signs during pregnancy and childbirth or not knowing at least two danger signs.	66.7% of women self-reported reception of counselling. Of the women who attended ANC, 33.3% of women were not counselled about obstetric danger signs.	27% of women knew at least two danger signs. Women who knew at least two danger signs of pregnancy and childbirth were 5.4 times more likely to receive SBA at birth.
(Bintabara et al. 2015) Tanzania	Assessed the BPCR.	Community-based cross-sectional	428 women were selected by a multi-stage clustered sampling among women who gave birth in the last 24 months regardless of the newborn outcome.	Women were regarded as knowledgeable for obstetric danger signs during three phases (pregnancy, childbirth and postpartum). Danger signs during pregnancy include vaginal bleeding, swollen hands/face and blurred vision. Danger signs during childbirth include severe vaginal bleeding, prolonged labour >12hours, convulsion and retained placenta. Danger signs during postpartum include severe vaginal bleeding, foul-	Did not report counselling or information provision on obstetric danger signs However, the study reported counselling on birth preparedness (90.2%) and complication readiness (84.8%). Details about the counselling components are not indicated.	68.7% of women did not know any danger signs in three phases 6.1% knew 1-4 danger signs in three phases 23.6% knew at least five danger signs in three phases

Citation and country	Aim	Study design	Population and number of participants	Measure of knowledge of obstetric danger signs	Counselling on danger signs offered	Knowledge of obstetric danger signs
				smelling vaginal discharge, and high fever.		
(Bintabara et al. 2017) Tanzania	Determined the knowledge of obstetric danger signs and associated factors.	Community-based cross-sectional study	428 women selected by multi-stage clustered sampling technique among women who gave birth in the last two years preceding the data collection.	Women were considered as knowledgeable for obstetric danger signs if they could mention at least five danger signs in the three phases (during pregnancy, childbirth and postpartum) with at least one danger sign in each phase.	The regression model indicated counselling on obstetric danger signs included in the study. The study indicated 363 (84.81%) women received counselling on obstetric danger signs.	Regarding knowledge of obstetric danger signs: during pregnancy, 25.2% of women spontaneously mentioned vaginal bleeding, 20.6% of women mentioned blurred vision, 20.1% of women mentioned swelling. During childbirth: 27.8%, 17.1%, 14.0% and 15.9% of respondents spontaneously mentioned severe vaginal bleeding, retained placenta, prolonged labour, and convulsions as key danger signs during childbirth or labour, respectively. During the postnatal period: 25.9%, 15.2%, 14.3% spontaneously mentioned severe vaginal bleeding, high fever, and foul-smelling vaginal discharge, respectively.

Citation and country	Aim	Study design	Population and number of participants	Measure of knowledge of obstetric danger signs	Counselling on danger signs offered	Knowledge of obstetric danger signs
						68.7% did not mention any danger signs in the three phases, while the remaining 31.3% mentioned at least one danger sign. 25.2% mentioned five key danger signs in the three phases. Counselling increased the odds of knowledge of obstetric danger signs more than three times.
(Brazier et al. 2014) Guinea	Explored women's knowledge on BPCR and association of each with healthcare-seeking for institutional birth.	Community-based cross-sectional study The data collection was completed in 6 weeks period. Exposure variables were counselling on BPCR and community level maternal health promotion.	2,335 women (1,333 women gave birth within the last 5 years and 763 women gave birth within the last 24 months preceding data collection)	Measured complication readiness by taking the following components: saved money, identified a place of birth, arranged transport, discussed the plan of birth with the partner/family, obtained approval for delivery plans from the decision-maker/ partner The score of two was used as a cut-off point to dichotomise into high and low. Additionally, birth preparedness was measured	Counselling during ANC was assessed for the following components: provision of counselling on (1). giving birth at a health facility, (2). advised about danger signs during pregnancy and childbirth, (3). advised on any birth preparedness, including saving money, discussing birth plans with family, arranging transport, and arranging potential blood donors. From the total score of 3, a cut-off point equal to	45% of women had high BPCR, 40% had a high score in community exposure index 31% had a high score on the BP knowledge index 14% had a high score on the CR knowledge index 81% had at least 1 ANC 57% had 4 ANC visits 52% had facility birth for the recent child Birth preparedness was positively associated with the provision of counselling

Citation and country	Aim	Study design	Population and number of participants	Measure of knowledge of obstetric danger signs	Counselling on danger signs offered	Knowledge of obstetric danger signs
		Analysis to identify factors associated with BPCR was done only for those who gave birth within the last 24 months to reduce a recall bias.		using the following components: discussed on facility birth, discussed means of transport, discussed how to pay for birth service, identified possible blood donors, saved money. A cut-off point greater than or equal to three was used to dichotomise into high and low BP. Further, community exposure index was created by considering whether women had exposure to community-level maternal health promotion, local health and hygiene committee, other community-level health agents. A score equal to or greater than two from a total of three was used to categorise it into high and low.	or greater than two was used to dichotomise into high and low exposure to counselling on birth preparedness. According to this criterion, 45% of women had a high BP/CR counselling index.	on BPCR AOR=4, attendance of more than 4 ANC visits AOR=1.6, and BP knowledge index AOR=2.2
(Darmstadt et al. 2010) Bangladesh	Examined the impact of a package of community-based maternal	Cluster RCT. Community health workers did two home visits during the pregnancy and	The analysis included women who gave birth in the three years	Measured change in the average composite score of knowledge of obstetric danger signs during the antenatal period (0-10),	The intervention consisted of multiple components, including delivering information on obstetric danger signs while	The mean knowledge scores for comparison at baseline and end line were 1 & 2.2, respectively, while the intervention group's

Citation and country	Aim	Study design	Population and number of participants	Measure of knowledge of obstetric danger signs	Counselling on danger signs offered	Knowledge of obstetric danger signs
	and newborn interventions.	four visits during the postpartum period).	preceding the survey. At baseline 9,987 women in the intervention and 11,153 in the comparison group. The number of women who gave live birth was: in the comparison group at baseline 2,644, at end line 1,759, and in the intervention group at baseline 2,371 and end line 1,732.	during childbirth (0-11) and during the postnatal period (0-9). The number of danger signs was 10 during pregnancy, 11 during childbirth and 9 during the postpartum period.	community health workers visited home during pregnancy.	knowledge score at baseline and end line were 1.1 & 2.9, respectively. The increase in the mean number of obstetric danger signs was significantly higher (1.8) in the intervention group than 1.1 in the control group.
(Duysburgh et al. 2013) Burkina Faso, Ghana and Tanzania	Assessed providers counselling practice on seven danger signs.	Facility-based cross-sectional study Observation and client exit interview were used to collect data. The observation was to assess providers	Studied pregnant women attending ANC at health facilities. To avoid potential bias, women participating in client exit interview were not the same as those	Seven individual danger signs were assessed by exit client interview approach.	Counselling on seven danger signs was observed directly. The seven danger signs were (i) vaginal bleeding, (ii) convulsions, (iii) severe headache with blurred vision, (iv) fever and being too weak to get out of bed, (v) severe abdominal pain, (vi) fast and difficult breathing, and (vii) swelling of fingers, face and legs.	Awareness of danger signs among the women was poor. In Burkina Faso, 58.2% were unable to mention any of the seven danger signs; in Ghana, 21.7%; and in Tanzania, 30.0%. Only three of 644 women interviewed in Burkina Faso were able to mention all seven danger signs, in Ghana, one of 710

Citation and country	Aim	Study design	Population and number of participants	Measure of knowledge of obstetric danger signs	Counselling on danger signs offered	Knowledge of obstetric danger signs
		counselling practice and exit client interview was to assess a client's knowledge of obstetric danger signs.	participating in the observation. The study planned to observe at least 35 ANC consultations and at least 60 women in a client exit interview in each health facility. Twelve health centres were involved in each country. The number of women observed was 411 in Burkina Faso, 420 in Ghana, and 418 in Tanzania. The number of women included in the exit client interview was 644 in Burkina Faso, 710 in Ghana, and 611 in Tanzania.		The most counselled danger signs were severe abdominal pain (66.4%) followed by vaginal bleeding (51.6%) in Burkina Faso, vaginal bleeding (60%) followed by severe abdominal pain in Ghana, vaginal bleeding (57.2%) followed by severe abdominal pain (54.3%) in Tanzania. The least counselled danger signs were swelling of extremities and face in Burkina Faso (11.4%, convulsions in Ghana (38.6%) and fast and difficult breathing in Tanzania (25.6%). From observation, about 1/3 of women were not counselled in any of the seven danger signs. Only 5.4% of women in Burkina Faso, 30.0% in Ghana and 22.5% in Tanzania were counselled on all seven danger signs.	women, and in Tanzania, none of the 611 women interviewed was able to mention all seven danger signs. Awareness of danger signs matches the danger signs counselled on

Citation and country	Aim	Study design	Population and number of participants	Measure of knowledge of obstetric danger signs	Counselling on danger signs offered	Knowledge of obstetric danger signs
					Health staff with a higher educational level provided better counselling in Burkina Faso. Still, in Tanzania, some of the less educated health cadres offer better counselling than their higher-educated colleagues.	
(Eze et al. 2020) Nigeria	To assess the influence of community behaviour change intervention in improving BPCR	Non-randomised experimental study. The interventions included advocacy visits and stakeholder engagement, training of community health workers, and household members and community leaders on BPCR, facilitation of emergency transport scheme. Trained CHWs provided training to pregnant women on BPCR	Pregnant women from rural are aged 18 and above. The sample was 150 before the intervention and 153 after the intervention.	Reported individual (discrete variables) of each danger sign as well as a composite score of knowledge danger signs that women knew.	Women received information on obstetric danger signs from trained health workers (64.5%), radio (21%) and print media (7.3%).	Women's knowledge of danger signs significantly increased from 3.96 to 4.31 after the intervention. The study explained that the increase in knowledge of danger signs could be due to information from healthcare providers.

Citation and country	Aim	Study design	Population and number of participants	Measure of knowledge of obstetric danger signs	Counselling on danger signs offered	Knowledge of obstetric danger signs
		and distributed IEC materials that contained information on danger signs, and childbirth.				
(Gebre et al. 2015) Ethiopia	Assessed PBCR and its associated factors.	Community-based cross-sectional study	569 pregnant women (gestational age of at least three months) were selected through multi-stage sampling. The provision of counselling was assessed among 342 women, and knowledge of danger signs was	The study did not emphasise knowledge of obstetric danger signs. Taking BPCR as an outcome variable, the study included knowledge of obstetric danger signs as an independent variable. In the regression model, knowledge of obstetric danger signs was dichotomised into two (stated as women who had knowledge of at least two danger signs and rated as 'yes' and 'no'). Women who had BPCR on at least 3 out of 5 components were considered well prepared.	Did not report details about counselling provision on obstetric danger signs. However, the regression result of the study indicated 83.3% of women received counselling on obstetric danger signs.	The number of women who knew at least two danger signs was reported 40.4% during pregnancy, 67.3% during childbirth and 28.8% during the postpartum period.
(Ijang et al. 2019) Cameroon	Assessed BPCR.	Facility-based Cross-sectional	345 pregnant women (gestational age of more than 32 weeks) attending ANC at governmental	A woman was considered as knowledgeable for obstetric danger signs if she could spontaneously mention at least three of any danger signs.	53% received information on danger signs 27.8% of them testified being provided with information on	Regarding the knowledge of unforeseen problems during pregnancy, leading to the woman's death, 305(88.4%) reported that it was possible, while 40(11.6%)

Citation and country	Aim	Study design	Population and number of participants	Measure of knowledge of obstetric danger signs	Counselling on danger signs offered	Knowledge of obstetric danger signs
			health facilities were included in the analysis. Convenient sampling was utilised (based on their willingness).	BPCR was categorised into "prepared" and "not prepared" based on the following seven components: identified health facility, saved funds for birth/complications, identified means of transportation in birth/emergency, identified blood donors, packed necessary materials for birth, identified decision-maker and birth companion.	obstetric danger signs during ANC follow-up	responded that it was impossible. 87.5% knew some of the danger signs. Vaginal bleeding was the most known 73.9%, followed by severe abdominal pain 40.6%, high fever 21.2%, abnormal foetal movement 17.4%.
(Jennings et al. 2010) Benin	Examined the effect of a job aids-focused intervention on quality of counselling and maternal understanding of care for mothers and newborns.	RCT (pre-and post-intervention). The intervention was the use of job aids and staff training.	686 pregnant women (415 intervention and 271 in the control group). Also, 55 ANC providers were involved in the study.	Maternal knowledge was measured based on the proportion of women with knowledge of at least three items within each topic area. This means maternal knowledge of obstetric danger signs was measured if she recalls at least three danger signs. The change in knowledge accounted by the intervention was measured before and after the	Counselling job aids were developed. The job aids are pictorial cards that contained culturally appropriate pictures designed to facilitate counselling sessions. The aids are based on the national ANC guideline. The counselling card has two sides, one side has a list of key messages to the provider guiding his/her counselling, and the other side consists of pictures illustrating the	51% of pregnant women in the intervention and 36% of women in the control group received the recommended messages. The difference in difference result showed an increased number of women who could recall at least three obstetric danger signs. In the control group, the percentage of women who mentioned at least three danger signs increased by 4.5%, whereas it increased

Citation and country	Aim	Study design	Population and number of participants	Measure of knowledge of obstetric danger signs	Counselling on danger signs offered	Knowledge of obstetric danger signs
				intervention in both the intervention and control groups.	messages to the pregnant woman. The messages conveyed using the cards include general pregnancy care, BPCR, obstetric danger signs, clean delivery, and newborn care. ANC providers took training on how to use job aids. Ten step process was followed in counselling which includes: 1) present the topic, 2) ask the woman, 3) present the counselling card, 4) ask the woman what she sees on the card, 5) encourage the woman what message she thinks the card conveys, 6) based on the woman's response, elaborate on messages provided on the card, 7) verify the woman's understanding, 8) encourage her to ask questions, 9) summarise, 10) check the back of the card all messages have been discussed.	by 33.2% after the intervention in the intervention group. The difference-in-difference result showed that the intervention's net effect was 28.7, which means the use of job aids and staff training increased the women's knowledge of obstetric danger signs by 28.7%.
(Karkee et al. 2014)	Examined the role of obstetric	Prospective cohort study	701 pregnant women (at least five months gestation).	Obstetric knowledge was measured using five components in which each	The entire cohort was exposed to counselling on obstetric danger signs, BPCR,	During pregnancy, vaginal bleeding was the most common mentioned danger

Citation and country	Aim	Study design	Population and number of participants	Measure of knowledge of obstetric danger signs	Counselling on danger signs offered	Knowledge of obstetric danger signs
Nepal	knowledge on SBA.			component was dichotomised into yes/no based on whether any of the specific danger signs during each phase are mentioned or not. Danger signs used during pregnancy include vaginal bleeding, swollen hands and body, severe abdominal pain, loss of consciousness and convulsions, blurred vision, severe headache and fever	and information on a facility birth.	sign 74.2%, followed by swollen hands and body 38.7%. About three fourth of women received information on pregnancy and childbirth, and the source of information was healthcare professionals, community health workers, families, relatives Although all cohorts were exposed to counselling service, not all women received SBA. There was 15% home birth.
Kusuma et al. 2018) India	Studied birth preparedness, place of birth and its determinants among migrant mothers.	Cross-sectional	458 women who migrated to the slum areas of Delhi city in the last 10 months were studied for their most recent childbirth.	Reported women who knew at least one danger sign	The study reported whether women had received information on obstetric danger signs or not. Accordingly: 13.1% received information on obstetric danger signs Severe headache with blurred vision 11.4% Convulsions or loss of consciousness 10.7%	13.1% knew at least one danger sign.

Citation and country	Aim	Study design	Population and number of participants	Measure of knowledge of obstetric danger signs	Counselling on danger signs offered	Knowledge of obstetric danger signs
					Prolonged labour 10% Vaginal leakage 10% High fever with or without abdominal pain 10.9% Decreased or absence of foetal movements 10%	
(Lakew et al. 2016) Ethiopia	Assessed the association of BPCR with SBA and postnatal care uptake	Community-based cross-sectional	728 women who gave birth within the last 6 months of data collection were included in the analysis.	Reported good knowledge versus poor knowledge using the mean as a cut-off value. Number of danger signs in three phases was identified 5 during pregnancy, 4 during childbirth, and 6 during postpartum. Women had good knowledge if they knew above 17 danger signs.	Reported advice on BPCR The study reported 68.8% of women received advice on BPCR during their ANC. However, the study did not specify the components of BPCR.	57% had good knowledge of obstetric danger signs
(Lori et al. 2014) Ghana	Examined women's understanding and recognising obstetric danger signs	Descriptive qualitative	68 pregnant women were selected by convenient sampling technique.	women's knowledge of obstetric danger signs was assessed by considering women's ability to spontaneously recognise and understand individual danger signs and their ability to differentiate from other minor pregnancy-related discomforts	One-hour antenatal health education covering the following contents was provided to all pregnant women in the waiting room. The contents of the education include nutrition, self-care, danger signs and newborn care.	Women were able to mention obstetric danger sings, including pain, bleeding, fits, headache, and excessive vomiting. Women also mentioned some pregnancy discomforts as danger signs which are normal such as sleeplessness, urinary frequency, loss of appetite, swelling of lower extremities and wrists

Citation and country	Aim	Study design	Population and number of participants	Measure of knowledge of obstetric danger signs	Counselling on danger signs offered	Knowledge of obstetric danger signs
						This indicates a misunderstanding of women to recognise danger signs Women were often unclear when to seek care for complications
(Lori et al. 2017) Ghana	Studied improving health literacy through GANC	Prospective cohort	240 pregnant women (120 in GANC and 120 in individual ANC).	No prior operationalised definition was reported. But obstetric danger signs known by the women were reported in the results by comparing women in GANC versus individual ANC	At their initial ANC visit and following the baseline interview, pregnant women were grouped into the intervention (GANC) and the comparison (individual ANC) group. The same education content, provider and women sit in a circular arrangement: used storytelling, role-play, experience sharing, and demonstration for their discussion for 60 minutes. Health literacy was set as an integral component of the sessions. Among the seven modules developed, one was informing women about	Women in GANC recalled self-care behaviour that they learnt during session more significantly than women in individual ANC. Women in GANC better recalled danger signs than women in individual ANC. Obstetric danger signs known by the women were: Vaginal bleeding 99% in GANC and 97.6% in individual ANC Fever 24% in GANC and 18.1% in individual abdominal pain 46% in GANC, and 28.9% in individual ANC swollen face 72% in GANC, 73.5% in individual ANC Blurred vision 91% in GANC 77.1% in individual ANC

Citation and country	Aim	Study design	Population and number of participants	Measure of knowledge of obstetric danger signs	Counselling on danger signs offered	Knowledge of obstetric danger signs
					danger signs during the third visit. Picture cards were used to facilitate discussions.	Reduced or no foetal movement 17% in GANC and 16.9% in individual ANC.
(Mullany et al. 2009) Nepal	Studied the impact of involving men in maternal healthcare services on women's knowledge of obstetric danger signs	Facility-based RCT Women were grouped into three groups (women and their husbands receiving education together, women receiving education alone, and women receiving no education (control). Control groups were offered with a flier, and intervention groups received antenatal health education at baseline and 2nd intervention later on.	Pregnant women receiving ANC at a hospital in Kathmandu. Three groups (two intervention and one control). The baseline sample included 145 couples in the first intervention group, 140 women in the second intervention group, and 149 women in the control group. Sample in follow-up intervention included: 133 couples and 130 women alone. Sample in the end line included: 133,	Using seven questions, the study reported a change in knowledge using the median as a cut-off point. A 'change in knowledge' variable was created based on the difference between each woman's baseline and follow-up knowledge score. A score of more than the median was considered as high. However, these seven questions were not directly asking danger signs; instead, they were about the timing of pregnancy risks, pregnancy complications, the use of a condom, STIs, breastfeeding, family planning, and weight gain during pregnancy.	The intervention groups received counselling. Women in the intervention groups received two health education interventions, each lasting 35-minute delivered in a private room in the hospital (either alone or with their husband). Women in the control group received routine ANC and no antenatal education.	Knowledge increased in a higher proportion for those who received the intervention compared to the control groups. The mean knowledge of danger signs significantly increased among those who received intervention in a couple (by 0.61) compared to the control group (by 0.34).

Citation and country	Aim	Study design	Population and number of participants	Measure of knowledge of obstetric danger signs	Counselling on danger signs offered	Knowledge of obstetric danger signs
			125 and 128, respectively. Systematic sampling was used to approach the study participants.			
(Mutiso et al. 2008) Kenya	Assessed BPCR	Cross-sectional descriptive study The client exit interview was used immediately after ANC visit	394 pregnant women (gestational age >32 weeks attending) attending ANC in governmental health facilities were selected using systematic sampling.	Described each danger sign and reported the percentage of women who knew at least three danger signs.	72.1 % received counselling on danger signs	67% knew at least one danger sign. Only 6.9% knew three or more danger signs. Haemorrhage was the most known danger signs (64.2%) followed by reduced foetal movement (20.6%)
(Mwilike et al. 2018) Tanzania	Assessed pregnant women's knowledge of obstetric danger signs during pregnancy	Health facility-based cross-sectional	392 postpartum women seeking immunisation for their children were selected using proportionate sampling.	Nine danger signs were considered to assess women's knowledge of obstetric danger signs. These include vaginal bleeding, severe headache with blurred vision, convulsions, severe abdominal pain, too weak to get out of the bed, fast or difficulty breathing, reduced foetal movement, fever, swelling of face and hands.	Antenatal health education was provided in the form of group sessions for women attending a health facility. 87.5% of women self-reported they heard about danger signs during pregnancy. The source of information was the reproductive health clinic for 81.8% of women, social gathering (17.4%) and radio (0.8%).	57.8% of women were able to mention 1 to 3 danger signs. 31% of women able to mention at least four danger signs. The most known danger sign was vaginal bleeding (81.2%). The mean score of the knowledge was 3. 2.7% of women were unable to mention any danger sign.

Citation and country	Aim	Study design	Population and number of participants	Measure of knowledge of obstetric danger signs	Counselling on danger signs offered	Knowledge of obstetric danger signs
				A woman was said "had no knowledge" if she could not mention any danger sign," had low knowledge" if she could mention one to three danger signs and "had sufficient knowledge" if she could mention four or more danger signs.	Nurse-midwives provided information about nutrition, birth preparations, obstetric danger signs, and vaccinations. Women were advised to visit a nearby health facility for care when they recognise a danger sign during pregnancy.	The most common danger signs mentioned was vaginal bleeding (81%) followed by swelling of faces and hands. Educational level, marital status, gravidity, ANC reception were not associated with knowledge of obstetric danger signs during pregnancy. Older women were 1.6 times more likely knowledgeable. 17.4% of women recognised danger signs in their last pregnancy
(Nkamba et al. 2021) Democratic Republic of Congo (DRC)	To assess the level of agreement on receipt of counselling on obstetric danger signs between direct observation of antenatal consultation and women's recall in the exit interview.	A cross-sectional study based on the DRC Service Provision Assessment survey was conducted between 2017 and 2018.	ANC attendees were observed while they receive ANC and were interviewed. Included 4512 women in the analysis.	Measured seven obstetric danger signs during pregnancy (vaginal bleeding, fever, swollen face or hands, tiredness or breathlessness, headache or blurred vision, cough or difficulty of breathing, and reduced or no foetal movement). The number of danger signs reported by the women in the exit interview was compared with the number	The occurrence of counselling on obstetric danger signs was measured by direct observation of ANC consultation. 35% of women were counselled on any obstetric danger sign. 28.4% of women reported that they received counselling during the current ANC contact. 17% counselled on vaginal bleeding.	More than two-thirds of women knew at least one danger sign, half knew at least two danger signs, and no woman knew all danger signs. 55% of women knew vaginal bleeding danger signs. 26% knew fever. 9% knew swollen face or hands. 10% knew tiredness or breathlessness.

Citation and country	Aim	Study design	Population and number of participants	Measure of knowledge of obstetric danger signs	Counselling on danger signs offered	Knowledge of obstetric danger signs
				of danger signs counselled. Then, the proportion of positive and negative agreement was computed. Reported the mean number of obstetric danger signs known by the women.	17% counselled on fever 6% counselled on swollen face or hands. 8% counselled on tiredness or breathlessness. 9% counselled on headache or blurred vision. 4% counselled in cough or difficulty breathing. 18% counselled on reduced or no foetal movement.	10% knew headache or blurred vision. 2% knew cough or difficulty breathing. 18% of women knew reduced or no foetal movement danger sign. Women's knowledge of danger signs was significantly higher among multigravida, those who attended private health facilities, received subsequent ANC visits, and varied by provinces where they were from.
(Nuraini and Parker 2005) Indonesia	The study compared the effect of the routine ANC and the new approach to ANC on the pregnant women's knowledge of ANC.	Quasi-experimental: (villages where women residing were grouped into the intervention and control groups). Women in the intervention and control villages	60 pregnant women (30 in the intervention and 30 in the control group)	Knowledge was scored from 0 to 100 using questionnaires to assess women's knowledge of ANC. Mean knowledge score was used to compare between the two groups (intervention and control groups) The score of knowledge was categorised into good	Counselling was one of the components in GANC. Women in the intervention group were counselled in a group.	Before the intervention, there was no knowledge difference between the intervention and control groups (81 vs 80). After the intervention, the mean knowledge score was higher in the intervention group (90.72) than in the control group (81.28).

Citation and country	Aim	Study design	Population and number of participants	Measure of knowledge of obstetric danger signs	Counselling on danger signs offered	Knowledge of obstetric danger signs
		visited ANC at least once for the recent pregnancy. Women from the intervention villages received GANC, whereas the women from the control villages received individual ANC at a health facility.		(scoring >70) and poor (scoring<70).		
(Pembe et al. 2009) Tanzania	Assessed rural women's awareness of danger signs and complications.	Community-based cross-sectional	1118 women who had been pregnant in the last two years were selected using multi-stage sampling.	No cut-off point used; instead, at least one danger sign in any of the three phases was used to develop regression modeling.	Of those who attended ANC (1100), 16.3% of women received advice on obstetric complications during ANC visits, and 38.2% of women advised to use a health facility during childbirth.	51.1% of women knew at least one obstetric danger sign that can occur at any phase. 26% of women knew at least one danger sign during pregnancy. 9.6% of women mentioned vaginal bleeding during pregnancy as a danger sign Women who completed secondary education or more had 5.8 times more likely to know obstetric danger signs in any phase. Knowledge of obstetric danger signs increased with

Citation and country	Aim	Study design	Population and number of participants	Measure of knowledge of obstetric danger signs	Counselling on danger signs offered	Knowledge of obstetric danger signs
						age, number of births, number of ANC visits, birthing at a health facility, and reception of information on obstetric danger signs during ANC visits.
(Pembe et al. 2010) Tanzania	Assessed the quality of ANC with respect to counselling provision	Facility-based cross-sectional study Data collection employed observation of client-provider interaction and exit client interviews with pregnant women.	438 pregnant women were observed during the client-provider interaction, then 3 dropped out in exit interview, leaving 435 pregnant women included in the exit interview and analysed. 32 ANC providers were observed while providing ANC.	Not operationally defined, and each danger sign was reported separately.	Observation and client exit interview result revealed that women were counselled on obstetric danger signs during their ANC visits. 42% of women were not informed of any danger signs. 8.7% of women were informed of all seven danger signs. The most commonly informed was vaginal bleeding 50% followed by blurred vision/severe headache 45% Nurse auxiliaries were nearly 3.7 times more likely to inform on obstetric danger signs compared to registered nurses, and public health nurses were 2.5 times more likely to inform on obstetric	Danger signs mentioned by the women include: vaginal bleeding 74% headache/blurred vision 55%, severe abdominal pain 38%, swollen hands and face 46%, Fever 28% baby stops movement 15%, and excessive tiredness/breathlessness 18%.

Citation and country	Aim	Study design	Population and number of participants	Measure of knowledge of obstetric danger signs	Counselling on danger signs offered	Knowledge of obstetric danger signs
					danger signs compared to the registered nurses The median provider-client interaction duration was 10 minutes, ranged from 2-54 minutes. The result from observation indicated that the ANC provider counselled women on Vaginal bleeding (50%), headache/blurred vision (45%), severe abdominal pain (33%), swollen hands and face (32%), Fever (28%), Baby stops movement (26%), and Excessive tiredness/breathlessness (19%).	
(Perreira et al. 2002) Guatemala	Assessed the effectiveness of IEC to increase awareness of obstetric danger signs	Quasi-experimental followed by three surveys: the first two were clinic-based and the third was community-based).	Pregnant and postpartum women In the first clinic-based survey, all 637 women were interviewed. In the 2nd clinic-based survey, 163	All respondents were asked if they had heard of danger signs during pregnancy. Respondents who had heard of danger signs were then asked to name these danger signs.	Multiple interventions 1. Clinic-based intervention: healthcare providers offered information for the pregnant women using purposely designed desktop flipcharts and by distributing educational calendar which	Women who could recall at least one obstetric danger sign increased from 66% at baseline to 98% at the end line among women who received counselling from the ANC using flipcharts.

Citation and country	Aim	Study design	Population and number of participants	Measure of knowledge of obstetric danger signs	Counselling on danger signs offered	Knowledge of obstetric danger signs
		The three surveys (the first clinic based is baseline survey, the second clinic-based survey was conducted during or after the intervention, and the third was community based after the two surveys).	women were interviewed. For the 3rd survey (community-based), 380 pregnant women and 258 postpartum women were randomly selected in their 1st 3 months. Total sample: 1438		could be kept in the client's billfolds. 2. Radio message intervention: promoting women to seek healthcare in case of obstetric complications. 3. Women groups: Women groups participated in discussions designed to increase women's awareness of obstetric complications. Nurses and auxiliary nurse-midwives received training in the use of flip charts and communication and counselling skills. Counselling was guided by following 10 Golden rules of counselling outlined on a poster. Nurse-midwives also received five printed bulletins focusing on maternal and perinatal health education, summarising technical information, and discussing strategies to improve service provision and quality of care.	Clinic-based interventions (counselling using flipcharts and provision of educational material) increased the likelihood of women's knowledge of obstetric danger signs by 16, and this increased by 20 when radio messages were a source of information on obstetric danger signs additional to clinic-based counselling.

Citation and country	Aim	Study design	Population and number of participants	Measure of knowledge of obstetric danger signs	Counselling on danger signs offered	Knowledge of obstetric danger signs
					Provision of counselling on obstetric danger signs increased by 15% (from 12% to 27%) when ANC providers used flipcharts and by 12% (from 3% to 15%) by distributing educational materials.	
(Salem et al. 2018) Madagascar	Assessed knowledge of obstetric danger signs and associated factors	Community-based cross-sectional	372 women in their 1st-year postpartum period were selected conveniently.	Considered when women mentioned at least one danger sign as knowledgeable Danger signs listed were vaginal bleeding, swollen hands and body, loss of consciousness and convulsions, blurred vision, headache, fever, acute abdominal pain, absence of foetal movement.	Information on obstetric complications was assessed by asking clients whether they have received during their ANC as 99.2% of women attended ANC at least once during their recent pregnancy. 70.8% of the women self-reported that they received information about potential problems during pregnancy, childbirth or postpartum.	Knowledge of at least one danger sign during pregnancy was 80.9% Fever was the most common mentioned danger signs 41.1% Receipt of the information on obstetric danger signs was significantly associated with knowledge of obstetric danger signs
(Sarker et al. 2010) Tanzania	Studied ANC provision and knowledge of obstetric danger signs	Facility-based cross-sectional that used a mixed-method Quantitative data were collected by	Healthcare providers and pregnant women. Quantitative study: 35 health workers and 28 women and	Reported the proportion of women who could mention at least 1 danger sign	Counselling on obstetric danger signs was 61% from the observed result and 100% from the health workers' self-report. The provision of counselling was measured against the	Only 54% of women were able to mention at least one danger sign during pregnancy. Additionally, 82% of women decided to use SBA.

Citation and country	Aim	Study design	Population and number of participants	Measure of knowledge of obstetric danger signs	Counselling on danger signs offered	Knowledge of obstetric danger signs
		using observation of service provision and interview of health workers	12 women in the follow-up. Therefore, the total sample was 75.		checklist from the national ANC guideline in which counselling of every woman on obstetric danger signs is expected to be given during each ANC visit.	
(Shukla et al. 2019) India	Assessed women's BPCR before and after counselling.	A facility-based prospective study (pre-and post-counselling)	130 pregnant women were initially followed After one month of follow-up, 44 were lost to follow-up giving 86 women remaining in the study.	Not clearly stated in the methods section, but the study result included the proportion of women who knew more than eight danger signs An index of BPCR was constructed, which consisted of seven indicators that include: percentage of women who knew at least eight danger signs, percentage of women who knew about transportation, percentage of women who knew about financial assistance, percentage of women who availed ANC in the 1st trimester, percentage of women who identified skilled birth attendant, percentage of women who identified mode transportations, and	Counselling was considered as the main exposure variable in assessing women's BPCR. Women's knowledge of obstetric danger signs was assessed before and after counselling.	The percentage of women who knew more than eight danger signs was 26.1%. Knowledge of eight or more danger signs significantly increased after counselling.

Citation and country	Aim	Study design	Population and number of participants	Measure of knowledge of obstetric danger signs	Counselling on danger signs offered	Knowledge of obstetric danger signs
				percentage of women who saved money. Therefore, knowledge of obstetric danger signs was measured in terms of women's ability to cite at least eight danger signs.		
(Smeele et al. 2018) Rwanda	Assessed practice around and factors associated with BPCR	Facility-based cross-sectional	350 pregnant women who were referred and admitted to emergency obstetric care service.	Women's knowledge of individual obstetric danger signs was reported in the result section	59.4% received counselling on danger signs during pregnancy, childbirth, or the Postnatal period.	There are two different results for the same variable. The percentage of women who could mention at least one danger sign was 82.3% in the abstract section but 84.6% in the main document. 6.6% could mention at least 3 during three phases. Knowledge of at least 2 danger signs was 31.7% during pregnancy, 16.57% during childbirth, and 15.43% during postpartum. Vaginal bleeding was the most known danger sign 61.1%. Knew none of the danger signs during pregnancy 15.4%

Citation and country	Aim	Study design	Population and number of participants	Measure of knowledge of obstetric danger signs	Counselling on danger signs offered	Knowledge of obstetric danger signs
(Sripad et al. 2019) Nigeria	Examined healthcare-seeking behaviour of pre-eclampsia survivors	Qualitative using Health belief model	42 women aged between 17-48 who suffered from pre-eclampsia were involved in the study.	Obstetric danger signs related to pre-eclampsia/eclampsia was the focus to assess women's awareness of obstetric danger signs	Women's experience in maternal healthcare service uptake during ANC, SBA at birth, and PNC was included in the study with more emphasis on respectful and non-judgmental care.	Qualitative narratives indicated women had limited awareness of the signs and symptoms of pre-eclampsia and eclampsia. Poor quality of provision of messages on obstetric complications was cited as the main reason while awareness did not vary by age, educational status, and parity. Women's experience of respectful and non-judgmental healthcare service provision during ANC, delivery, and postnatal care had improved healthcare-seeking behaviour.
(Thapa et al. 2019) Nepal	Assessed the effectiveness of group ANC by community health workers and Midwives	Prospective non-randomised clustered controlled trial measuring difference-in-difference of SBA before and after the intervention.	Quantitative: pregnant women Qualitative FGDs: women, healthcare providers, community leaders, government care providers,	Knowledge of obstetric danger signs was not categorised. The study reported the proportion of women who knew key danger signs during pregnancy in both the intervention and the control group.	Counselling was an integral part of GANC to improve knowledge as illustrated by the figure in the conceptual framework.	Difference-in-difference did not show a significant change in SBA and completion of ANC. However, there was a significant change between baseline and end-line surveys in terms of SBA and ANC completion.

Citation and country	Aim	Study design	Population and number of participants	Measure of knowledge of obstetric danger signs	Counselling on danger signs offered	Knowledge of obstetric danger signs
		Also assessed the change in the knowledge of obstetric danger signs one year after the intervention. The intervention was a home visit for both the intervention and comparison groups, while the intervention group additionally received GANC. End line survey was conducted during the postpartum period. Additionally, the study involved a qualitative study.	community health supervisory staffs. Key informant interview was excluded due to poor quality. Intervention 62 women, and comparison 52 women			From the end line survey, 31% women in the intervention group 10% women in the comparison group knew key danger signs. The difference in knowledge change from baseline to end line survey within the intervention group was 2% at the baseline and 31% at the end line, whereas the difference within the comparison group was changed from 2% to 10%.
(Vallely et al. 2019)	Explored knowledge of obstetric danger signs	Community-based cross-sectional survey	Reproductive age group women who had given birth since 2010 or being	Maternal knowledge of obstetric danger signs was defined as when the woman	More than half (53.6%) of surveyed women reported that they had received	39.9% of women were aware of obstetric danger signs during pregnancy.

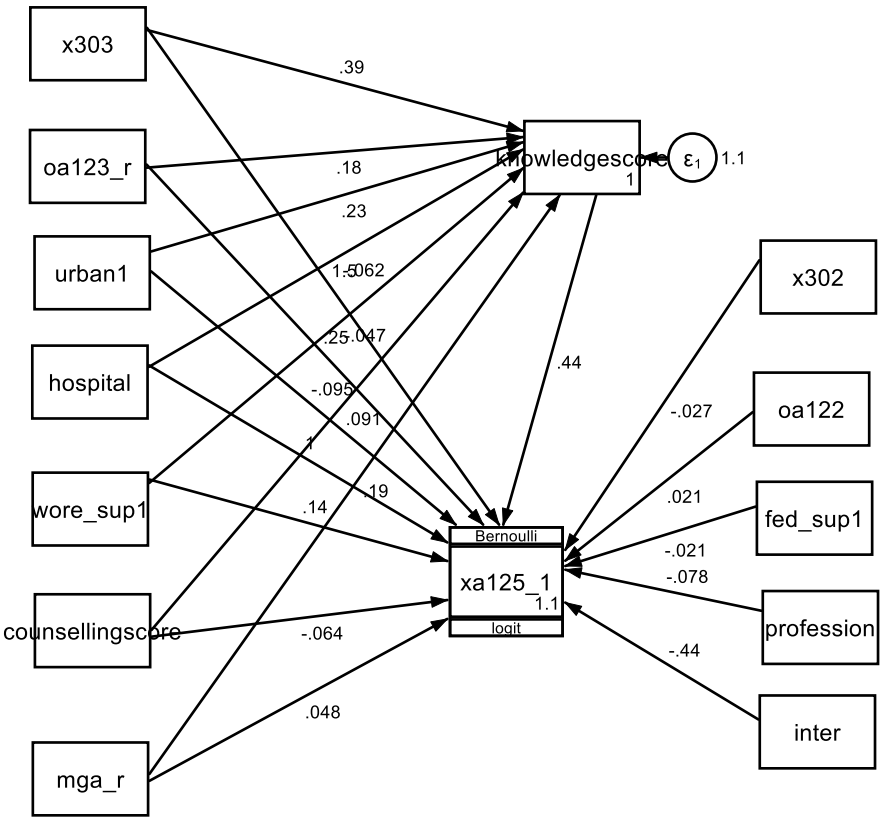
Citation and country	Aim	Study design	Population and number of participants	Measure of knowledge of obstetric danger signs	Counselling on danger signs offered	Knowledge of obstetric danger signs
Papua New Guinea			pregnant in the recent surveys (2012-2013) 482 pregnant women included in the analysis.	can spontaneously mention at least one danger sign.	information on obstetric danger signs during ANC.	Vaginal bleeding was the most cited obstetric danger signs. Women who were informed on obstetric danger signs during ANC were more likely to know obstetric danger signs (unquantified). Receiving counselling increased the odds of knowing any of the danger signs by more than seven times.
(Woldeamanuel et al. 2019) Ethiopia	Assessed knowledge of obstetric danger signs	Community-based cross-sectional	563 pregnant women were selected through multi-stage sampling.	Women were considered knowledgeable when they were able to mention at least three danger signs in each phase	The study reported 51.9% of 292 women received maternal health education. The study calculated the proportion of women taking the denominator the total sample, while 34.1% of 192 women had no ANC attendance. Thus, the proportion of women who received maternal health education would be 292/563-192=78.7%	The overall knowledge of obstetric danger signs was 37.5%. 56.1% of women were knowledgeable of at least three danger signs during pregnancy. Vaginal bleeding was the most cited, 72.6%. Factors associated with knowledge of obstetric danger signs included previous pregnancy history, distance from the health facility less than 20 minutes,

Citation and country	Aim	Study design	Population and number of participants	Measure of knowledge of obstetric danger signs	Counselling on danger signs offered	Knowledge of obstetric danger signs
					The study also reported 60% of women got information from health workers while the remaining got from neighbours and media.	attending formal education, receiving maternal health education and urban residence.
Total sample			**47,971 women**			

Appendix 6 Variable measurement in study 1 and study 2

Variables	Data type	Variable categories	Variable coding in Stata
Age in years	Metric	-	x302
Ever attended school	Binary	1. Yes 2. No	x303
Gestational age in weeks	Metric	-	oa122
Number of ANC visits	Binary	1. Yes 2. No	oa123_r
Number of pregnancies	Binary	1. First pregnancy 2. Not first pregnancy	oa124
Decision where to give birth	Binary	1. At health facility 2. Not at health facility	xa125_1
Facility location	Binary	1. Urban 2. Rural	ftype
Facility type	Binary	1. Hospital 2. Non-hospital	facility
Facility sector	Binary	1. Government/Public 2. Non-government	mga_r
Facility received supervision from the federal level	Binary	1. Yes 2. No	q350
Facility received supervision from the regional level	Binary	1. Yes 2. No	q352a
Facility received supervision from the zonal level	Binary	1. Yes 2. No	q352d
Facility received supervision from the woreda level	Binary	1. Yes 2. No	q352g
Presence of routine management meeting	Binary	1. Yes 2. No	q410
Presence of health management information system (HMIS)	Binary	1. Yes 2. No	q460
ANC guidelines present	Binary	1. Yes 2. No	q1409
ANC providers' sex	Binary	1. Male 2. Female	cprovsex
ANC providers' profession	Binary	1. Nurses or Midwives 2. Others	profession
ANC providers received training	Binary	1. Yes 2. No	q1422a
ANC counselling	Metric	-	counsellingscore
Knowledge of danger signs	Metric	-	knowledgescore

Appendix 7 Structural model showing the effect of ANC counselling and maternal health literacy on women's decision to give birth at a health facility



(N.B: x303= Ever attended school, oa123_r= ANC is revisit, urban1= facility is urban, hospital= facility type is hospital, wore_sup1= facility is supervised at woreda or district level, counsellingscore= the number of danger signs included in counselling, mga_r= facility owner is government, knowledgescore= number of danger signs that the women knew, xa125_1= women's decision to give birth is at a health facility, x302= women's age in years, oa122= gestational age in weeks, profession= profession is Nurse or Midwife, inter= interaction term of school attendance and knowledge of danger signs.) The values with the corresponding arrow represent the adjusted β coefficient.

References

Abbas, D. F., Mirzazada, S., Durocher, J., Pamiri, S., Byrne, M. E. & Winikoff, B. 2020, 'Testing a home-based model of care using misoprostol for prevention and treatment of postpartum hemorrhage: results from a randomized placebo-controlled trial conducted in Badakhshan province, Afghanistan', *Reproductive Health,* 17 (88). *10.1186/s12978-020-00933-8.*

Abebe, F., Berhane, Y. & Girma, B. 2012, 'Factors associated with home delivery in Bahirdar, Ethiopia: a case control study', *BMC Research Notes,* 5 (653).

Abed Saeedi, Z., Ghazi Tabatabaie, M., Moudi, Z., Vedadhir, A. A. & Navidian, A. 2013, 'Childbirth at home: A qualitative study exploring perceptions of risk and risk management among Baloch women in Iran', *Midwifery,* 29**,** 44-52. *10.1016/j.midw.2011.11.001.*

AbouZahr, C. 2003, 'Safe Motherhood: a brief history of the global movement 1947–2002', *British Medical Bulletin,* 67 (1)**,** 13-25. *10.1093/bmb/ldg014.*

Adaji, S. E., Jimoh, A., Bawa, U., Ibrahim, H. I., Olorukooba, A. A., Adelaiye, H., et al. 2019, 'Women's experience with group prenatal care in a rural community in northern Nigeria', *International Journal of Gynecology & Obstetrics,* 145 (2)**,** 164-9. *10.1002/ijgo.12788.*

Adanikin, A. I., Onwudiegwu, U. & Loto, O. M. 2013, 'Influence of multiple antenatal counselling sessions on modern contraceptive uptake in Nigeria', *The European Journal of Contraception and Reproductive Health Care,* 18 (5)**,** 381-7. *10.3109/13625187.2013.816672.*

Adjiwanou, V. & Legrand, T. 2013, 'Does antenatal care matter in the use of skilled birth attendance in rural Africa: a multi-country analysis', *Social Science & Medicine,* 86**,** 26-34. *10.1016/j.socscimed.2013.02.047.*

Adu, J., Tenkorang, E., Banchani, E., Allison, J. & Mulay, S. 2018, 'The effects of individual and community-level factors on maternal health outcomes in Ghana', *PLoS ONE,* 13 (11). *10.1371/journal.pone.0207942.*

Afulani, P. A. & Moyer, C. 2016, 'Explaining Disparities in Use of Skilled Birth Attendants in Developing Countries: A Conceptual Framework', *PLOS ONE,* 11 (4)**,** e0154110. *10.1371/journal.pone.0154110.*

Ahmad, D., Mohanty, I., Hazra, A. & Niyonsenga, T. 2021, 'The knowledge of danger signs of obstetric complications among women in rural India: evaluating an integrated microfinance and health literacy program', *BMC Pregnancy and Childbirth,* 21 (79). *10.1186/s12884-021-03563-5.*

Ahmad Tajuddin, N. A. N., Suhaimi, J., Ramdzan, S. N., Malek, K. A., Ismail, I. A., Shamsuddin, N. H., et al. 2020, 'Why women chose unassisted home birth in Malaysia: a qualitative study', *BMC pregnancy and childbirth,* 20 (309). *10.1186/s12884-020-02987-9.*

Ahmed, M., Demissie, M., Medhanyie, A. A., Worku, A. & Berhane, Y. 2018, 'Utilization of Institutional Delivery Service in a Predominantly Pastoralist Community of Northeast Ethiopia', *Ethiop J Health Sci,* 28 (4)**,** 403-12. *10.4314/ejhs.v28i4.6.*

Akshaya, K. M. & Shivalli, S. 2017, 'Birth preparedness and complication readiness among the women beneficiaries of selected rural primary health centers of Dakshina Kannada district, Karnataka, India', *PLoS ONE,* 12 (8). *10.1371/journal.pone.0183739.*

Akter, S., Rich, J. L., Davies, K. & Inder, K. J. 2019, 'Access to maternal healthcare services among Indigenous women in the Chittagong Hill Tracts, Bangladesh: A cross-sectional study', *BMJ Open,* 9 (10). *10.1136/bmjopen-2019-033224.*

Ali, M. S., Prieto-Alhambra, D., Lopes, L. C., Ramos, D., Bispo, N., Ichihara, M. Y., et al. 2019, 'Propensity score methods in health technology assessment: principles, extended applications, and recent advances', *Frontiers in Pharmacology,* 10 (973). *10.3389/fphar.2019.00973.*

Allan, V., Ramagopalan, S. V., Mardekian, J., Jenkins, A., Li, X., Pan, X., et al. 2020, 'Propensity score matching and inverse probability of treatment weighting to address confounding by indication in comparative effectiveness research of oral anticoagulants', *Journal of Comparative Effectiveness Research,* 9 (9)**,** 603-14. *10.2217/cer-2020-0013.*

Amegavluie, R. E. A., Ani-Amponsah, M. & Naab, F. 2022, 'Women's experiences of surviving severe obstetric complications: a qualitative inquiry in southern Ghana', *BMC Pregnancy and Childbirth,* 22 (212). *10.1186/s12884-022-04538-w.*

Ameyaw, E. K., Ahinkorah, B. O. & Seidu, A.-A. 2020, 'Does knowledge of pregnancy complications influence health facility delivery? Analysis of 2014 Bangladesh Demographic and Health Survey', *PLOS ONE,* 15 (8)**,** e0237963. *10.1371/journal.pone.0237963.*

Amoakoh-Coleman, M., Agyepong, I. A., Zuithoff, N. P. A., Kayode, G. A., Grobbee, D. E., Klipstein-Grobusch, K., et al. 2016, 'Client factors affect provider adherence to clinical guidelines during first antenatal care', *PLoS ONE,* 11 (6). *10.1371/journal.pone.0157542.*

Anastasi, E., Borchert, M., Campbell, O. M. R., Sondorp, E., Kaducu, F., Hill, O., et al. 2015, 'Losing women along the path to safe motherhood: Why is there such a gap between women's use of antenatal care and skilled birth attendance? A mixed methods study in northern Uganda', *BMC Pregnancy and Childbirth,* 15 (287). *10.1186/s12884-015-0695-9.*

Anya, S. E., Hydara, A. & Jaiteh, L. E. S. 2008, 'Antenatal care in The Gambia: Missed opportunity for information, education and communication', *BMC Pregnancy and Childbirth,* 8 (9). *10.1186/1471-2393-8-9.*

Arora, S., Deosthali, P. B. & Rege, S. 2019, 'Effectiveness of a counselling intervention implemented in antenatal setting for pregnant women facing domestic violence: A pre-experimental study', *BJOG,* 126 (S4)**,** 50–7. *10.1111/1471-0528.15846.*

Arpino, B. & Mealli, F. 2011, 'The specification of the propensity score in multilevel observational studies', *Computational Statistics & Data Analysis,* 55 (4)**,** 1770-80. *https://doi.org/10.1016/j.csda.2010.11.008.*

Asefa, A., Gebremedhin, S., Messele, T., Letamo, Y., Shibru, E., Alano, A., et al. 2019, 'Mismatch between antenatal care attendance and institutional delivery in south Ethiopia: A multilevel analysis', *BMJ Open,* 9 (3)**,** e024783. *10.1136/bmjopen-2018-024783.*

Asefa, A., Semaan, A., Delvaux, T., Huysmans, E., Galle, A., Sacks, E., et al. 2022, 'The impact of COVID-19 on the provision of respectful maternity care: Findings from a global survey of health workers', *Women and Birth,* 35 (4)**,** 378-86. *https://doi.org/10.1016/j.wombi.2021.09.003.*

Asresie, M. B. & Dagnew, G. W. 2019, 'Effect of attending pregnant women's conference on institutional delivery, Northwest Ethiopia: comparative cross-sectional study', *BMC Pregnancy and Childbirth,* 19 (353). *10.1186/s12884-019-2537-7.*

Assaf, S. 2018, 'Counseling and Knowledge of Danger Signs of Pregnancy Complications in Haiti, Malawi, and Senegal', *Maternal and Child Health Journal,* 22 (11)**,** 1659-67. *10.1007/s10995-018-2563-5.*

Assefa, Y., Gelaw, Y. A., Hill, P. S., Taye, B. W. & Van Damme, W. 2019, 'Community health extension program of Ethiopia, 2003–2018: successes and challenges toward universal coverage for primary healthcare services', *Globalization and Health,* 15 (24). *10.1186/s12992-019-0470-1.*

August, F., Pembe, A. B., Mpembeni, R., Axemo, P. & Darj, E. 2016, 'Effectiveness of the Home Based Life Saving Skills training by community health workers on knowledge of danger signs, birth preparedness, complication readiness and facility delivery, among women in Rural Tanzania', *BMC Pregnancy and Childbirth,* 16 (129). *10.1186/s12884-016-0916-x.*

Austin, A., Gulema, H., Belizan, M., Colaci, D. S., Kendall, T., Tebeka, M., et al. 2015, 'Barriers to providing quality emergency obstetric care in Addis Ababa, Ethiopia: Healthcare providers' perspectives on training, referrals and supervision, a mixed methods study', *BMC Pregnancy and Childbirth,* 15 (74). *10.1186/s12884-015-0493-4.*

Austin, P. C. 2009, 'Balance diagnostics for comparing the distribution of baseline covariates between treatment groups in propensity-score matched samples', *Statistics in Medicine,* 28 (25)**,** 3083-107. *10.1002/sim.3697.*

Austin, P. C. 2011, 'An Introduction to Propensity Score Methods for Reducing the Effects of Confounding in Observational Studies', *Multivariate Behavioral Research,* 46 (3)**,** 399-424. *10.1080/00273171.2011.568786.*

Ayana, A., Kassie, A. & Azale, T. 2021, 'Intention to use institutional delivery service and its predictors among pregnant women, North West Ethiopia: Using theory of planned behavior', *PLOS ONE,* 16 (5)**,** e0248697. *10.1371/journal.pone.0248697.*

Ayele, G. S., Melku, A. T. & Belda, S. S. 2019, 'Utilization of skilled birth attendant at birth and associated factors among women who gave birth in the last 24 months preceding the survey in Gura Dhamole Woreda, Bale zone, southeast Ethiopia', *BMC Public Health,* 19 (1501). *10.1186/s12889-019-7818-6.*

Ayenew, A. A., Nigussie, A. A. & Zewdu, B. F. 2021, 'Childbirth at home and associated factors in Ethiopia: a systematic review and meta-analysis', *Archives of Public Health,* 79 (48). *10.1186/s13690-021-00569-5.*

Azeze, G. A., Mokonnon, T. M. & Kercho, M. W. 2019, 'Birth preparedness and complication readiness practice and influencing factors among women in Sodo town, Wolaita zone, Southern Ethiopia, 2018; Community based cross-sectional study', *Reproductive Health,* 16 (39). *10.1186/s12978-019-0703-z.*

Bahri Khomami, M., Walker, R., Kilpatrick, M., de Jersey, S., Skouteris, H. & Moran, L. J. 2021, 'The role of midwives and obstetrical nurses in the promotion of healthy lifestyle during pregnancy', *Therapeutic Advances in Reproductive Health,* 15**,** 1-12. *10.1177/26334941211031866.*

Bakar, R. R., Mmbaga, B. T., Nielsen, B. B. & Manongi, R. N. 2019, 'Awareness of Danger Signs during Pregnancy and Post-Delivery Period among Women of Reproductive Age in Unguja Island, Zanzibar: A Qualitative Study', *African Journal of Reproductive Health,* 23 (1)**,** 27-36. *10.29063/ajrh2019/v23i1.3.*

Barreix, M., Lawrie, T. A., Kidula, N., Tall, F., Bucagu, M., Chahar, R., et al. 2020, 'Development of the WHO Antenatal Care Recommendations Adaptation Toolkit: a standardised approach for countries', *Health Research Policy and Systems,* 18 (70). *10.1186/s12961-020-00554-4.*

Batterham, R. W., Hawkins, M., Collins, P. A., Buchbinder, R. & Osborne, R. H. 2016, 'Health literacy: applying current concepts to improve health services and reduce health inequalities', *Public Health,* 132**,** 3-12. *https://doi.org/10.1016/j.puhe.2016.01.001*.

Bayou, N. B. & Gacho, Y. H. 2013, 'Utilization of clean and safe delivery service package of health services extension program and associated factors in rural kebeles of Kafa Zone, Southwest Ethiopia', *Ethiop J Health Sci,* 23 (2)**,** 79-89.

Bayou, Y. T., Mashalla, Y. S. & Thupayagale-Tshweneagae, G. 2016, 'The adequacy of antenatal care services among slum residents in Addis Ababa, Ethiopia', *BMC Pregnancy and Childbirth,* 16 (142). *10.1186/s12884-016-0930-z.*

Becker, S. O. & Caliendo, M. 2007, 'Sensitivity Analysis for Average Treatment Effects', *The Stata Journal,* 7 (1)**,** 71-83. *10.1177/1536867X0700700104.*

Belsley, D. A., Kuh, E. & Welsch, R. E. 2004, *Regression diagnostics: Identifying influential data and sources of collinearity*, John Wiley & Sons.

Benjamin, R. M. 2010, Improving health by improving health literacy. *Public Health Reports.* 2010/12/03 ed.

Benova, L., Tunçalp, Ö., Moran, A. C. & Campbell, O. M. R. 2018, 'Not just a number: examining coverage and content of antenatal care in low-income and middle-income countries', *BMJ Global Health,* 3 (2)**,** e000779. *10.1136/bmjgh-2018-000779.*

Benski, C., Di Filippo, D., Taraschi, G. & Reich, M. R. 2020, 'Guidelines for Pregnancy Management During the COVID-19 Pandemic: A Public Health Conundrum', *International Journal of Environmental Research and Public Health,* 17 (21). *10.3390/ijerph17218277.*

Bergstra, S. A., Sepriano, A., Ramiro, S. & Landewé, R. 2019, 'Three handy tips and a practical guide to improve your propensity score models', *RMD Open,* 5**,** e000953. *10.1136/rmdopen-2019-000953.*

Bililign, N. & Mulatu, T. 2017, 'Knowledge of obstetric danger signs and associated factors among reproductive age women in Raya Kobo district of Ethiopia: A community based cross-sectional study', *BMC Pregnancy and Childbirth,* 17 (70). *10.1186/s12884-017-1253-4.*

Bintabara, D., Mohamed, M. A., Mghamba, J., Wasswa, P. & Mpembeni, R. N. M. 2015, 'Birth preparedness and complication readiness among recently delivered women in chamwino district, central Tanzania: A cross sectional study 'Obstetrics'', *Reproductive Health,* 12 (44). *10.1186/s12978-015-0041-8.*

Bintabara, D., Mpembeni, R. N. M. & Mohamed, A. A. 2017, 'Knowledge of obstetric danger signs among recently-delivered women in Chamwino district, Tanzania: a cross-sectional study', *BMC Pregnancy and Childbirth,* 17 (276).

Biza, A., Jille-Traas, I., Colomar, M., Belizan, M., Requejo Harris, J., Crahay, B., et al. 2015, 'Challenges and opportunities for implementing evidence-based antenatal care in Mozambique: a qualitative study', *BMC Pregnancy and Childbirth,* 15 (200). *10.1186/s12884-015-0625-x.*

Boah, M., Mahama, A. B. & Ayamga, E. A. 2018, 'They receive antenatal care in health facilities, yet do not deliver there: predictors of health facility delivery by women in rural Ghana', *BMC pregnancy and childbirth,* 18 (125). *10.1186/s12884-018-1749-6.*

Bobo, F. T., Asante, A., Woldie, M. & Hayen, A. 2021, 'Poor coverage and quality for poor women: Inequalities in quality antenatal care in nine East African countries', *Health Policy and Planning,* 36 (5)**,** 662-72. *10.1093/heapol/czaa192.*

Bogale, D. & Markos, D. 2015, 'Knowledge of obstetric danger signs among child bearing age women in Goba district, Ethiopia: A cross-sectional study', *BMC Pregnancy and Childbirth,* 15 (1). *10.1186/s12884-015-0508-1.*

borkena. 2020, Council ratify Ethiopia's new ethnic-Sidama statehood. *https://borkena.com/2020/06/18/council-ratify-ethiopias-new-ethnic-sidama-statehood/*.

Branco da Fonseca, C. R., Strufaldi, M. W. L., de Carvalho, L. R. & Puccini, R. F. 2014, 'Adequacy of antenatal care and its relationship with low birth weight in Botucatu, São Paulo, Brazil: a case-control study', *BMC Pregnancy and Childbirth,* 14 (255). *10.1186/1471-2393-14-255.*

Brazier, E., Fiorentino, R., Barry, S., Kasse, Y. & Millimono, S. 2014, 'Rethinking how to promote maternity care-seeking: Factors associated with institutional delivery in Guinea', *Health Care for Women International,* 35 (7-9)**,** 878-95. *10.1080/07399332.2014.916293.*

Brookhart, M. A., Schneeweiss, S., Rothman, K. J., Glynn, R. J., Avorn, J. & Sturmer, T. 2006, 'Variable selection for propensity score models', *American Journal of Epidemiology,* 163 (12)**,** 1149-56. *10.1093/aje/kwj149.*

Budhathoki, S. S., Pokharel, P. K., Good, S., Limbu, S., Bhattachan, M. & Osborne, R. H. 2017, 'The potential of health literacy to address the health related UN sustainable development goal 3 (SDG3) in Nepal: a rapid review', *BMC Health Services Research,* 17 (237). *10.1186/s12913-017-2183-6.*

Caliendo, M. & Kopeinig, S. 2008, 'Some practical guidance for the implementation of propensity score matching: IZA Discussion Paper No. 1588', *IZA,* 22**,** 31-72.

Calvello, E. J., Skog, A. P., Tenner, A. G. & Wallis, L. A. 2015, 'Applying the lessons of maternal mortality reduction to global emergency health', *Bulletin of the World Health Organization,* 93 (6)**,** 417-23. *10.2471/blt.14.146571.*

Choi, J., Dekkers, O. M. & le Cessie, S. 2019, 'A comparison of different methods to handle missing data in the context of propensity score analysis', *European Journal of Epidemiology,* 34**,** 23-36. *10.1007/s10654-018-0447-z.*

Choulagai, B., Onta, S., Subedi, N., Mehata, S., Bhandari, G. P., Poudyal, A., et al. 2013, 'Barriers to using skilled birth attendants' services in mid- and far-western Nepal: a cross-sectional study', *BMC International Health and Human Rights,* 13 (49). *10.1186/1472-698X-13-49.*

Chowdhury, M. Z. I. & Turin, T. C. 2020, 'Variable selection strategies and its importance in clinical prediction modelling', *Family Medicine and Community Health,* 8**,** e000262. *10.1136/fmch-2019-000262.*

Cofie, L. E., Barrington, C., Singh, K., Sodzi-Tettey, S. & Akaligaung, A. 2015, 'Birth location preferences of mothers and fathers in rural Ghana: Implications for pregnancy, labor and birth outcomes', *BMC pregnancy and childbirth,* 15 (165). *10.1186/s12884-015-0604-2.*

Cohen, S. A. 1987, 'The Safe Motherhood Conference', *International Family Planning Perspectives,* 13 (2)**,** 68-70. *10.2307/2947837.*

Corrarino, J. E. 2013, 'Health literacy and women's health: challenges and opportunities', *Journal of Midwifery and Women's Health,* 58 (3)**,** 257-64. *10.1111/jmwh.12018.*

CSA [Ethiopia] & ICF International 2012, Ethiopia Demographic and Health Survey 2011. Addis Ababa, Ethiopia: Central Statistical Agency and ICF International.

CSA [Ethiopia] & ORC Macro 2001, Ethiopia demographic and health survey 2000. Addis Ababa: Central Statistical Authority [Ethiopia] and ORC Macro.

CSA [Ethiopia] & ORC Macro 2006, Ethiopia demographic and health survey 2005. Central Statistical Agency and ORC Macro.

CSA/Ethiopia & ICF 2017, Ethiopia Demographic and Health Survey 2016. Addis Ababa, Ethiopia: CSA and ICF.

Dankwah, E., Zeng, W., Feng, C., Kirychuk, S. & Farag, M. 2019, 'The social determinants of health facility delivery in Ghana', *Reproductive Health,* 16 (101). *10.1186/s12978-019-0753-2.*

Darmstadt, G. L., Choi, Y., Arifeen, S. E., Bari, S., Rahman, S. M., Mannan, I., et al. 2010, 'Evaluation of a cluster-randomized controlled trial of a package of community-based maternal and newborn interventions in Mirzapur, Bangladesh', *PLoS ONE,* 5 (3). *10.1371/journal.pone.0009696.*

Dawson, A., Tappis, H. & Tran, N. T. 2022, 'Self-care interventions for sexual and reproductive health in humanitarian and fragile settings: a scoping review', *BMC Health Services Research,* 22 (757)**,** 757. *10.1186/s12913-022-07916-4.*

Day, R. 2019, *BBC Media Action Radio for Development: Exploring maternal health programs with a gender and development lens in Ethiopia.* Malmö universitet/Kultur och samhälle.

de la Perrelle, L., Radisic, G., Cations, M., Kaambwa, B., Barbery, G. & Laver, K. 2020, 'Costs and economic evaluations of Quality Improvement Collaboratives in healthcare: a systematic review', *BMC Health Services Research,* 20 (155). *10.1186/s12913-020-4981-5.*

Defar, A., Getachew, T., Taye, G., Tadele, T., Getnet, M., Shumet, T., et al. 2020, 'Quality antenatal care services delivery at health facilities of Ethiopia, assessment of the structure/input of care setting', *BMC Health Services Research,* 20 (485). *10.1186/s12913-020-05372-6.*

Desta, M., Kassie, B., Chanie, H., Mulugeta, H., Yirga, T., Temesgen, H., et al. 2019, 'Adherence of iron and folic acid supplementation and determinants among pregnant women in Ethiopia: a systematic review and meta-analysis', *Reproductive Health,* 16 (182). *10.1186/s12978-019-0848-9.*

Doctor, H. V., Nkhana-Salimu, S. & Abdulsalam-Anibilowo, M. 2018, 'Health facility delivery in sub-Saharan Africa: successes, challenges, and implications for the 2030 development agenda', *BMC public health,* 18 (765). *10.1186/s12889-018-5695-z.*

Downe, S., Finlayson, K., Tunçalp, Ö. & Gülmezoglu, A. M. 2019a, 'Provision and uptake of routine antenatal services: a qualitative evidence synthesis', *Cochrane Database Syst Rev,* 6 (6)**,** Cd012392. *10.1002/14651858.CD012392.pub2.*

Downe, S., Finlayson, K., Tunçalp, Ö. & Gülmezoglu, A. M. 2019b, 'Provision and uptake of routine antenatal services: a qualitative evidence synthesis', *Cochrane Database of Systematic Reviews,* (6). *10.1002/14651858.CD012392.pub2.*

Dugoff, E. H., Schuler, M. & Stuart, E. A. 2014, 'Generalizing observational study results: applying propensity score methods to complex surveys', *Health Services Research,* 49 (1)**,** 284-303. *10.1111/1475-6773.12090.*

Duysburgh, E., Ye, M., Williams, A., Massawe, S., Sié, A., Williams, J., et al. 2013, 'Counselling on and women's awareness of pregnancy danger signs in selected rural health facilities in Burkina Faso, Ghana and Tanzania', *Tropical Medicine and International Health,* 18 (12)**,** 1498-509. *10.1111/tmi.12214.*

Elo, S. & Kyngäs, H. 2008, 'The qualitative content analysis process', *Journal of Advanced Nursing,* 62 (1)**,** 107-15.

Ensor, T., Quigley, P., Green, C., Razak Badru, A., Kaluba, D. & Siziya, S. 2013, 'Knowledgeable antenatal care as a pathway to skilled delivery: modelling the interactions between use of services and knowledge in Zambia', *Health Policy and Planning,* 29 (5)**,** 580-8. *10.1093/heapol/czt044.*

EPHI, FMoH & ICF. 2014, *Ethiopia Service Provision Assessment Plus Survey 2014* [Online]. Addis Ababa: The Ethiopian Public Health Institute. Available: https://www.ephi.gov.et/images/pictures/FINAL%20Key%20finding%20SPA+%20%20-%20Aug%2017%20-%202015.pdf [Accessed 08 July 2021].

EPHI & ICF 2019, 'Ethiopia Mini Demographic and Health Survey 2019: Key Indicators. Rockville, Maryland, USA: EPHIand ICF'.

Ethiopia News Agency. 2021, *South West Ethiopia Peoples Region Officially Established* [Online]. Addis Ababa: Ethiopia News Agency (ENA). Available: https://www.msn.com/en-xl/africa/other/south-west-ethiopia-peoples-region-officially-established/ar-AAR3s1N [Accessed 11 January 2022].

Exavery, A., Kanté, A. M., Njozi, M., Tani, K., Doctor, H. V., Hingora, A., et al. 2014, 'Access to institutional delivery care and reasons for home delivery in three districts of Tanzania', *International Journal for Equity in Health,* 13 (48). *10.1186/1475-9276-13-48.*

Eze, I. I., Mbachu, C. O., Ossai, E. N., Nweze, C. A. & Uneke, C. J. 2020, 'Unlocking community capabilities for addressing social norms/practices: behavioural change intervention study to improve birth preparedness and complication readiness among pregnant women in rural Nigeria', *BMC Pregnancy and Childbirth,* 20 (369). *10.1186/s12884-020-03061-0.*

Farahani, M. A., Mohammadi, E., Ahmadi, F. & Mohammadi, N. 2013, 'Factors influencing the patient education: A qualitative research', *Iranian Journal of Nursing and Midwifery Research,* 18 (2)**,** 133-9.

FDRE Ministry of Education 2009, Curriculum Framework for Ethiopian Education (KG-12). *In:* EDUCATION, M. O. (ed.). Addis Ababa: Ministry of Education.

Federal Government of Somalia 2020, The Somali Health and Demographic Survey 2020. *https://reliefweb.int/attachments/2ddedb07-7ee1-391d-aff3-b84773f44f2a/FINAL%20SHDS%20Report%202020_V7_0.pdf.*

Fekadu, G. A., Kassa, G. M., Berhe, A. K., Muche, A. A. & Katiso, N. A. 2018, 'The effect of antenatal care on use of institutional delivery service and postnatal care in Ethiopia: a systematic review and meta-analysis', *BMC Health Services Research,* 18 (577). *10.1186/s12913-018-3370-9.*

Feroz, A., Perveen, S. & Aftab, W. 2017, 'Role of mHealth applications for improving antenatal and postnatal care in low and middle income countries: a systematic review', *BMC Health Services Research,* 17 (704). *10.1186/s12913-017-2664-7.*

Firdausia, S. T., Budihastuti, U. R. & Dewi, Y. L. R. 2021, 'The Effectiveness of Edutainment toward Pregnancy Care on Knowledge, Attitude, and Action in Pregnant Women', *Journal of Maternal Child Health,* 6 (1)**,** 56-66.

FMOH 2015, HSTP: Health Sector Transformation Plan : 2015/16 - 2019/20 (2008-2012 EFY). Federal Democratic Republic of Ethiopia Ministry of Health.

Gabrysch, S. & Campbell, O. M. R. 2009, 'Still too far to walk: Literature review of the determinants of delivery service use', *BMC Pregnancy and Childbirth,* 9 (34). *10.1186/1471-2393-9-34.*

Gabrysch, S., Nesbitt, R. C., Schoeps, A., Hurt, L., Soremekun, S., Edmond, K., et al. 2019, 'Does facility birth reduce maternal and perinatal mortality in Brong Ahafo, Ghana? A secondary analysis using data on 119 244 pregnancies from two cluster-randomised controlled trials', *The Lancet Global Health,* 7 (8)**,** e1074-e87.

Gardiner, E., Lai, J. F., Khanna, D., Meza, G., de Wildt, G. & Taylor, B. 2021, 'Exploring women's decisions of where to give birth in the Peruvian Amazon; why do women continue to give birth at home? A qualitative study', *PLOS ONE,* 16 (9)**,** e0257135. *10.1371/journal.pone.0257135.*

Garrido, M. M., Kelley, A. S., Paris, J., Roza, K., Meier, D. E., Morrison, R. S., et al. 2014, 'Methods for constructing and assessing propensity scores', *Health Services Research,* 49 (5)**,** 1701-20. *10.1111/1475-6773.12182.*

Gebre, M., Gebremariam, A. & Abebe, T. A. 2015, 'Birth preparedness and complication readiness among pregnant women in Duguna Fango District, Wolayta Zone, Ethiopia', *PLoS ONE,* 10 (9). *10.1371/journal.pone.0137570.*

Geleto, A., Chojenta, C., Musa, A. & Loxton, D. 2019, 'WOMEN's Knowledge of Obstetric Danger signs in Ethiopia (WOMEN's KODE):a systematic review and meta-analysis', *Systematic Reviews,* 8 (63). *10.1186/s13643-019-0979-7.*

Gesesew, H., Berhane, K., Siraj, E. S., Siraj, D., Gebregziabher, M., Gebre, Y. G., et al. 2021, 'The impact of war on the health system of the Tigray region in Ethiopia: an assessment', *BMJ Global Health,* 6 (11). *10.1136/bmjgh-2021-007328.*

Gharachourlo, M., Mahmoodi, Z., Kamrani, M. A., Tehranizadeh, M. & Kabir, K. 2018, 'The effect of a health literacy approach to counselling on the lifestyle of women with gestational diabetes: A clinical trial', *F1000Research,* 7. *10.12688/f1000research.13838.1.*

Goyet, S., Broch-Alvarez, V. & Becker, C. 2019, 'Quality improvement in maternal and newborn healthcare: lessons from programmes supported by the German development organisation in Africa and Asia', *BMJ Global Health* 4(5)**,** e001562. *10.1136/bmjgh-2019-001562*

Gross, K., Schellenberg, J. A., Kessy, F., Pfeiffer, C. & Obrist, B. 2011, 'Antenatal care in practice: an exploratory study in antenatal care clinics in the Kilombero Valley,

south-eastern Tanzania', *BMC Pregnancy and Childbirth,* 11 (36). *10.1186/1471-2393-11-36.*

Gudayu, T. W. & Araya, B. M. 2019, 'Outcomes among Mothers Who Gave Birth in the Health Facility: Does Birth Preparedness and Complication Readiness Have a Role?', *Obstetrics and Gynecology International,* 2019**,** 5147853. *10.1155/2019/5147853.*

Hasanzadeh, S., AsghariJafarabadi, M. & Sadeghi-Bazargani, H. 2019, Generalized Structural Equation Modeling (GSEM) in prediction of injury leading to motorcyclist hospitalization: a case-control study. *24th International Conference on Safe Community.* Tabriz University of Medical Sciences.

Hazra, A., Atmavilas, Y., Hay, K., Saggurti, N., Verma, R. K., Ahmad, J., et al. 2020, 'Effects of health behaviour change intervention through women's self-help groups on maternal and newborn health practices and related inequalities in rural india: A quasi-experimental study', *EClinicalMedicine,* 18**,** 100198. *10.1016/j.eclinm.2019.10.011.*

Heinonen, K. 2021, 'Strengthening Antenatal Care towards a Salutogenic Approach: A Meta-Ethnography', *International journal of environmental research and public health,* 18 (10)**,** 5168. *10.3390/ijerph18105168.*

Heredia-Pi, I., Servan-Mori, E., Darney, B. G., Reyes-Morales, H. & Lozano, R. 2016, 'Measuring the adequacy of antenatal health care: a national cross-sectional study in Mexico', *Bulletin of the World Health Organization,* 94 (6)**,** 452-61. *10.2471/blt.15.168302.*

Hinton, L., Dumelow, C., Rowe, R. & Hollowell, J. 2018, 'Birthplace choices: what are the information needs of women when choosing where to give birth in England? A qualitative study using online and face to face focus groups', *BMC Pregnancy and Childbirth,* 18 (12). *10.1186/s12884-017-1601-4.*

Hodgins, S. & D'Agostino, A. 2014, 'The quality-coverage gap in antenatal care: toward better measurement of effective coverage', *Global Health: Science and Practice* 2(2)**,** 173-81. *10.9745/ghsp-d-13-00176.*

Hodgins, S., Tielsch, J., Rankin, K., Robinson, A., Kearns, A. & Caglia, J. 2016, 'A New Look at Care in Pregnancy: Simple, Effective Interventions for Neglected Populations', *PLOS ONE,* 11 (8)**,** e0160562. *10.1371/journal.pone.0160562.*

Homer, C. S., Oats, J., Middleton, P., Ramson, J. & Diplock, S. 2018, 'Updated clinical practice guidelines on pregnancy care', *The Medical Journal of Australia,* 209 (9)**,** 409-12. *10.5694/mja18.00286.*

Horiuchi, S., Nakdouangma, B., Khongsavat, T., Kubota, S. & Yamaoka, K. 2020, 'Potential factors associated with institutional childbirth among women in rural villages of Lao People's Democratic Republic: A preliminary study', *BMC Pregnancy and Childbirth,* 20 (89). *10.1186/s12884-020-2776-7.*

IBM Corp 2020, IBM SPSS Statistics for Windows, Version 27.0. Armonk, NY: IBM Corp. *Released 2020.*

Iftikhar ul Husnain, M., Rashid, M. & Shakoor, U. 2018, 'Decision-making for birth location among women in Pakistan: evidence from national survey', *BMC Pregnancy and Childbirth,* 18 (226). *10.1186/s12884-018-1844-8.*

Ijang, Y. P., Cumber, S. N. N., Nkfusai, C. N., Venyuy, M. A., Bede, F. & Tebeu, P. M. 2019, 'Awareness and practice of birth preparedness and complication

readiness among pregnant women in the Bamenda Health District, Cameroon', *BMC Pregnancy and Childbirth,* 19 (71). *10.1186/s12884-019-2511-4.*

IOM 1990, Clinical Practice Guidelines: Directions for a New Program *In:* FIELD, M. J. & LOHR, K. N. (eds.) *Clinical Practice Guidelines: Directions for a New Program.* 4th ed. Washington DC: National Academies Press.

Islam, M. M. & Masud, M. S. 2018, 'Determinants of frequency and contents of antenatal care visits in Bangladesh: Assessing the extent of compliance with the WHO recommendations', *PLOS ONE,* 13 (9)**,** e0204752. *10.1371/journal.pone.0204752.*

Jackson, M. K., Schmied, V. & Dahlen, H. G. 2020, 'Birthing outside the system: the motivation behind the choice to freebirth or have a homebirth with risk factors in Australia', *BMC pregnancy and childbirth,* 20 (254). *10.1186/s12884-020-02944-6.*

Jansen, T., Rademakers, J., Waverijn, G., Verheij, R., Osborne, R. & Heijmans, M. 2018, 'The role of health literacy in explaining the association between educational attainment and the use of out-of-hours primary care services in chronically ill people: a survey study', *BMC Health Services Research,* 18 (394). *10.1186/s12913-018-3197-4.*

Jawad, M., Hone, T., Vamos, E. P., Cetorelli, V. & Millett, C. 2021, 'Implications of armed conflict for maternal and child health: A regression analysis of data from 181 countries for 2000–2019', *PLOS Medicine,* 18 (9)**,** e1003810. *10.1371/journal.pmed.1003810.*

JBI. 2017, *Critical Appraisal Tools* [Online]. Available: https://joannabriggs.org/ebp/critical_appraisal_tools [Accessed 20 January 2021].

Jennings, L., Omoni, A., Akerele, A., Ibrahim, Y. & Ekanem, E. 2015, 'Disparities in mobile phone access and maternal health service utilization in Nigeria: A population-based survey', *International Journal of Medical Informatics,* 84 (5)**,** 341-8. *10.1016/j.ijmedinf.2015.01.016.*

Jennings, L., Yebadokpo, A. S., Affo, J. & Agbogbe, M. 2010, 'Antenatal counseling in maternal and newborn care: use of job aids to improve health worker performance and maternal understanding in Benin', *BMC Pregnancy and Childbirth,* 10 (75). *10.1186/1471-2393-10-75.*

Jennings, L., Yebadokpo, A. S., Affo, J., Agbogbe, M. & Tankoano, A. 2011, 'Task shifting in maternal and newborn care: a non-inferiority study examining delegation of antenatal counseling to lay nurse aides supported by job aids in Benin', *Implementation Science,* 6 (2). *10.1186/1748-5908-6-2.*

Jhons Hopkins Bloomberg 2008, 'Entertainment-Education for Better Health', *Info reports,* (7).

Jhpiego 2004, Monitoring birth preparedness and complication readiness: tools and indicators for maternal and newborn health.

Jhpiego. 2021, *Ethiopia Group Antenatal Care Study at the Health Post Level (ARC004)* [Online]. ClinicalTrials.gov. Available: https://clinicaltrials.gov/ct2/show/NCT05054491 [Accessed 08 August 2022].

Jones, G. L., Mitchell, C. A., Hirst, J. E. & Anumba, D. O. C. 2022, 'Understanding the relationship between social determinants of health and maternal mortality:

Scientific Impact Paper No. 67', *BJOG,* 129 (7)**,** 1211-28. *10.1111/1471-0528.17044.*

Kaba, M., Bulto, T., Tafesse, Z., Lingerh, W. & Ali, I. 2016, 'Sociocultural determinants of home delivery in Ethiopia: a qualitative study', *International Journal of Women's Health,* 8**,** 93-102.

Kamau, M., Kimani, S. & Mirie, W. 2018, 'Counselling and knowledge on iron and folic acid supplementation (IFAS) among pregnant women in Kiambu County, Kenya: a cross-sectional study', *AAS Open Res,* 1**,** 21. *10.12688/aasopenres.12891.3.*

Karim, A. M., Admassu, K., Schellenberg, J., Alemu, H., Getachew, N., Ameha, A., et al. 2013, 'Effect of Ethiopia's Health Extension Program on Maternal and Newborn Health Care Practices in 101 Rural Districts: A Dose-Response Study', *PLOS ONE,* 8 (6)**,** e65160. *10.1371/journal.pone.0065160.*

Karkee, R., Baral, O. B., Khanal, V. & Lee, A. H. 2014, 'The role of obstetric knowledge in utilization of delivery service in Nepal', *Health Education Research,* 29 (6)**,** 1041-8. *10.1093/her/cyu059.*

Kassebaum, N. J., Bertozzi-Villa, A., Coggeshall, M. S., Shackelford, K. A., Steiner, C., Heuton, K. R., et al. 2014, 'Global, regional, and national levels and causes of maternal mortality during 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013', *Lancet,* 384 (9947)**,** 980-1004. *10.1016/s0140-6736(14)60696-6.*

Kebede, A. A., Taye, B. T., Wondie, K. Y., Tiguh, A. E., Eriku, G. A. & Mihret, M. S. 2021a, 'Healthcare provider's adherence to immediate postpartum care guidelines in Gondar province hospitals, northwest Ethiopia: A multicenter study', *PLoS One,* 16 (10)**,** e0259263. *10.1371/journal.pone.0259263.*

Kebede, T. T., Godana, W., Utaile, M. M. & Sebsibe, Y. B. 2021b, 'Effects of antenatal care service utilization on maternal near miss in Gamo Gofa zone, southern Ethiopia: retrospective cohort study', *BMC Pregnancy and Childbirth,* 21 (219). *10.1186/s12884-021-03683-y.*

Khatiwada, J., Muzembo, B. A., Wada, K. & Ikeda, S. 2020, 'Dimensions of women's empowerment on access to skilled delivery services in Nepal', *BMC Pregnancy and Childbirth,* 20 (622). *10.1186/s12884-020-03309-9.*

Kifle, D., Azale, T., Gelaw, Y. A. & Melsew, Y. A. 2017, 'Maternal health care service seeking behaviors and associated factors among women in rural Haramaya District, Eastern Ethiopia: a triangulated community-based cross-sectional study', *Reproductive Health,* 14 (6). *10.1186/s12978-016-0270-5.*

Kindig, D., Dyanne D., A., Eric H., C., Marilyn H., G., Cathy D., M., Ruth, P., et al. 2004, *Health literacy: a prescription to end confusion*, National Academies Press.

Kruk, M. E., Gage, A. D., Arsenault, C., Jordan, K., Leslie, H. H., Roder-DeWan, S., et al. 2018, 'High-quality health systems in the Sustainable Development Goals era: time for a revolution', *Lancet Global Health,* 6 (11)**,** e1196-e252. *10.1016/s2214-109x(18)30386-3.*

Kruk, M. E., Myers, M., Varpilah, S. T. & Dahn, B. T. 2015, 'What is a resilient health system? Lessons from Ebola', *The Lancet,* 385 (9980)**,** 1910-2.

Kuhnt, J. & Vollmer, S. 2017, 'Antenatal care services and its implications for vital and health outcomes of children: evidence from 193 surveys in 69 low-income and middle-income countries', *BMJ Open,* 7 (11)**,** e017122. *10.1136/bmjopen-2017-017122*

Kurzawa, Z., Cotton, C. S., Mazurkewich, N., Verney, A., Busch-Hallen, J. & Kashi, B. 2021, 'Training healthcare workers increases IFA use and adherence: Evidence and cost-effectiveness analysis from Bangladesh', *Maternal & Child Health Nutrition,* 17. *10.1111/mcn.13124.*

Kusuma, Y. S., Kaushal, S., Garg, R. & Babu, B. V. 2018, 'Birth preparedness and determinants of birth place among migrants living in slums and slum-like pockets in Delhi, India', *Sexual and Reproductive Healthcare,* 16**,** 160-6. *10.1016/j.srhc.2018.04.004.*

Lakew, Y., Tessema, F. & Hailu, C. 2016, 'Birth Preparedness and Its Association with Skilled Birth Attendance and Postpartum Checkups among Mothers in Gibe Wereda, Hadiya Zone, South Ethiopia', *Journal of Environmental and Public Health,* 2016**,** 6458283. *10.1155/2016/6458283.*

Larki, M., Sharifi, F. & Roudsari, R. L. 2020, 'Models of maternity care for pregnant women during the COVID-19 pandemic', *Eastern Mediterranean Health Journal,* 26 (9)**,** 994-8. *10.26719/emhj.20.097.*

Lassi, Z. S., Musavi, N. B., Maliqi, B., Mansoor, N., de Francisco, A., Toure, K., et al. 2016, 'Systematic review on human resources for health interventions to improve maternal health outcomes: evidence from low- and middle-income countries', *Human resources for health,* 14 (10). *10.1186/s12960-016-0106-y.*

Lattof, S. R., Moran, A. C., Kidula, N., Moller, A.-B., Jayathilaka, C. A., Diaz, T., et al. 2020, 'Implementation of the new WHO antenatal care model for a positive pregnancy experience: a monitoring framework', *BMJ Global Health,* 5 (6). *10.1136/bmjgh-2020-002605.*

Lee, H., Herbert, R. D. & McAuley, J. H. 2019, 'Mediation Analysis', *JAMA,* 321 (7)**,** 697-8. *10.1001/jama.2018.21973.*

Lee, T. W., Lee, S. H., Kim, H. H. & Kang, S. J. 2012, 'Effective Intervention Strategies to Improve Health Outcomes for Cardiovascular Disease Patients with Low Health Literacy Skills: A Systematic Review', *Asian Nursing Research,* 6 (4)**,** 128-36. https://doi.org/10.1016/j.anr.2012.09.001.

Leslie, H. H., Gage, A., Nsona, H., Hirschhorn, L. R. & Kruk, M. E. 2016, 'Training and supervision did not meaningfully improve quality of care for pregnant women or sick children in sub-Saharan Africa', *Global Health Affairs,* 35 (9)**,** 1716-24. *10.1377/hlthaff.2016.0261.*

Leslie, H. H., Malata, A., Ndiaye, Y. & Kruk, M. E. 2017, 'Effective coverage of primary care services in eight high-mortality countries', *BMJ Global Health,* 2 (3)**,** e000424. *10.1136/bmjgh-2017-000424.*

Leuven, E. & Sianesi, B. 2003, PSMATCH2: Stata module to perform full Mahalanobis and propensity score matching, common support graphing, and covariate imbalance testing. *Statistical Software Components.* Boston College Department of Economics.

Lombardi, S., Santini, G., Marchetti, G. M. & Focardi, S. 2017, 'Generalized structural equations improve sexual-selection analyses', *PLOS ONE,* 12 (8)**,** e0181305. *10.1371/journal.pone.0181305.*

Lori, J. R., Dahlem, C. H., Ackah, J. V. & Adanu, R. M. 2014, 'Examining antenatal health literacy in Ghana', *Journal of Nursing Scholarship,* 46 (6)**,** 432-40. *10.1111/jnu.12094.*

Lori, J. R., Munro, M. L. & Chuey, M. R. 2016, 'Use of a facilitated discussion model for antenatal care to improve communication', *International Journal of Nursing Studies,* 54**,** 84-94. *10.1016/j.ijnurstu.2015.03.018.*

Lori, J. R., Ofosu-Darkwah, H., Boyd, C. J., Banerjee, T. & Adanu, R. M. K. 2017, 'Improving health literacy through group antenatal care: A prospective cohort study', *BMC Pregnancy and Childbirth,* 17 (228). *10.1186/s12884-017-1414-5.*

Lupattelli, A., Picinardi, M., Einarson, A. & Nordeng, H. 2014, 'Health literacy and its association with perception of teratogenic risks and health behavior during pregnancy', *Patient Education and Counseling,* 96 (2)**,** 171-8. https://doi.org/10.1016/j.pec.2014.04.014.

Machiyama, K., Hirose, A., Cresswell, J. A., Barreix, M., Chou, D., Kostanjsek, N., et al. 2017, 'Consequences of maternal morbidity on health-related functioning: a systematic scoping review', *BMJ Open,* 7 (6). *10.1136/bmjopen-2016-013903.*

Mahler, H. 1987, 'The safe motherhood initiative: a call to action', *Lancet,* 1 (8534)**,** 668-70. *10.1016/s0140-6736(87)90423-5.*

Manzi, A., Nyirazinyoye, L., Ntaganira, J., Magge, H., Bigirimana, E., Mukanzabikeshimana, L., et al. 2018, 'Beyond coverage: improving the quality of antenatal care delivery through integrated mentorship and quality improvement at health centers in rural Rwanda', *BMC Health Services Research,* 18 (136). *10.1186/s12913-018-2939-7.*

Masebo, T. M., Fikadu, B. K., Mehari, E., Gelaye, B., Habte, A., Mersha, T. B., et al. 2022, 'The need for rigour and balance in reporting the health impacts of conflict in Tigray, Ethiopia', *BMJ Global Health,* 7 (3)**,** e008263. *10.1136/bmjgh-2021-008263*

Masoi, T. J. & Kibusi, S. M. 2019, 'Improving pregnant women's knowledge on danger signs and birth preparedness practices using an interactive mobile messaging alert system in Dodoma region, Tanzania: a controlled quasi experimental study', *Reproductive Health,* 16 (177). *10.1186/s12978-019-0838-y.*

Mehretie Adinew, Y., Abera Assefa, N. & Mehretie Adinew, Y. 2018, 'Why Do Some Ethiopian Women Give Birth at Home after Receiving Antenatal Care? Phenomenological Study', *BioMed Research International,* 2018**,** 3249786. *10.1155/2018/3249786.*

Merdad, L. & Ali, M. M. 2018, 'Timing of maternal death: Levels, trends, and ecological correlates using sibling data from 34 sub-Saharan African countries', *PLoS One,* 13 (1)**,** e0189416. *10.1371/journal.pone.0189416.*

Merriel, A., Dembo, Z., Hussein, J., Larkin, M., McHenga, A., Tobias, A., et al. 2021, 'Assessing the impact of a motivational intervention to improve the working lives of maternity healthcare workers: a quantitative and qualitative evaluation of a feasibility study in Malawi', *Pilot and Feasibility Studies,* 7 (34). *10.1186/s40814-021-00774-7.*

Mian, N. u., Alvi, M. A., Malik, M. Z., Iqbal, S., Zakar, R., Zakar, M. Z., et al. 2018, 'Approaches towards improving the quality of maternal and newborn health services in South Asia: challenges and opportunities for healthcare systems', *Globalization and Health,* 14 (17). *10.1186/s12992-018-0338-9.*

Miller, S., Abalos, E., Chamillard, M., Ciapponi, A., Colaci, D., Comandé, D., et al. 2016, 'Beyond too little, too late and too much, too soon: a pathway towards

evidence-based, respectful maternity care worldwide', *Lancet,* 388 (10056)**,** 2176-92. *10.1016/s0140-6736(16)31472-6.*

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G. & The Prisma Group 2009, 'Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement', *PLoS Medicine,* 6 (7)**,** e1000097. *10.1371/journal.pmed.1000097.*

Molla, M., Mitiku, I., Worku, A. & Yamin, A. E. 2015, 'Impacts of maternal mortality on living children and families: A qualitative study from Butajira, Ethiopia', *Reproductive Health,* 12 (S6). *10.1186/1742-4755-12-S1-S6.*

Moucheraud, C., Worku, A., Molla, M., Finlay, J. E., Leaning, J. & Yamin, A. E. 2015, 'Consequences of maternal mortality on infant and child survival: a 25-year longitudinal analysis in Butajira Ethiopia (1987-2011)', *Reproductive Health,* 12 (S4). *10.1186/1742-4755-12-S1-S4.*

Moyo, N., Makasa, M., Chola, M. & Musonda, P. 2018, 'Access factors linked to maternal deaths in Lundazi district, Eastern Province of Zambia: a case control study analysing maternal death reviews', *BMC Pregnancy and Childbirth,* 18 (101). *10.1186/s12884-018-1717-1.*

Mullany, B. C., Lakhey, B., Shrestha, D., Hindin, M. J. & Becker, S. 2009, 'Impact of husbands' participation in antenatal health education services on maternal health knowledge', *Journal of Nepal Medical Association,* 48 (173)**,** 28-34.

Mutiso, S. M., Qureshi, Z. & Kinuthia, J. 2008, 'Birth preparedness among antenatal clients', *East African Medical Journal,* 85 (6)**,** 275-83. *10.4314/eamj.v85i6.9625.*

Mwilike, B., Nalwadda, G., Kagawa, M., Malima, K., Mselle, L. & Horiuchi, S. 2018, 'Knowledge of danger signs during pregnancy and subsequent healthcare seeking actions among women in Urban Tanzania: A cross-sectional study', *BMC Pregnancy and Childbirth,* 18 (4). *10.1186/s12884-017-1628-6.*

Nair, M., Yoshida, S., Lambrechts, T., Boschi-Pinto, C., Bose, K., Mason, E. M., et al. 2014, 'Facilitators and barriers to quality of care in maternal, newborn and child health: a global situational analysis through metareview', *BMJ Open,* 4 (5)**,** e004749. *10.1136/bmjopen-2013-004749.*

Namasivayam, A., Arcos González, P., Castro Delgado, R. & Chi, P. C. 2017, 'The Effect of Armed Conflict on the Utilization of Maternal Health Services in Uganda: A Population-based Study', *PLoS Currents Disasters,* 9. *10.1371/currents.dis.557b987d6519d8c7c96f2006ed3c271a.*

Negero, M. G., Sibbritt, D. & Dawson, A. 2021, 'How can human resources for health interventions contribute to sexual, reproductive, maternal, and newborn healthcare quality across the continuum in low- and lower-middle-income countries? A systematic review', *Human Resources for Health,* 19 (54). *10.1186/s12960-021-00601-3.*

Nikiéma, B., Beninguisse, G. & Haggerty, J. L. 2009, 'Providing information on pregnancy complications during antenatal visits: unmet educational needs in sub-Saharan Africa', *Health Policy and Planning,* 24 (5)**,** 367-76. *10.1093/heapol/czp017*

Nkamba, D. M., Wembodinga, G., Bernard, P., Ditekemena, J. & Robert, A. 2021, 'Awareness of obstetric danger signs among pregnant women in the Democratic Republic of Congo: evidence from a nationwide cross-sectional study', *BMC Women's Health,* 21 (82). *10.1186/s12905-021-01234-3.*

NPC [Nigeria] & ICF 2019, 'Nigeria Demographic and Health Survey 2018. Abuja, Nigeria, and Rockville, Maryland, USA: NPC and ICF.'.

Nuraini, E. & Parker, E. 2005, 'Improving knowledge of antenatal care (ANC) among pregnant women: a field trial in central Java, Indonesia', *Asia Pac J Public Health,* 17 (1)**,** 3-8. *10.1177/101053950501700102.*

Nutbeam, D. 2015, 'Defining, measuring and improving health literacy', *Health Evaluation and Promotion,* 42 (4)**,** 450-6. *10.7143/jhep.42.450.*

Oka, M., Horiuchi, S., Shimpuku, Y., Madeni, F. & Leshabari, S. 2019, 'Effects of a job aid-supported intervention during antenatal care visit in rural Tanzania', *International Journal of Africa Nursing Sciences,* 10**,** 31-7. https://doi.org/10.1016/j.ijans.2018.11.005.

Okawa, S., Win, H. H., Nanishi, K., Shibanuma, A., Aye, P. P., Saw, T. N., et al. 2019, 'Advice on healthy pregnancy, delivery, motherhood and information on non-communicable diseases in the maternal care programme in Myanmar: a cross-sectional study', *BMJ Open,* 9 (3)**,** e025186. *10.1136/bmjopen-2018-025186.*

Okedo-Alex, I. N., Akamike, I. C., Ezeanosike, O. B. & Uneke, C. J. 2019, 'Determinants of antenatal care utilisation in sub-Saharan Africa: a systematic review', *BMJ Open,* 9 (10)**,** e031890. *10.1136/bmjopen-2019-031890.*

Origlia, P., Jevitt, C., Sayn-Wittgenstein, F. z. & Cignacco, E. 2017, 'Experiences of Antenatal Care Among Women Who Are Socioeconomically Deprived in High-Income Industrialized Countries: An Integrative Review', *Journal of Midwifery & Women's Health,* 62 (5)**,** 589-98. *10.1111/jmwh.12627.*

Owili, P. O., Muga, M. A., Chou, Y. J., Hsu, Y. E., Huang, N. & Chien, L. Y. 2017, 'Relationship between women's characteristics and continuum of care for maternal health in Kenya: Complex survey analysis using structural equation modeling', *Women & Health,* 57 (8)**,** 942-61. *10.1080/03630242.2016.1222327.*

Patil, C. L., Abrams, E. T., Klima, C. & et al. 2013, 'CenteringPregnancy-Africa: a pilot of group antenatal care to address Millennium Development Goals', *Midwifery,* 29 (10)**,** 1190-8.

Patil, C. L., Klima, C. S., Leshabari, S. C., Steffen, A. D., Pauls, H., McGown, M., et al. 2017, 'Randomized controlled pilot of a group antenatal care model and the sociodemographic factors associated with pregnancy-related empowerment in sub-Saharan Africa', *BMC Pregnancy and Childbirth,* 17 (336). *10.1186/s12884-017-1493-3.*

Pembe, A. B., Carlstedt, A., Urassa, D. P., Lindmark, G., Nystrom, L. & Darj, E. 2010, 'Quality of antenatal care in rural Tanzania: counselling on pregnancy danger signs', *BMC Pregnancy and Childbirth,* 10 (35). *10.1186/1471-2393-10-35.*

Pembe, A. B., Urassa, D. P., Carlstedt, A., Lindmark, G., Nyström, L. & Darj, E. 2009, 'Rural Tanzanian women's awareness of danger signs of obstetric complications', *BMC Pregnancy and Childbirth,* 9. *10.1186/1471-2393-9-12.*

Perreira, K. M., Bailey, P. E., de Bocaletti, E., Hurtado, E., Recinos de Villagrán, S. & Matute, J. 2002, 'Increasing awareness of danger signs in pregnancy through community- and clinic-based education in Guatemala', *Maternal & Child Health Journal,* 6 (1)**,** 19-28.

Phommachanh, S., Essink, D. R., Jansen, M., Broerse, J. E. W., Wright, P. & Mayxay, M. 2019a, 'Improvement of Quality of Antenatal Care (ANC) Service Provision at the Public Health Facilities in Lao PDR: Perspective and Experiences of Supply

and Demand Sides', *BMC Pregnancy and Childbirth,* 19 (255). *10.1186/s12884-019-2345-0.*

Phommachanh, S., Essink, D. R., Wright, E. P., Broerse, J. E. W. & Mayxay, M. 2019b, 'Do health care providers give sufficient information and good counseling during ante-natal care in Lao PDR?: an observational study', *BMC Health Services Research,* 19 (449). *10.1186/s12913-019-4258-z.*

Pittrof, R., Campbell, O. R. & Filippi, V. A. 2002, 'What is quality in maternity care? An international perspective', *Acta Obstetricia et Gynecologica Scandinavica,* 81 (4)**,** 277-83. *10.1080/j.1600-0412.2002.810401.x.*

Ploeg, J., Wong, S. T., Hassani, K., Yous, M.-L., Fortin, M., Kendall, C., et al. 2019, 'Contextual factors influencing the implementation of innovations in community-based primary health care: the experience of 12 Canadian research teams', *Primary Health Care Research & Development,* 20**,** e107. *10.1017/S1463423619000483.*

Prost, A., Colbourn, T., Seward, N., Azad, K., Coomarasamy, A., Copas, A., et al. 2013, 'Women's groups practising participatory learning and action to improve maternal and newborn health in low-resource settings: a systematic review and meta-analysis', *Lancet,* 381 (9879)**,** 1736-46. *10.1016/s0140-6736(13)60685-6.*

Renfrew, M. J., McFadden, A., Bastos, M. H., Campbell, J., Channon, A. A., Cheung, N. F., et al. 2014, 'Midwifery and quality care: findings from a new evidence-informed framework for maternal and newborn care', *The Lancet,* 384 (9948)**,** 1129-45. *https://doi.org/10.1016/S0140-6736(14)60789-3*.

Renkert, S. & Nutbeam, D. J. H. P. I. 2001, 'Opportunities to improve maternal health literacy through antenatal education: an exploratory study', *HEALTH PROMOTION INTERNATIONAL,* 16 (4)**,** 381-8.

Rising, S. S. 1998, 'Centering pregnancy. An interdisciplinary model of empowerment', *Journal of Nurse-Midwifery,* 43 (1)**,** 46-54.

Rising, S. S., Kennedy, H. P. & Klima, C. S. 2004, 'Redesigning prenatal care through CenteringPregnancy', *Journal of Midwifery & Women's Health,* 49 (5)**,** 398-404. *10.1016/j.jmwh.2004.04.018.*

Rono, H., Bastawrous, A., Macleod, D., Mamboleo, R., Bunywera, C., Wanjala, E., et al. 2021, 'Effectiveness of an mHealth system on access to eye health services in Kenya: a cluster-randomised controlled trial', *The Lancet. Digital health,* 3 (7)**,** e414-e24. *10.1016/S2589-7500(21)00083-2.*

Rosado, C., Callaghan-Koru, J. A., Estifanos, A. S., Sheferaw, E., Shay, T., De Graft-Johnson, J., et al. 2019, 'Effect of Birth Preparedness on Institutional Delivery in Semiurban Ethiopia: A Cross-Sectional Study', *Annals of Global Health,* 85 (1)**,** 44, 1-11.

Rosenbaum, P. R. 2002, *Observational Studies*, Springer Science+Business Media New York.

Rosenbaum, P. R. & Rubin, D. B. 1983, 'The Central Role of the Propensity Score in Observational Studies for Causal Effects', *Biometrika,* 70 (1)**,** 41-55. *10.2307/2335942.*

Rosenfield, A. & Maine, D. 1985, 'MATERNAL MORTALITY-A NEGLECTED TRAGEDY: Where is the M in MCH?', *The Lancet,* 326 (8446)**,** 83-5. *https://doi.org/10.1016/S0140-6736(85)90188-6*.

Rowe, A. K., Rowe, S. Y., Peters, D. H., Holloway, K. A., Chalker, J. & Ross-Degnan, D. 2018, 'Effectiveness of strategies to improve health-care provider practices in low-income and middle-income countries: a systematic review', *Lancet Global Health,* 6 (11)**,** 1163-75.

Rowe, R. E., Garcia, J., Macfarlane, A. J. & Davidson, L. L. 2002, 'Improving communication between health professionals and women in maternity care: a structured review', *Health expectations* 5(1)**,** 63-83. *10.1046/j.1369-6513.2002.00159.x.*

Rowe, S., Karkhaneh, Z., MacDonald, I., Chambers, T., Amjad, S., Osornio-Vargas, A., et al. 2020, 'Systematic review of the measurement properties of indices of prenatal care utilization', *BMC Pregnancy and Childbirth,* 20 (171). *10.1186/s12884-020-2822-5.*

Roy, S. 2018, 'Effect of antenatal care and social well-being on early neonatal mortality in Bangladesh', *BMC Pregnancy and Childbirth,* 18 (485). *10.1186/s12884-018-2129-y.*

Rubin, D. B. 2001, 'Using Propensity Scores to Help Design Observational Studies: Application to the Tobacco Litigation', *Health Services and Outcomes Research Methodology,* 2 (3)**,** 169-88. *10.1023/A:1020363010465.*

Saaka, M., Aryee, P., kuganab-lem, R., Ali, M. & Masahudu, A. R. 2017, 'The effect of social behavior change communication package on maternal knowledge in obstetric danger signs among mothers in East Mamprusi District of Ghana', *Globalization and Health,* 13 (19). *10.1186/s12992-017-0243-7.*

Sado, L., Spaho, A. & Hotchkiss, D. R. 2014, 'The influence of women's empowerment on maternal health care utilization: evidence from Albania', *Social Science & Medicine,* 114**,** 169-77. *10.1016/j.socscimed.2014.05.047.*

Sageer, R., Kongnyuy, E., Adebimpe, W. O., Omosehin, O., Ogunsola, E. A. & Sanni, B. 2019, 'Causes and contributory factors of maternal mortality: evidence from maternal and perinatal death surveillance and response in Ogun state, Southwest Nigeria', *BMC Pregnancy and Childbirth,* 19 (63). *10.1186/s12884-019-2202-1.*

Saha, S., Kermode, M. & Annear, P. L. 2015, 'Effect of combining a health program with a microfinance-based self-help group on health behaviors and outcomes', *Public Health,* 129 (11)**,** 1510-8. *10.1016/j.puhe.2015.07.010.*

Salam, F. T. & Sarfraz, M. 2018, 'Perceptions and practices among married women of child bearing age regarding obstetric danger signs in rural Islamabad: A qualitative study', *Journal of the Pakistan Medical Association,* 68 (10)**,** 1496-501.

Salem, A., Lacour, O., Scaringella, S., Herinianasolo, J., Benski, A. C., Stancanelli, G., et al. 2018, 'Cross-sectional survey of knowledge of obstetric danger signs among women in rural Madagascar', *BMC Pregnancy and Childbirth,* 18**,** 1-. *10.1186/s12884-018-1664-x.*

Sarker, M., Schmid, G., Larsson, E., Kirenga, S., De Allegri, M., Neuhann, F., et al. 2010, 'Quality of antenatal care in rural southern Tanzania: A reality check', *BMC Research Notes,* 3 (209). *10.1186/1756-0500-3-209.*

Say, L., Chou, D., Gemmill, A., Tuncalp, O., Moller, A. B., Daniels, J., et al. 2014, 'Global causes of maternal death: a WHO systematic analysis', *Lancet Global Health,* 2 (6)**,** e323-33. *10.1016/s2214-109x(14)70227-x.*

Schardt, C., Adams, M. B., Owens, T., Keitz, S. & Fontelo, P. 2007, 'Utilization of the PICO framework to improve searching PubMed for clinical questions', *BMC Medical Informatics and Decision Making,* 7 (16). *doi:10.1186/1472-6947-7-16.*

Seyoum, T., Alemayehu, M., Christensson, K. & Lindgren, H. 2021, 'Provider-perceived benefits and constraints of complete adherence to antenatal care guideline among public health facilities, Ethiopia: A qualitative study', *PLOS ONE,* 16 (8). *10.1371/journal.pone.0255297.*

Shahil Feroz, A. 2022, 'Strengthening self-care agency in pregnancy: A new approach to improve maternal health outcomes in low-and middle-income countries', *Front Public Health,* 10**,** 968375. *10.3389/fpubh.2022.968375.*

Sharma, B. B., Loxton, D. J., Murray, H., Angeli, G. L., Oldmeadow, C., Chiu, S., et al. 2018, 'A first step to improving maternal mortality in a low-literacy setting; the successful use of singing to improve knowledge regarding antenatal care', *American Journal of Obstetrics & Gynecology,* 219 (6)**,** 615.e1-.e11. *10.1016/j.ajog.2018.09.038.*

Sheffel, A., Heidkamp, R., Mpembeni, R., Bujari, P., Gupta, J., Niyeha, D., et al. 2019, 'Understanding client and provider perspectives of antenatal care service quality: a qualitative multi-method study from Tanzania', *Journal of Global Health,* 9 (1). *10.7189/jogh.09.01101.*

Shidhaye, R., Madhivanan, P., Shidhaye, P. & Krupp, K. 2020, 'An Integrated Approach to Improve Maternal Mental Health and Well-Being During the COVID-19 Crisis', *Frontiers in Psychiatry,* 11**,** 598746. *10.3389/fpsyt.2020.598746.*

Shimamoto, K. & Gipson, J. D. 2019, 'Investigating pathways linking women's status and empowerment to skilled attendance at birth in Tanzania: A structural equation modeling approach', *PLOS ONE,* 14 (2)**,** e0212038. *10.1371/journal.pone.0212038.*

Shukla, A., Acharya, R., Kumar, A., Mozumdar, A., Aruldas, K. & Saggurti, N. 2020, 'Client-provider interaction: understanding client experience with family planning service providers through the mystery client approach in India', *Sexual and Reproductive Health Matters,* 28 (1)**,** 1822492. *10.1080/26410397.2020.1822492.*

Shukla, M., Khan, N. Z., Agarwal, A., Dwivedi, A. D., Singh, J. V. & Alam, S. 2019, 'Effect of focused birth preparedness and complication readiness counseling on pregnancy outcome among females attending tertiary care hospital in Barabanki district, Uttar Pradesh, India', *Journal of Education and Health Promotion,* 8 (1). *10.4103/jehp.jehp_451_18.*

Siegel, S. 1956, *Nonparametric statistics for the behavioral sciences,* Unites States of America, McGraw-Hill Book Company

Singh, N. S., Ataullahjan, A., Ndiaye, K., Das, J. K., Wise, P. H., Altare, C., et al. 2021, 'Delivering health interventions to women, children, and adolescents in conflict settings: what have we learned from ten country case studies?', *The Lancet (British edition),* 397 (10273)**,** 533-42. *10.1016/S0140-6736(21)00132-X.*

Sipsma, H., Callands, T. A., Bradley, E., Harris, B., Johnson, B. & Hansen, N. B. 2013, 'Healthcare utilisation and empowerment among women in Liberia', *Journal of Epidemiology and Community Health,* 67 (11)**,** 953-9. *10.1136/jech-2013-202647.*

Siyoum, M., Astatkie, A., Mekonnen, S., Bekele, G., Taye, K., Tenaw, Z., et al. 2018, 'Home birth and its determinants among antenatal care-booked women in public hospitals in Wolayta Zone, southern Ethiopia', *PLoS ONE,* 13 (9). *10.1371/journal.pone.0203609.*

Sk, M. I. K., Paswan, B., Anand, A. & Mondal, N. A. 2019, 'Praying until death: revisiting three delays model to contextualize the socio-cultural factors associated with maternal deaths in a region with high prevalence of eclampsia in India', *BMC Pregnancy and Childbirth,* 19 (314). *10.1186/s12884-019-2458-5.*

Smeele, P., Kalisa, R., van Elteren, M., van Roosmalen, J. & van den Akker, T. 2018, 'Birth preparedness and complication readiness among pregnant women admitted in a rural hospital in Rwanda', *BMC Pregnancy and Childbirth,* 18 (190). *10.1186/s12884-018-1818-x.*

Smith-Greenaway, E. 2013, 'Maternal reading skills and child mortality in Nigeria: a reassessment of why education matters', *Demography,* 50 (5)**,** 1551-61. *10.1007/s13524-013-0209-1.*

Smith, H. J., Portela, A. G. & Marston, C. 2017, 'Improving implementation of health promotion interventions for maternal and newborn health', *BMC Pregnancy and Childbirth,* 17 (280). *10.1186/s12884-017-1450-1.*

Soares Goncalves, A., Maria Ferreira, I., Pestana-Santos, M., McCourt, C. & Paula Prata, A. 2022, 'Antenatal care policy in high-income countries with a universal health system: A scoping review', *Sexual & reproductive healthcare,* 32**,** 100717-. *10.1016/j.srhc.2022.100717.*

Solhi, M., Abbasi, K., Azar, F. E. F. & Hosseini, A. 2019, 'Effect of health literacy education on self-care in pregnant women: A randomized controlled clinical trial', *IJCBNM,* 7 (1)**,** 2-12. *10.30476/IJCBNM.2019.40841.*

Solnes Miltenburg, A., van Pelt, S., Lindskog, B., Sundby, J. & Meguid, T. 2022, 'Understanding women's decision-making process for birth location in Tanzania based on individual women's reproductive pathways: a life-course perspective', *Global health action,* 15. *10.1080/16549716.2022.2040149.*

Sommer Albert, J., Younas, A. & Victor, G. 2020, 'Quality of Antenatal Care Services in a Developing Country: A Cross-Sectional Survey', *Creative Nursing,* 26 (1)**,** e25-e34. *10.1891/1078-4535.26.1.e25.*

Sommers-Flanagan, J. & Sommers-Flanagan, R. 2018, *Counseling and psychotherapy theories in context and practice: Skills, strategies, and techniques*, John Wiley & Sons.

Soubeiga, D., Sia, D. & Gauvin, L. 2014, 'Increasing institutional deliveries among antenatal clients: effect of birth preparedness counselling', *Health Policy and Planning,* 29 (8)**,** 1061-70. *10.1093/heapol/czt089.*

Sripad, P., Kirk, K., Adoyi, G., Dempsey, A., Ishaku, S. & Warren, C. E. 2019, 'Exploring survivor perceptions of pre-eclampsia and eclampsia in Nigeria through the health belief model', *BMC Pregnancy and Childbirth,* 19 (431). *10.1186/s12884-019-2582-2.*

Stata, A. 2017, Stata Structural Equation Modeling Reference Manual. Release.

StataCorp 2021, 'Stata Statistical Software: Release 17. College Station, TX: StataCorp LLC.'.

StataCorp LLC 2020, Stata/IC 16.1 for Windows (64-bit x86-64). 16 ed.: USA.

Stoltzfus, J. C. 2011, 'Logistic Regression: A Brief Primer', *Society for Academic Emergency Medicine,* 18**,** 1099-104. *https://doi.org/10.1111/j.1553-2712.2011.01185.x.*

Stormacq, C., Van den Broucke, S. & Wosinski, J. 2018, 'Does health literacy mediate the relationship between socioeconomic status and health disparities? Integrative review', *Health Promotion International,* 34 (5)**,** e1-e17. *10.1093/heapro/day062.*

Sukirman, R., Wahyono, T. Y. M. & Shivalli, S. 2020, 'Determinants of healthcare facility utilization for childbirth in Kuantan Singingi regency, Riau province, Indonesia 2017', *BMC Public Health,* 20 (933). *10.1186/s12889-020-09035-3.*

Tafere, T. E., Afework, M. F. & Yalew, A. W. 2018, 'Counseling on family planning during ANC service increases the likelihood of postpartum family planning use in Bahir Dar City Administration, Northwest Ethiopia: a prospective follow up study', *Contraception and Reproductive Medicine,* 3 (28). *10.1186/s40834-018-0081-x.*

Taggart, J., Williams, A., Dennis, S., Newall, A., Shortus, T., Zwar, N., et al. 2012, 'A systematic review of interventions in primary care to improve health literacy for chronic disease behavioral risk factors', *BMC Family Practice* 13 (49). *10.1186/1471-2296-13-49.*

Tegegne, T. K., Chojenta, C., Getachew, T., Smith, R. & Loxton, D. 2020, 'Giving birth in Ethiopia: a spatial and multilevel analysis to determine availability and factors associated with healthcare facility births', *BJOG,* 127**,** 1537–46. *10.1111/1471-0528.16275.*

Tekelab, T., Chojenta, C., Smith, R. & Loxton, D. 2019, 'Factors affecting utilization of antenatal care in Ethiopia: A systematic review and meta-analysis', *PLOS ONE,* 14 (4)**,** e0214848. *10.1371/journal.pone.0214848.*

Tequame, M. & Tirivayi, N. 2015, *Higher education and fertility:* , UNU-MERIT. UNU-MERIT Working Papers No. 019.

Tessema, G. A., Gomersall, J. S., Laurence, C. O. & Mahmood, M. A. 2019, 'Healthcare providers' perspectives on use of the national guideline for family planning services in Amhara Region, Ethiopia: a qualitative study', *BMJ Open,* 9 (2)**,** e023403. *10.1136/bmjopen-2018-023403.*

Tessema, G. A., Laurence, C. O., Melaku, Y. A., Misganaw, A., Woldie, S. A., Hiruye, A., et al. 2017, 'Trends and causes of maternal mortality in Ethiopia during 1990-2013: findings from the Global Burden of Diseases study 2013', *BMC Public Health,* 17 (160). *10.1186/s12889-017-4071-8.*

Thaddeus, S. & Maine, D. 1994, 'Too far to walk: maternal mortality in context', *Soc Sci Med,* 38 (8)**,** 1091-110. *10.1016/0277-9536(94)90226-7.*

Thapa, P., Bangura, A. H., Nirola, I., Citrin, D., Belbase, B., Bogati, B., et al. 2019, 'The power of peers: an effectiveness evaluation of a cluster-controlled trial of group antenatal care in rural Nepal', *Reproductive Health,* 16 (150). *10.1186/s12978-019-0820-8.*

Thavaneswaran, A. & Lix, L. 2008, *Propensity score matching in observational studies* [Online]. Available: http://www.umanitoba.ca/faculties/health_sciences/medicine/units/chs/departmental_units/mchp/protocol/media/propensity_score_matching.pdf [Accessed 8 January 2022].

The EndNote Team 2020, EndNote. X.9.3.3 ed. Philadelphia, PA: Clarivate Analytics.

The World Bank. 2019, *The World Bank In Ethiopia* [Online]. World Bank. Available: https://www.worldbank.org/en/country/ethiopia/overview [Accessed 13 November 2019].

The World Bank. 2022, *World Bank Country and Lending Groups* [Online]. The World Bank Group. Available: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups [Accessed 10 March 2022].

Thi Hoai Thu, N., Wilson, A. & McDonald, F. 2015, 'Motivation or demotivation of health workers providing maternal health services in rural areas in Vietnam: findings from a mixed-methods study', *Human Resources for Health,* 13 (91). *10.1186/s12960-015-0092-5.*

Timša, L., Marrone, G., Ekirapa, E. & Waiswa, P. 2015, 'Strategies for helping families prepare for birth: Experiences from eastern central Uganda', *Global Health Action,* 8 (1). *10.3402/gha.v8.23969.*

Tokhi, M., Comrie-Thomson, L., Davis, J., Portela, A., Chersich, M. & Luchters, S. 2018, 'Involving men to improve maternal and newborn health: A systematic review of the effectiveness of interventions', *PLoS ONE,* 13 (1)**,** e0191620. *10.1371/journal.pone.0191620.*

Tran, N. T., Greer, A., Dah, T., Malilo, B., Kakule, B., Morisho, T. F., et al. 2021, 'Strengthening healthcare providers' capacity for safe abortion and post-abortion care services in humanitarian settings: lessons learned from the clinical outreach refresher training model (S-CORT) in Uganda, Nigeria, and the Democratic Republic of Congo', *Conflict and Health,* 15 (20). *10.1186/s13031-021-00344-x.*

Triastin, S. A., Syarif, S., Ahmad, M., Jusuf, E. C., Manapa, E. S. & Bahar, B. 2021, 'THE INFLUENCE OF "MATTAMPU" EDUCATIONAL MEDIA APPLICATION OF CHILDBIRTH PREPARATION TO PREGNANT WOMEN'S KNOWLEDGE', *Turkish Journal of Physiotherapy Rehabilitation,* 32 (2)**,** 833-9.

Tunçalp, Ö., Were, W., MacLennan, C., Oladapo, O., Gülmezoglu, A., Bahl, R., et al. 2015, 'Quality of care for pregnant women and newborns—the WHO vision', *BJOG,* 122 (8)**,** 1045-9. *https://doi.org/10.1111/1471-0528.13451*.

UN 2015, The millennium development goals report.

UN 2016, Final list of proposed Sustainable Development Goal indicators. *Report of the Inter-Agency and Expert Group on Sustainable.*

UN 2017, The Sustainable Development Goals Report 2017. New York: United Nations.

UNICEF. 2021, *Antenatal care* [Online]. Available: https://data.unicef.org/topic/maternal-health/antenatal-care/ [Accessed 30 May 2022].

Vallely, L. M., Emori, R., Gouda, H., Phuanukoonnon, S., Homer, C. S. E. & Vallely, A. J. 2019, 'Women's knowledge of maternal danger signs during pregnancy: Findings from a cross-sectional survey in Papua New Guinea', *Midwifery,* 72**,** 7-13. *10.1016/j.midw.2019.02.001.*

Vamos, C. A., Merrell, L., Detman, L., Louis, J. & Daley, E. 2019, 'Exploring Women's Experiences in Accessing, Understanding, Appraising, and Applying Health Information During Pregnancy', *Journal of Midwifery & Women's Health,* 64 (4)**,** 472-80. *10.1111/jmwh.12965.*

VanderWeele, T. J. 2015, *Explanation in causal inference: methods for mediation and interaction*, Oxford University Press.
VanderWeele, T. J. 2016, 'Mediation Analysis: A Practitioner's Guide', *Annual Review of Public Health,* 37**,** 17-32. *10.1146/annurev-publhealth-032315-021402.*
Veritas Health Innovation 2019, 'Covidence systematic review software, Veritas Health Innovation, Melbourne, Australia.'.
Vickers, K. S., Kircher, K. J., Smith, M. D., Petersen, L. R. & Rasmussen, N. H. 2007, 'Health behavior counseling in primary care: provider-reported rate and confidence', *Family Medicine,* 39 (10)**,** 730-5.
Villadsen, S. F., Negussie, D., GebreMariam, A., Tilahun, A., Friis, H. & Rasch, V. 2015, 'Antenatal care strengthening for improved quality of care in Jimma, Ethiopia: an effectiveness study', *BMC Public Health,* 15 (360). *10.1186/s12889-015-1708-3.*
Wagner, Z., Heft-Neal, S., Wise, P. H., Black, R. E., Burke, M., Boerma, T., et al. 2019, 'Women and children living in areas of armed conflict in Africa: a geospatial analysis of mortality and orphanhood', *Lancet Glob Health,* 7 (12)**,** e1622-e31. *10.1016/s2214-109x(19)30407-3.*
Wagnew, F., Dessie, G., Alebel, A., Mulugeta, H., Belay, Y. A. & Abajobir, A. A. 2018, 'Does short message service improve focused antenatal care visit and skilled birth attendance? A systematic review and meta-analysis of randomized clinical trials', *Reproductive Health,* 15 (191). *10.1186/s12978-018-0635-z.*
Wallace, H. J., McDonald, S., Belton, S., Miranda, A. I., da Costa, E., Matos, L. d. C., et al. 2018, 'The decision to seek care antenatally and during labour and birth – Who and what influences this in Timor-Leste? A qualitative project exploring the perceptions of Timorese women and men', *Midwifery,* 65**,** 35-42. *https://doi.org/10.1016/j.midw.2018.05.013*.
WB & IMF 2015, *Global monitoring report 2015/2016: development goals in an era of demographic change,* Washington, THE WORLD BANK.
West, S. G., Cham, H., Thoemmes, F., Renneberg, B., Schulze, J. & Weiler, M. 2014, 'Propensity scores as a basis for equating groups: basic principles and application in clinical treatment outcome research', *Journal of Consulting and Clinical Psychology,* 82 (5)**,** 906-19. *10.1037/a0036387.*
WHO 1977, 'WHO: recommended definitions, terminology and format for statistical tables related to the perinatal period and use of a new certificate for cause of perinatal deaths. Modifications recommended by FIGO as amended October 14, 1976', *Acta Obstet Gynecol Scand,* 56 (3)**,** 247-53.
WHO. 2004, *Making pregnancy safer: the critical role of the skilled attendant: a joint statement by WHO, ICM and FIGO* [Online]. World health organization. Available: https://apps.who.int/iris/rest/bitstreams/50974/retrieve [Accessed 16 2021].
WHO. 2007, *Standards for maternal and neonatal care* [Online]. Available: https://apps.who.int/iris/rest/bitstreams/65895/retrieve [Accessed 12 January 2021].
WHO. 2013, *Counselling for Maternal and Newborn Health Care: A Handbook for Building Skills* [Online]. Geneva: World Health Organization. Available: https://apps.who.int/iris/bitstream/handle/10665/44016/9789241547628_eng.pdf?sequence=1&isAllowed=y [Accessed 25 November 2020].

WHO. 2014, *A handbook for building skills: Counselling for Maternal and Newborn Health: Adaptation Guide* [Online]. World Health Organization. Available: https://www.scribd.com/document/532319843/Adaptation-Guide-Counselling-Handbook [Accessed Jan 11 2021].
WHO. 2015a, *Strategies toward ending preventable maternal mortality (EPMM)* [Online]. WHO Department of Reproductive Health and Research. Available: https://apps.who.int/iris/bitstream/handle/10665/153544/9789241508483_eng.pdf?sequence=1&isAllowed=y [Accessed 20 Dec 2021].
WHO. 2015b, *WHO recommendations on health promotion interventions for maternal and newborn health* [Online]. World Health Organization. Available: https://apps.who.int/iris/rest/bitstreams/777349/retrieve [Accessed 23 January 2022].
WHO. 2016a, *Standards for improving quality of maternal and newborn care in health facilities* [Online]. Geneva, Switzerland: World Health Organization. Available: https://apps.who.int/iris/bitstream/handle/10665/249155/9789241511216-eng.pdf?sequence=1 [Accessed 03 December 2021].
WHO. 2016b, *WHO recommendations on antenatal care for a positive pregnancy experience* [Online]. Geneva: World Health Organization. Available: https://apps.who.int/iris/rest/bitstreams/1064182/retrieve [Accessed 25 March 2019].
WHO. 2018, *Defining competent maternal and newborn health professionals: background document to the 2018 joint statement by WHO, UNFPA, UNICEF, ICM, ICN, FIGO and IPA: definition of skilled health personnel providing care during childbirth* [Online]. World Health Organization. Available: https://apps.who.int/iris/bitstream/handle/10665/272817/9789241514200-eng.pdf?sequence=1&isAllowed=y [Accessed 06 July 2020].
WHO 2019a, SEVENTY-SECONDWORLD HEALTH ASSEMBLY: A72/11 Rev.1 Provisional agenda item 11.4. Geneva.
WHO 2019b, Trends in maternal mortality 2000 to 2017: estimates by WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division: executive summary.
WHO 2019c, WHO consolidated guideline on self-care interventions for health: sexual and reproductive health and rights. *In:* HEALTH, S. A. R. (ed.). Geneva, Switzerland: World Health Organization.
WHO 2019d, World health statistics overview 2019: monitoring health for the SDGs, sustainable development goals. Geneva: World Health Organization; 2019 (WHO/DAD/2019.1). Licence: CC BY-NC-SA 3.0 IGO.
WHO 2021, World Health Statistics 2020. *Monitoring health for the SDGs, sustainable development goals.* Geneva, Switzerland.
WHO. 2022, *Births attended by skilled health personnel (%) (SDG indicator 3.1.2)* [Online]. World Health Organization. Available: https://www.who.int/data/gho/indicator-metadata-registry/imr-details/25 [Accessed 01 August 2022].
WHO, Organisation for Economic Co-operation Development & The World Bank 2018, *Delivering quality health services: a global imperative for universal health coverage,* Geneva, Switzerland.

WHO & UNFPA 2021, Ending Preventable Maternal Mortality (EPMM): A Renewed focus for improving maternal and newborn health and welbeing World Health Organization.

Willcox, M., Harrison, H., Asiedu, A., Nelson, A., Gomez, P. & LeFevre, A. 2017, 'Incremental cost and cost-effectiveness of low-dose, high-frequency training in basic emergency obstetric and newborn care as compared to status quo: part of a cluster-randomized training intervention evaluation in Ghana', *Globalization and Health,* 13 (88). *10.1186/s12992-017-0313-x.*

Williams, O. & Swierad, E. M. 2019, 'A Multisensory Multilevel Health Education Model for Diverse Communities', *International Journal of Environ Res Public Health,* 16 (5). *10.3390/ijerph16050872.*

Wise, P. H., Shiel, A., Southard, N., Bendavid, E., Welsh, J., Stedman, S., et al. 2021, 'The political and security dimensions of the humanitarian health response to violent conflict', *Lancet,* 397 (10273)**,** 511-21. *10.1016/s0140-6736(21)00130-6.*

Woldeamanuel, G. G., Lemma, G. & Zegeye, B. 2019, 'Knowledge of obstetric danger signs and its associated factors among pregnant women in Angolela Tera District, Northern Ethiopia', *BMC Research Notes,* 12 (606). *10.1186/s13104-019-4639-8.*

Woolf, S. H., Grol, R., Hutchinson, A., Eccles, M. & Grimshaw, J. 1999, 'Potential benefits, limitations, and harms of clinical guidelines', *BMJ Education and Debate,* 318 (7182)**,** 527-30.

Woolfe, R., Dryden, W. & Strawbridge, S. 2003, *Handbook of counselling psychology,* London; Thousand Oaks, Calif., SAGE Publications.

Worsley, C., Webb, S. & Vaux, E. 2016, 'Training healthcare professionals in quality improvement', *Future Hospital Journal* 3(3)**,** 207. *10.7861/futurehosp.3-3-207.*

Wright, S. 1920, 'The Relative Importance of Heredity and Environment in Determining the Piebald Pattern of Guinea-Pigs', *Proceedings of the National Academy of Sciences of the United States of America,* 6 (6)**,** 320-32. *10.1073/pnas.6.6.320.*

Wu, Y., Zhou, H., Wang, Q., Cao, M., Medina, A. & Rozelle, S. 2019, 'Use of maternal health services among women in the ethnic rural areas of western China', *BMC Health Services Research,* 19 (179). *10.1186/s12913-019-3996-2.*

Wulandari, R. D. & Laksono, A. D. 2020, 'Determinants of knowledge of pregnancy danger signs in Indonesia', *PLoS ONE,* 15 (5)**,** e0232550. *10.1371/journal.pone.0232550.*

Yao, X. I., Wang, X., Speicher, P. J., Hwang, E. S., Cheng, P., Harpole, D. H., et al. 2017, 'Reporting and Guidelines in Propensity Score Analysis: A Systematic Review of Cancer and Cancer Surgical Studies', *Journal of the National Cancer Institute,* 109 (8). *10.1093/jnci/djw323.*

Yeneabat, T., Hayen, A. & Dawson, A. 2022, Does antenatal care counselling affect maternal health literacy on obstetric danger signs in low and lower-middle-income countries? A Systematic Review. *Under review.*

Yitbarek, K., Abraham, G. & Morankar, S. 2019, 'Contribution of women's development army to maternal and child health in Ethiopia: A systematic review of evidence', *BMJ Open,* 9 (5). *10.1136/bmjopen-2018-025937.*

Yoseph, M., Abebe, S. M., Mekonnen, F. A., Sisay, M. & Gonete, K. A. 2020, 'Institutional delivery services utilization and its determinant factors among

women who gave birth in the past 24 months in Southwest Ethiopia', *BMC Health Services Research,* 20 (265). *10.1186/s12913-020-05121-9.*

Zhou, H., Zhang, L., Ye, F., Wang, H.-j., Huntington, D., Huang, Y., et al. 2016, 'The Effect of Maternal Death on the Health of the Husband and Children in a Rural Area of China: A Prospective Cohort Study', *PLOS ONE,* 11 (6). *10.1371/journal.pone.0157122.*