

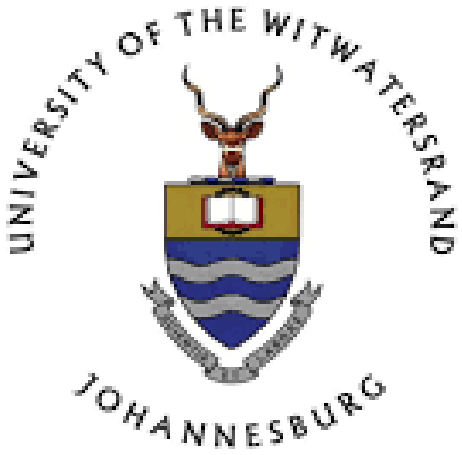
https://dspace.org/

Factors associated with antenatal care utilization among women of reproductive age in Sub- Saharan Africa: a systematic review and meta-analysis report from 2016-2023

Mpesela-Mariti, Marethabile Nthabiseng

2024
University of the Witwatersrand, Johannesburg
https://hdl.handle.net/10539/46862
Mpesela-Mariti, Marethabile Nthabiseng. (2024).Factors associated with antenatal care utilization among women of reproductive age in Sub- Saharan Africa: a systematic review and meta-analysis report from 2016-2023 [Master`s dissertation, University of the Witwatersrand, Johannesburg]. WIReDSpace.

Downloaded from a DSpace repository. https://dspace.org/



FACULTY OF HEALTH SCIENCES
SCHOOL OF PUBLIC HEALTH

Factors associated with antenatal care utilization among women of reproductive age in Sub-Saharan Africa: a systematic review and meta-analysis report from 2016-2023

By

Marethabile Nthabiseng Mpesela-Mariti
Student number: 2014166

A Research Report Submitted to the faculty of Health Sciences, University of the Witwatersrand, Johannesburg in partial fulfilment of the requirements of Master of Science (MSc) in Epidemiology in the field of Implementation Science.

Declaration

I, Marethabile Nthabiseng Mpesela-Mariti, hereby declare that this paper is my own original work and any other secondary work used in this research were all acknowledged and referenced using the Vancouver referencing style.

The research report is thus, being submitted for a Master of Science in Epidemiology in the field of Implementation Science at University of the Witwatersrand, Johannesburg. I therefore proclaim that this paper has not been submitted in part or in full for any degree or examination at any other university before.



(Candidate's signature)

Date: 22/07/2024

Dedication

This work is dedicated to my beloved family, whose unwavering support and encouragement have been the cornerstone of my journey. In particular, I express my deepest gratitude to my husband, Mariti Mariti, whose boundless love and understanding have been my source of strength. To my cherished daughters, Rethabile and Boitumelo Mariti, your presence fills my life with joy and purpose, motivating me to strive for excellence in all endeavors. This endeavor is a tribute to the profound influence you have had on my life, and I am forever grateful for your unwavering belief in me.

Abstract

Background: Despite the recommendations by the World Health Organization (WHO), antenatal care utilization among women in sub-Saharan Africa remains sub-optimal. Antenatal care (ANC) is the routine care provided to women with a confirmed pregnancy status by a skilled healthcare provider. Maternal and Neonatal deaths are public health concerns that antenatal care utilization (ANC) seeks to address. The United Nations' SDG global target 3.1. and 3.8. aims to reduce the Maternal Mortality Ratio to less than 70 per 100 000 viable births by 2030. Antenatal Care aims to optimize health outcomes by reducing undesirable maternal and neonatal health outcomes. This study aims to characterize (determine and describe) factors associated with antenatal care utilization among women of reproductive age in sub-Saharan Africa from 2016-2023 through literature synthesis and meta-analysis.

Methods: A data search from PubMed, Google Scholar, EBSCO-Host (Global health), ProQuest (Public health), SABINET African Journals and Scopus databases using keywords was conducted. Critical appraisal and data extraction was conducted by two reviewers (M.M and M.M) working independently of each other in Joanna Briggs Institute System for the Unified Management, Assessment, and Review Information (JBI SUMARI). For meta-analysis, a random effects model was used for pooled prevalence proportions of antenatal care utilization based on attendance, optimal timing and optimal number of visits. The presence of statistical heterogeneity was checked using the Cochran Q test, and its level was quantified using the I^2 statistics. To assess for publication bias, funnel plot and Egger's test were conducted at 95% CI and p-value=0.05 significance level.

Results: A total of 15 observational cross-sectional studies were included in this study from 14 countries in SSA. The pooled prevalence estimates of antenatal care attendance were 59.1% (95% CI: 39.0%, 79.3%), optimal timing 36.8% (95% CI: 29.0%, 44.6%) and optimal number of visits were 20.3 (95% CI: 14.4%, 26.2%). Factors that were found to influence antenatal care utilization as identified by the number of studies included for analysis were: maternal age 100%, maternal education 93.3%, partner's education 40%, household size 26.7%, household headship 20%, birth order 40%, ethnicity 20%, religion 46.7%, employment status 53.3%, wealth index 73.3%, marital status 80%, residence 100%, distance from the healthcare facility 46.7%, media exposure 46.7%, parity 60%, and health insurance 46.7%.

Conclusion: The synthesized studies elucidated the pooled prevalence estimates and factors associated with ANC utilization, providing a comprehensive understanding of the socio-demographic, economic, and healthcare-related determinants shaping maternal health-

seeking behaviors. The findings call for policymakers, healthcare practitioners, and researchers alike, to advocate for multifaceted interventions aimed at addressing structural, socioeconomic, and healthcare-related barriers to enhance ANC access, thereby fostering equitable and inclusive maternal healthcare provision.

Protocol registration
CRD42024478260

Acknowledgements

I would like to express my heartfelt gratitude to everyone who contributed to the successful completion of this research report. What a journey it has been!

Firstly, God Almighty who carried me through even on days I wanted to quit. I would like to thank my research supervisor Prof. Juliana Kagura, for her invaluable guidance, unwavering support, and expert mentorship throughout this research journey. Her expertise and unwavering commitment to excellence have been instrumental in shaping this study.

I would like to extend my heartfelt gratitude to Dr. Joel Francis, whose expertise and dedication have been instrumental in enhancing my understanding of meta-analysis methodology. I am deeply grateful for the time he has generously devoted to providing insightful feedback and clarifications, which have significantly enriched the quality of this study.

I am also grateful to my colleagues; Mokete Motlatsi and Daniel Elkapa for their role as reviewers for this work, and Sabelo Msomi for providing valuable feedback, engaged in thought-provoking discussions, and offered their expertise, enhancing the quality of this work.

I would like to acknowledge the support and understanding of my family and friends, who stood by me throughout this academic endeavor. Your encouragement was a constant source of motivation.

Lastly, I wish to express my appreciation to all the authors and researchers whose work laid the foundation for this study. Their contributions have significantly shaped the academic discourse in this field.

This research would not have been possible without the collective efforts of these individuals. Thank you for your invaluable contributions and unwavering support.

Table of Contents

Declaration ..... **i**

Dedication ..... **ii**

Abstract ..... **iii**

Acknowledgements ..... **v**

List of figures ..... **viii**

List of tables ..... **ix**

List of appendices ..... **x**

List of abbreviations/ nomenclature ..... **xi**

Chapter 1. Introduction **1**

1.1. Background 1

1.2. Problem statement 3

1.3. Justification 3

1.4. Research question 3

1.5. Aim 3

1.6. Objectives 3

Chapter 2. Literature Review **4**

2.1. The inception of ANC 5

2.2. Factors associated with ANC utilization, as cited by other researchers. 5

2.2.1. Socio-demographic factors 5

2.2.2. Community factors 8

2.3. Conceptual framework 11

Chapter 3. Methods **12**

3.1. Development of the review methodology 12

3.2. Databases and search strategy 12

3.3. Study selection 13

3.3.1. Eligible studies 13

3.3.2. Study setting 13

3.4. Validity Assessment 14

3.5. Data extraction 15

3.6. Data synthesis and statistical analysis 16

3.7. Ethical considerations 17

Chapter 4. Results **19**

4.1. Meta-analysis for antenatal care attendance 25

4.1.2. Meta-analysis on timing of the ANC visits 33
4.1.3. Meta-analysis on optimal number (8 or >) of ANC visits. 36
4.2. Factors associated with ANC utilization. 39
4.3. Factors associated with ANC utilization by regions 40
4.3.1. Predisposing Factors 41
4.3.2. Enabling Factors 42
4.3.3. Need Factors 42

Chapter 5. Discussion 43

5.1. Limitations 54
5.2. Strengths of the study 54

Chapter 5. Conclusion and recommendations 56

References 58

Appendices 67

List of figures

Figure 1. Andersen's Behavioral Model of Health Service Use 11
Figure 2. The labelled map of the sub-Saharan Africa illustrative of the study setting for this paper(46) 14
Figure 3. PRISMA flow diagram of the search and study selection process on factors associated with antenatal care utilization among women of reproductive age in sub-Saharan Africa. 17
Figure 4. Geographical spread of included studies. 24
Figure 5. Forest plot illustrating pooled proportions on the levels of antenatal care utilization from 2016-2023 by study setting. 25
Figure 6 Forest plot on proportion of antenatal care utilization among women of reproductive age in Sub-Saharan Africa by study design and publication year. 28
Figure 7 Forest plot on proportions of antenatal care utilization among women of reproductive age in Sub-Saharan Africa by year of study. 30
Figure 8 Sensitive analysis on antenatal care utilization among women of reproductive age in Sub-Saharan Africa. 31
Figure 9 Forest plot on proportion of antenatal care timing (<3months or <12weeks of pregnancy) among women of reproductive age in Sub-Saharan Africa by year of the study. 33
Figure 10 Forest plot on proportion of antenatal care timing (<3months or <12weeks of pregnancy) among women of reproductive age in Sub-Saharan Africa by study setting. 34
Figure 11 Forest plot on proportion of antenatal care visits (8 or ANC visits during pregnancy) among women of reproductive age in Sub-Saharan Africa by study setting. 36
Figure 12 Forest plot on proportion of antenatal care visits (8 or ANC visits during pregnancy) among women of reproductive age in Sub-Saharan Africa by year of study. 38
Figure 13 Funnel plot for proportion of any resistance 90

List of tables

Table 1. The concept grids. PECo Framework (47)..... 17
Table 2 Number of studies reporting the factors associated with antenatal care utilization in included studies. 39
Table 3 Summary of factors identified by region in sub-Saharan Africa based on the included studies..... 41

List of appendices

Appendix 1. Ethical weaver certificate 67
Appendix 2. Plagiarism declaration form 68
Appendix 3. Turnit in report 69
Appendix 4. Studies included for factors determination based on regions of the SSA 70
Appendix 5. Data search strategy 71
Appendix 6. JBI Cross-sectional quality assessment results 73

List of abbreviations/ nomenclature

ANC.	Antenatal care utilization
JBI	Joanna Briggs Institute
MDGs	Millennium Development Goals
MMR.	Maternal mortality rate
SDGs	Sustainable Development Goals
SSA	Sub-Saharan Africa
WHO	World Health Organization
SUMARI.	System for the Unified Management of the Assessment and Review of Information

Chapter 1. Introduction

1.1. Background

The World Health Organization (WHO) reported an estimated 295,000 maternal deaths related to pregnancy and delivery in 2017, of which 94% occurred in developing countries, with sub-Saharan Africa accounting for 86% (1). Subsequently, this guided the Millennium Development Goals (MDGs) for Sustainable Development Goals (SDGs) on strategies for pregnancy-related illnesses and mortality reduction by 2030, which called for a per-country maternal mortality ratio reduction. This was an average of two-thirds of the country's 2010 baseline data (1).

In Sub-Saharan Africa (SSA), the maternal mortality ratio (MMR) stood notably higher at 542 deaths per 100,000 live births, against the global average of 216 deaths per 100,000 live births. Given these alarming statistics, it becomes imperative to strategically prioritize maternal mortality interventions within SSA nations, aiming to mitigate the MMR's pervasive elevation and to align with the Sustainable Development Goals (SDG). SDG 3.1 mandates that individual countries strive to reduce their MMRs by two-thirds from their 2010 baseline, particularly emphasizing nations where the MMR exceeds 420, compelling them to lower MMRs to no more than 140 maternal deaths per 100,000 live births (2,3).

This underscores the critical need for cause-specific data to inform and delineate priority areas for intervention within this critical context. Furthermore, evidence-based interventions that are sustainable must be implemented to achieve the set SDGs (4). The Antenatal care (ANC) is the routine care provided to women with confirmed pregnancy status by a skilled healthcare provider (1). The ANC aims to optimize health outcomes by reducing undesirable maternal and neonatal health outcomes. Although pregnancy-related complications may occur, timely diagnosis and treatment may alleviate unwanted maternal and neonatal deaths.

The ANC visits are scheduled interval visits conducted from conception to the onset of labor. Pregnancy and childbirth are crucial occurrences for mothers, their unborn children, and their families. Maternal and neonatal deaths can be avoided through adequate ANC utilization, which has been reported as suboptimal universally and not unique to SSA.

Moreover, ANC anchors overall maternal and neonatal health by promoting good health, early diagnosis, treatment, and management of pregnancy-related illnesses, and early detection of deviations from normal in maternal and child health. The World Health Organization

recommended that pregnant women attend at least four ANC visits for optimal care. However, these recommendations were revisited by the WHO in 2016 when new recommendations were prescribed for eight ANC visits (5).

Some countries in SSA have implemented interventions to ascertain the high uptake of ANC utilization, such as Zimbabwe, which devised a Maternal and Neonatal Health Road map launched in 2009, where they prioritized innovative and cost-effective interventions to increase maternal healthcare services. These innovations include community mobilization, engagement, and capacity building concerning maternal health (6).

Maternal health is a cornerstone of the nation's overall public health, which also informs the country's socioeconomic status (7). Although recommendations have been made by the WHO for adequate antenatal visits, underutilization is still observed globally, especially in sub-Saharan Africa (1). Reiteratively, ANC has a positive health and social impact on pregnant women and their unborn babies and is often a focal point for women's reproductive health services.

Despite this, antenatal utilization among women in sub-Saharan Africa remains low (4,8).
The World Health Organization urges women to attend at least eight ANC visits, with the first visit booked in the first trimester of pregnancy (5), which is the crucial period for fetal development and significant changes in a woman's body. However, underutilization has been reported in existing literature (9).

Furthermore, this is also reported by the UN ANC data, which indicate that although 87% of women attend at least one ANC visit with skilled health personnel, only 66% of these women attend the prescribed eight ANC visits (10). The WHO envisions an era in which mothers and their new-born babies receive high-quality care (11). If compliant with these recommendations, ANC can assist in the timely diagnosis of deviations from normal pregnancies, and therefore inform treatment measures in the fight against alarming maternal morbidities and mortalities.

Factors associated with ANC utilization have been studied in terms of geographical region, socio-demographic characteristics, and health facility characteristics, such as access, waiting time, and quality of care (8,12). This study aimed to synthesize the existing literature to describe and determine the factors associated with ANC utilization among women of reproductive age (15-49years) in sub-Saharan Africa, to increase the proportion of pregnant women following prescribed ANC visits (13).

1.2. Problem statement

Previous research has demonstrated that Maternal Mortality Ratio remains a concern in the realm of public health. Achieving a global target of less than 70 maternal deaths per 100,000 live births seems ambitious, and evidence-based interventions need to be implemented to fast-track these targets (14). Underutilization of antenatal services predisposes women and their babies to pregnancy- and childbirth-related morbidities and mortalities (15).

It is estimated that 52% of women receive an average of four ANC visits (13), despite various recommendations by the WHO and underutilization contributing to maternal and neonatal morbidities and mortalities. The top three maternal and neonatal mortalities were due to preeclampsia and eclampsia, postpartum hemorrhage, and sepsis. These maternal and neonatal mortality risk factors could be managed during ANC by skilled health personnel, improving both the health outcomes of mothers and their unborn babies and thus reducing alarming maternal and neonatal mortality rates.

1.3. Justification

There is an existing literature that is inconsistent in reporting multilevel characteristics influencing ANC utilization. These are context-specific and necessitate a systematic review to illuminate which factors influence ANC utilization in SSA. This study will highlight areas of focus and inform the government, policymakers on guidelines, and project implementors on the status of maternal health in sub-Saharan Africa, aiding in the direction of limited resource allocation.

1.4. Research question

What factors are associated with ANC utilization among women of reproductive age in sub-Saharan Africa from 2016-2023?

1.5. Aim

To characterize (determine and describe) factors associated with ANC utilization among women of reproductive age in sub-Saharan Africa from 2016-2023 through literature synthesis.

1.6. Objectives

1. To describe the proportions of ANC utilization among women of reproductive age in sub-Saharan Africa from 2016-2023.
2. To determine factors associated with ANC utilization among women of reproductive age in sub-Saharan Africa from 2016-2023.

Chapter 2. Literature Review

Based on existing literature, ANC was initially introduced in the 1900s where the mothers and their babies' overall health were assessed throughout pregnancy, childbirth, and post-delivery. Before 2016, the WHO recommended focused ANC of at least 4 contact visits with skilled health personnel. In 2016, the WHO revised the recommendations to at least eight contact visits of which 5 during the third trimester, two in the second trimester, and one in the first trimester (5). However, studies have indicated that the adoption of these recommendations remains low in developing countries (16).

Following these recommendations, Kourouma and colleagues conducted a study on the feasibility of the 8 or more ANC contact which yielded high acceptance by the health care workers though several determinants needed to be assessed and addressed before the actual roll-out of these recommendations, those recommendations mentioned were the strengthening of health systems and community engagement as the key stakeholders of ANC users (17).

Globally, maternal, and neonatal mortality rates that can be avoided through optimum ANC utilization occur frequently, regardless of the numerous recommendations by WHO regarding maternal and neonatal mortality reduction. Maternal morbidity and mortality refer to pregnancy-related and childbirth illnesses, and deaths, respectively. According to United Nations inter-agency estimates, there has a marked decrease in the global maternal mortality ratio by 38%, that is, 342 mortalities in 2000 to 211 in 2017 per 100,000 live births (18).

Sub-Saharan Africa marked a 39% decrease in maternal and neonatal deaths as opposed to Southern Asia, which achieved a 56% reduction (18); however, other maternal and neonatal deaths due to home deliveries and illegal termination of pregnancies fall through cracks because they are usually under-reported or misclassified. Additionally, Sub-Saharan Africa and Southern Asia have been reported to have suboptimal ANC utilization, which in turn leads to high maternal mortality rates.

The percentage of women accessing recommended ANC visits (at least eight visits) in sub-Saharan Africa is 24%, whereas developed countries indicate more than 90% of recommended ANC visits. This illustrates that ANC care utilization differs greatly across different countries (18). Further research indicates that an estimated 35% of women underutilize ANC, 53% adequately utilize ANC, 13% do not attend ANC completely, and (1)

strategies aimed at reaching 13% non-attendees need to be explored and implemented, as this may impede strides intended for maternal mortality reduction.

Factors such as socioeconomic status, maternal age, and health facility characteristics, including quality of care, have been noted as contributing factors to the underutilization of ANC services (19,20). This translates to the low adoption of the eight ANC contacts, as recommended by the WHO, as many developing countries are still compliant with the four ANC contacts between women and skilled personnel. This necessitates aggressive measures by quality improvement teams, program implementers, and policymakers to drive the success of WHO recommendations to reach the global targets 3.1. and substantially reducing maternal and neonatal deaths.

2.1. The inception of ANC

In 2016, the World Health Organization introduced a comprehensive guideline on ANC (ANC), titled "WHO Recommendations on Antenatal Care for a Positive Pregnancy Experience." The primary aim was to enhance the standard of regular healthcare provided to pregnant women and adolescent girls. The key principle of fostering a positive pregnancy experience encouraged nations to broaden their healthcare objectives beyond mere survival, focusing on optimizing health, human rights, and the potential of their citizens. The ANC guidelines acknowledge the value of ANC as a platform for vital healthcare functions, such as health promotion and disease prevention. Of the 49 recommendations in the WHO 2016 ANC guidelines, 14 specifically addressed nutritional interventions during pregnancy (5).

The world was forced to redesign ANC pathway during the COVID-19 pandemic in March 2020 where in person visits were reduced and priorities given to high-risk patients only. Strategies such as telemedicine or hybrid care were employed. (21,22). This evolution gave rise to the accelerated adaptation of digital technologies in ANC and disparities were reported from high income countries (HICs) and low to middle income countries (LMICs) with the later less advanced (23).

2.2. Factors associated with ANC utilization, as cited by other researchers.

2.2.1. Socio-demographic factors

The ANC utilization, a crucial component of maternal health services, is predominantly influenced by socio-demographic factors that encompass a range of individual characteristics and social contexts. This research report focuses on understanding how socio-demographic variables such as age, marital status, parity, educational attainment, employment, and urban-

rural residence shape the utilization patterns of ANC. These factors interact dynamically, impacting the timing, frequency, and quality of care sought during pregnancy.

Maternal age

Age plays a crucial role in ANC as it significantly affects the health and well-being of both mothers and children during pregnancy. Ensuring proper ANC is vital to guarantee a safe and healthy pregnancy and to address any potential complications that may arise throughout its course. This has been proven by several researchers. Nwosu noted among the socioeconomic inequalities in maternal health service utilization that age influences the women's ANC utilization (24). Similarly, Khatri and colleagues noted the same observations in Nepal (25). It has been noted in various empirical studies that as age increases, so does the utilization of ANC with younger women aged 15-24 years under utilizing these services (1,9,26).

Maternal and paternal education

Despite the importance of ANC, not all women have adequate access to or utilization of these services to their fullest potential. A higher educational level was reported to be directly correlated with early registration, more frequent visits, and the completion of at least four ANC visits, highlighting the significance of education in promoting ANC utilization (27). This could be due to the comprehension of the shared information about maternal health and its benefits, which may challenge women with no formal education.

Marital status

This is a significant factor in maternal health service utilization by women of reproductive age. It was observed in a study conducted in Tanzania on "Prevalence and factors which influence early antenatal booking among women of reproductive age in Tanzania: An analysis of data from the 2015-16 Tanzania Demographic Health Survey and Malaria Indicators Survey" that married women utilized ANC services as opposed to other women of different marital status (28). These findings are similar to those of a study conducted in Ethiopia, which focused on the timing of ANC access (29).

Parity/number of viable child births

Household size is another important predisposing factor believed to influence ANC utilization. Household size is measured as the number of persons in a particular household that is dependent on the pregnant mother for their daily sustenance. It is widely acknowledged that women with large families tend to underutilize maternal healthcare services due to excessive demand for their money, time, and other resources (30). This can further be explained based on past pregnancy-related experiences, which may inform women's choice of maternal healthcare utilization.

Location/region

Despite efforts to improve maternal healthcare worldwide, location still plays a significant role in determining the quality and accessibility of ANC services. Location greatly affects ANC by creating disparities in access, resources, and support systems between different geographical regions. Urban, peri-urban, and rural locations present different challenges for access to ANC (31,32). The disparity between urban and rural areas could be explained by exposure to mass media, quality and access to health care services, quality of education, and other socio-economic factors. This is further corroborated by a study conducted in Nigeria that assessed women's autonomy towards health care utilization (33).

Wealth index

Wealth disparity has been reported as a contributing factor to ANC utilization. As illustrated by Yaya et al., women from richer homes were more likely to utilize ANC during pregnancy than those from poorer households. This could mean that financial factors are of utmost importance in the utilization and understanding of ANC (29). In contrast, a Tanzanian study assessing "persistence of inequalities in ANC utilization among women" demonstrated that there were no ANC disparities between women of different wealth quintiles (34). While there may be inconsistent evidence on the wealth index as a contributing factor to ANC utilization, the majority of studies cited it as a barrier because it informs the educational attainment of the study population and the area of residence (35–37).

Employment

This has been proven to be an influencing factor in ANC utilization. This is corroborated by a study conducted across 31 African countries (38), where Adedokun and colleagues noted that employed women were more likely to utilize maternal health services than unemployed women. This may be due to women's empowerment within the workplace, being trusted with roles and responsibilities granted to them at work, and their understanding of the need to utilize these services. Furthermore, employment grants a sense of power since one contributes to daily household operations, and therefore empowers decision-making for oneself.

Disease outbreaks

In a qualitative research study conducted by Ariani during covid-19 second wave in Indonesia, underutilization of ANC was observed. Among the contributing factors leading to ANC underutilization were women's lack of support from their spouses and transport inaccessibility as movement was restricted in an effort to curb the virus (39). Another factor was the observing

of covid-19 restrictions, health facilities were decongested, and priority services were directed towards chronic patients. Further to the strict triage that the health facilities had to adhere to, patients who did not meet the priority list were neglected, and contact visits were minimized.

Conflicts/political instabilities

Conflicts and wars have been an unfortunate and enduring aspect of human history, often disrupting the lives of both individuals and communities. Among the many adverse effects of conflicts and wars is their impact on ANC. Conflicts and wars negatively affect ANC by limiting access to healthcare services, increasing stress among pregnant women, and contributing to poor maternal and neonatal health outcomes (40). This has contributed to delayed milestones in achieving the set global targets for halting maternal and neonatal morbidities and mortalities.

2.2.2. Community factors

Cultural norms and values

Cultural norms and values play a significant role in shaping the decisions and behaviors of individuals within a society, including their approach to healthcare, and significantly influence the utilization of ANC, impacting health outcomes for both mothers and their children. These can act as barriers to accessing ANC and facilitate or encourage its use (41).

In some cultures, early months of pregnancy are kept secret and women stay indoors and do not seek maternal services; however, this violates the recommendations of optimal ANC utilization, which suggests ANC booking at 12 weeks of pregnancy, which is the prime time for fetal development and a need for supplements such as folic acid, ferrous sulfate, and tetanus vaccinations (42), and other blood works critical in the first trimester of pregnancy (43).

Religion

Religious beliefs and teachings can promote or discourage ANC utilization, based on how religious communities can influence adherence to recommended practices. In a study conducted in Uganda on the continuum of maternal care, religion was cited as a contributing factor to maternal health service utilization (44), where Christian women were observed to utilize maternal services more than their religious counterparts. In contrast, Chikako et al. noted that religion had no significant effect on ANC utilization (45).

Sex of the household head

Households led by a male figure were reported to utilize ANC, as opposed to those led solely by women. Yaya et al… reported that 75.2% of women accessing ANC timely and completing at least four contact visits were from male headed families (29). This demonstrates that men

contribute to decisions made regarding maternal health access. Households led by a male figure are regarded as stable and are not prone to societal discrimination based on social norms and values.

Conversely, women who had to seek approval from their spouses to utilize ANC were less likely to achieve the required ANC visits than women who decided independently (46). Having a male-led household may be both an enabling factor and a barrier to the utilization of ANC.

Mass media exposure

Utilizing mass media to spread ANC messages could be an effective approach to improve the uptake of early initiation of recommended ANC. The frequency of mass media (e.g., regular listening to radio messages) has been shown to positively impact the utilization of maternal healthcare services, including the regularity of ANC visits by women (45).

Subsequently, Ekholuenetale et al. reported that women who were exposed to media were twice as likely to achieve prescribed ANC visits (47). Mass media is critical, especially for illiterate women, as the importance of ANC may be dramatized through radio jiggles for those with no access to television.

2.2.3. Health facility factors

Distance

Antenatal care utilization is significantly influenced by geographical distance to healthcare facilities, a critical socio-demographic factor affecting access and utilization patterns. Studies consistently highlight that increased distance from healthcare facilities is associated with decreased frequency and quality of ANC visits (48). Rural dwellers often face longer travel times and logistical challenges in accessing healthcare compared to their urban counterparts, impacting their ability to seek timely and comprehensive ANC services (49).

The social exclusion and discrimination against rural women, poor livelihood objectives and outcomes, and shorter life expectancy with the prevalence of diseases further worsen the social gradient in rural societies. Hence, such conditions inhibit vulnerable groups, with women being the majority group to access healthcare (30). Most socially marginalized women live in rural areas and beyond social gradients, with scarce information on ANC requirements by the WHO and their associated benefits on maternal, neonatal, and child health.

Transportation has been reported as a barrier to access and utilization of maternal health services. This was corroborated by a systematic review study by Alibhai et al., who demonstrated that women living farthest from healthcare facilities were less likely to seek timely ANC and achieve the prescribed contact visits for optimum care (50).

Patient flow-waiting period

This qualitative variable may have either a positive or negative impact on the utilization of maternal services. In a qualitative case study conducted in the Western cape on “Perspectives on waiting times in an antenatal clinic,” Baron et al... noted that patient waiting times associated with ANC utilization were diverse and correlated (51). These influencing factors may be remedied by implementing innovative patient flow strategies, addressing communication barriers, availing appropriate equipment, timely referrals, and deploying skilled healthcare providers.

Availability of quality maternal services

The quality of health care services is a crucial factor in increasing end-user uptake. Hard-to-reach areas are prone to low-quality ANC services because these services are offered during outreaches on mobile clinics to bridge the implementation gaps and achieve the set global targets for maternal and neonatal deaths.

This factor is multifaceted, as it entails factors such as healthcare facilities, health personnel, and medical supplies including supplements, infrastructure, and appropriate equipment. When these factors are compromised, maternal health quality is compromised by default (52). Thus, the utilization will be suboptimal.

Prescribed number of ANC visits

This is a multifaceted factor that can be affected by various enablers or barriers. As cited by Arifaynie et al., the number of ANC contact visits may be influenced by maternal age, educational attainment as a measure of the knowledge base, exposure to mass media as a means of information dissemination, and other factors (53).

Middle-aged women have been reported to achieve the prescribed number of ANC contact visits, which may be a prime reproductive age, and the majority are multiparous women with different experiences of pregnancy and childbirth. Furthermore, they have better knowledge and understanding of the benefits of ANC.

2.3. Conceptual framework

This systematic review applied the Andersen's model of healthcare utilization which conceptualizes factors that influence health care services utilization. In this context, healthcare service utilization being assessed is ANC (ANC). The factors incorporated in this framework are predisposing factors, enabling factors, need factors and the actual healthcare service being assessed.

Predisposing factors are predominantly contextual factors focusing on individual, demographic, social, and social norms, and values influencing individuals to utilize healthcare services such as age, marital status, ethnicity.

Enabling factors are the financial and organizational factors available within communities which facilitate the usage of healthcare services such as but not limited to income, transportation costs to the health facility.

Need factors are those factors perceived at individual level to influence the person's need to utilize healthcare services based on their general health status and previous health experiences (54)

This model was widely used by various studies focusing on healthcare services utilization (48,55) and this systematic review will adopt the same conceptual framework.

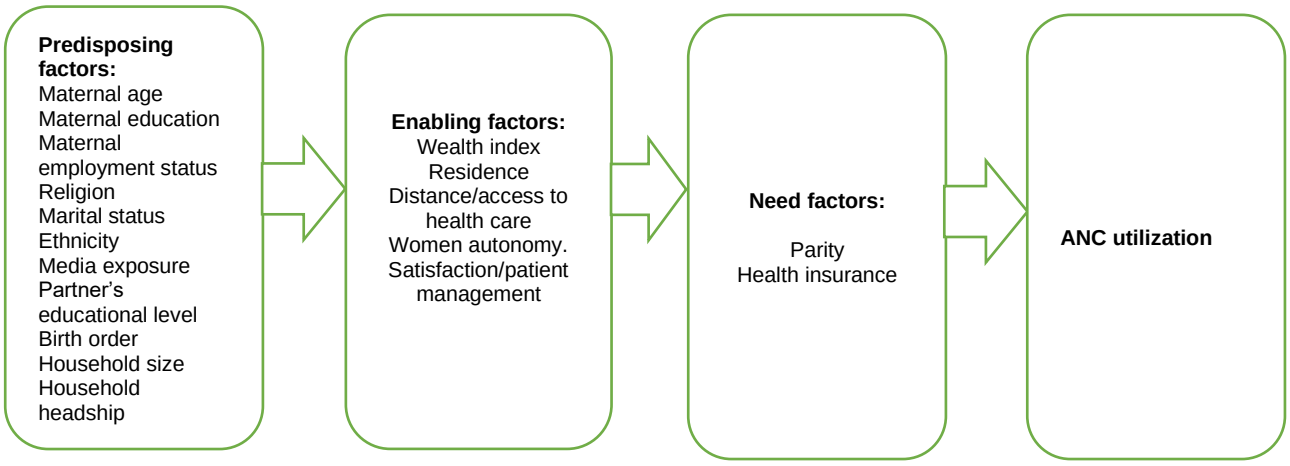


Figure 1. Andersen's Behavioral Model of Health Service Use

Chapter 3. Methods

In this chapter, the strategies undertaken during this systematic review will be detailed out. The study design, setting, search strategy, inclusion and exclusion criteria, data extraction and quality appraisal of selected studies will be elaborated in depth.

3.1. Development of the review methodology

The systematic review methodology was formulated in accordance with the guidelines outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols (PRISMA-P) 2015 Statement (56). Each item on the PRISMA-P checklist was meticulously addressed Additional table 2 (Page 89-91). The study selection process, as depicted in the PRISMA flow chart Figure 3 (Page 18), was comprehensively documented in the results section. This presentation delineated the progression from the initial identification of records to the inclusion of studies in the final analysis. The systematic review and meta-analysis protocol for this report was recorded in the international prospective register of systematic reviews PROSPERO and secured the registration identifier **CRD42024478260** accessible at PROSPERO and a title registration done in JBI.

3.2. Databases and search strategy

The primary author (MM) and the first reviewer conducted an extensive literature search, focusing on papers published in English between January 1, 2016, and December 31, 2023. The inclusion of 2016 was motivated by the World Health Organization's transition from 4 to 8 or more ANC visits by this year. To identify pertinent literature for the review, 6 of the major electronic databases, namely PubMed, EBSCO-Host (Global Health), ProQuest (Public Health), Scopus, and SABINET Journal for Africa were systematically searched. Additionally, to encompass grey literature, a search was conducted using the Google search engine and Google Scholar.

The search employed specific keywords derived from the terms "antenatal care utilization," "prenatal care utilization," "Sub-Saharan Africa," and "ANC-associated factors." These search terms were adapted and combined to formulate appropriate search strings for each specific database. A detailed account of the search strategy for the selected databases is provided in Appendix 5 (Page 75).

Upon the completion of the initial search, search strings were formulated utilizing the concept grids following Population Exposure Context (PECo) framework (57)

Table 1 (Page 18) for each database to streamline the searches for precision. This strategy yielded accurate results compared to the initial search. The results from the databases were as follows: Google Scholar, 176; EBSCO-host (Global health), 9; ProQuest (public health), 263; PubMed, 7; SABINET African Journals, 201; Scopus:30. A total of 686 articles were found, 14 articles were excluded due to duplication and 505 articles were imported onto JBI SUMARI.

3.3. Study selection

This research incorporated quantitative observational studies sourced from Demographic and Health Surveys (DHS) reports of various countries. The primary focus of the selected studies was on factors associated with ANC utilization among women of reproductive age (15–49 years) who were either pregnant or had given birth within the five years preceding the studies. The geographical scope was limited to Sub-Saharan African countries.

For inclusion, studies had to define ANC utilization as a minimum of 8 or more ANC visits, with the initial visit scheduled during the first trimester of pregnancy or within the first 12 weeks of gestation. The selected studies encompassed research conducted in both community and facility settings, utilizing either primary or secondary data for analysis. Additionally, studies were included if they presented statistical measure of association statistics, strategies to account for confounding or test statistics such as regressions, multivariable analysis, correlation analysis and Structural Equation Modeling (SEM) that explicitly demonstrated how factors influenced ANC utilization.

3.3.1. Eligible studies

The primary author, M.M, and an independent reviewer, M.M, conducted a thorough examination of the full texts belonging to the included and undecided categories of studies, adhering to the predetermined eligibility criteria for final inclusion. Studies found ineligible upon full-text examination were excluded, and the rationale for exclusion was meticulously documented. In cases of discrepancies between the two reviewers, resolution was achieved through extensive discussion and consensus, with the primary author serving as the final arbiter. The Figure 3 (Page 28)

Figure 3illustrates the screening and selection processes.

3.3.2. Study setting

Sub-Saharan Africa, South of Sahara, or Non-Mediterranean Africa, as described by the United Nations, lie partially or completely south of the Sahara, which constitutes 46 countries, as demonstrated by Figure 2 (Page 25) Figure 2. The labelled map of the sub-Saharan Africa illustrative of the study setting for this paper(58)

Sub-Saharan Africa is divided into regions namely: Central (Angola, Burundi, Cameroon, Central African Republic, Chad, Democratic Republic of Congo, Republic of Congo, Equatorial Guinea, Gabon, Rwanda, São Tomé, and Príncipe).

East (Burundi, Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Rwanda, Seychelles, Somalia, South Sudan, Sudan, Tanzania, Uganda, Zambia, Zimbabwe, and Somaliland).

Southern (Angola, Botswana, Comoros, Eswatini, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, South Africa, Zambia, Zimbabwe)

Western Africa (Benin, Burkina Faso, Cabo Verde, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mauritania, Niger, Nigeria, Saint Helena, Senegal, Sierra Leone, Togo)



Figure 2. The labelled map of the sub-Saharan Africa illustrative of the study setting for this paper(58)

3.4. Validity Assessment

The initial exploration for eligible studies involved the application of search strings and filters within databases, along with consultation of other pertinent sources. Identified studies were subsequently imported into the Rayyan software for systematic reviews. The screening process was commenced by M.M as the primary author and D.E as a reviewer. The studies were evaluated based on their titles and abstracts in alignment with predefined inclusion criteria with the supervisor J.K overseeing and guiding the process. Following this screening, titles and abstracts were categorized as included, excluded, or undecided. Full texts of all included and undecided studies were then retrieved for a comprehensive assessment of eligibility.

The results of these studies were further exported from Rayyan to JBI SUMARI. Another reviewer was invited for eligibility careening process in JBI. The primary author M.M and a

reviewer M.M independently screened these studies for inclusion criteria. This process was initiated to facilitate seamless quality assessment and extraction.

Most studies were cross-sectional with data from DHS; therefore, the critical appraisal of studies that met the eligibility criteria was conducted using the Joanna Briggs Institute (JBI) critical appraisal tools for cross-sectional studies (57). The primary author MM and reviewer MM critically appraised the studies for quality and biasness. This assessment tool comprised of 8 questions with 3 options, “yes”, “no” and “unclear”. Studies included were those with clear methodology including but not limited to inclusion criteria, study setting and participants characteristics, validity and reliability of results, identification and accounting for confounding variables and the statistical analysis used. Those that scored 8 and above were considered for the inclusion in the final analysis.

3.5. Data extraction

Data extraction from eligible studies was performed by the primary author M.M and a reviewer M.M using a standardized JBI data collection tool to minimize selection bias. A data extraction tool aligning with the research objectives was used to answer the research question. This incorporated the authors’ last name, year of publication, outcome of interest and identified factors which were found to be associated with ANC utilization.

Disagreements between the reviewers were discussed, and a consensus was reached. The primary reviewer then resolved conflicting decisions based on what was agreed between the reviewers. This is a build in feature for JBI where the primary author breaks the tie by default. Studies with unclear methodologies, including those with missing outcomes of interest, were excluded.

All synthesized articles were uploaded to Mendeley to maintain and manage references and facilitate the review process. Quality assessment tools for observational cross-sectional studies from JBI SUMARI was used for quality assurance. Exposures were considered, and these were maternal age, marital status, parity, residence, maternal educational attainment, employment status, religion, wealth index, partner’s education, household size and headship, health insurance, patient satisfaction/management, access or distance to the health facility, and women’s autonomy.

The geographical map demonstrating the geo-spread of studies included for the analysis was done using the Microsoft excel 365 software (Microsoft Corporation. Microsoft Excel [Internet]. 2018. Available from: https://office.microsoft.com/excel)

3.6. Data synthesis and statistical analysis

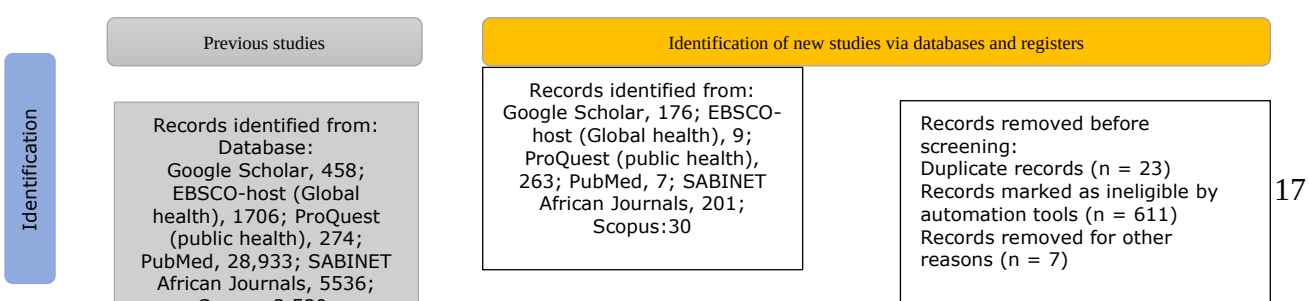
This study incorporated descriptive analysis through use of summary tables describing the characteristics of the included studies. Furthermore, statistical analyses were performed using Stata SE 18^1^ and to meta-analyze ANC utilization. The pooled proportions presented in percentages on effect sizes with 95% confidence interval were calculated. The significance level was at p-value <0.05. Heterogeneity was conducted through Cochran's Q statistics for heterogeneity and it was quantified using I^2 where I^2 *of >50%* was reported as a significant heterogeneity (StataCorp. Stata Statistical Software: Release 18. College Station, TX: StataCorp LLC; [2024])

Graphical data presentation was conducted through forest plots for the first and second objectives of this study. To assess for publication bias, a funnel plot of the effect sizes and their corresponding standard errors was conducted. To further investigate the possibility of publication bias, Egger's test with the null hypothesis denoting no existence of small study effect. For the studies robustness assessment and their influence on the estimates, resistance test was conducted for sensitivity analysis (StataCorp. Stata Statistical Software: Release 18. College Station, TX: StataCorp LLC; [2024]).

The factors demonstrating a significant association with the outcome variable were systematically classified and organized into three distinct groups, namely "attendance," "timing," and "visits," based on their relevance to ANC utilization. Additional predictors were synthesized using summary tables, adopting a thematic approach for a comprehensive analysis.

Table 1. The concept grids. PECo Framework (57)

POPULATION	EXPOSURE	CONTEXT	OUTCOME
Women of reproductive age who gave birth 5 years preceding the time of the study.	Determinants	Sub-Saharan Africa OR Africa OR Sub*Saharan Africa OR Africa	ANC utilization



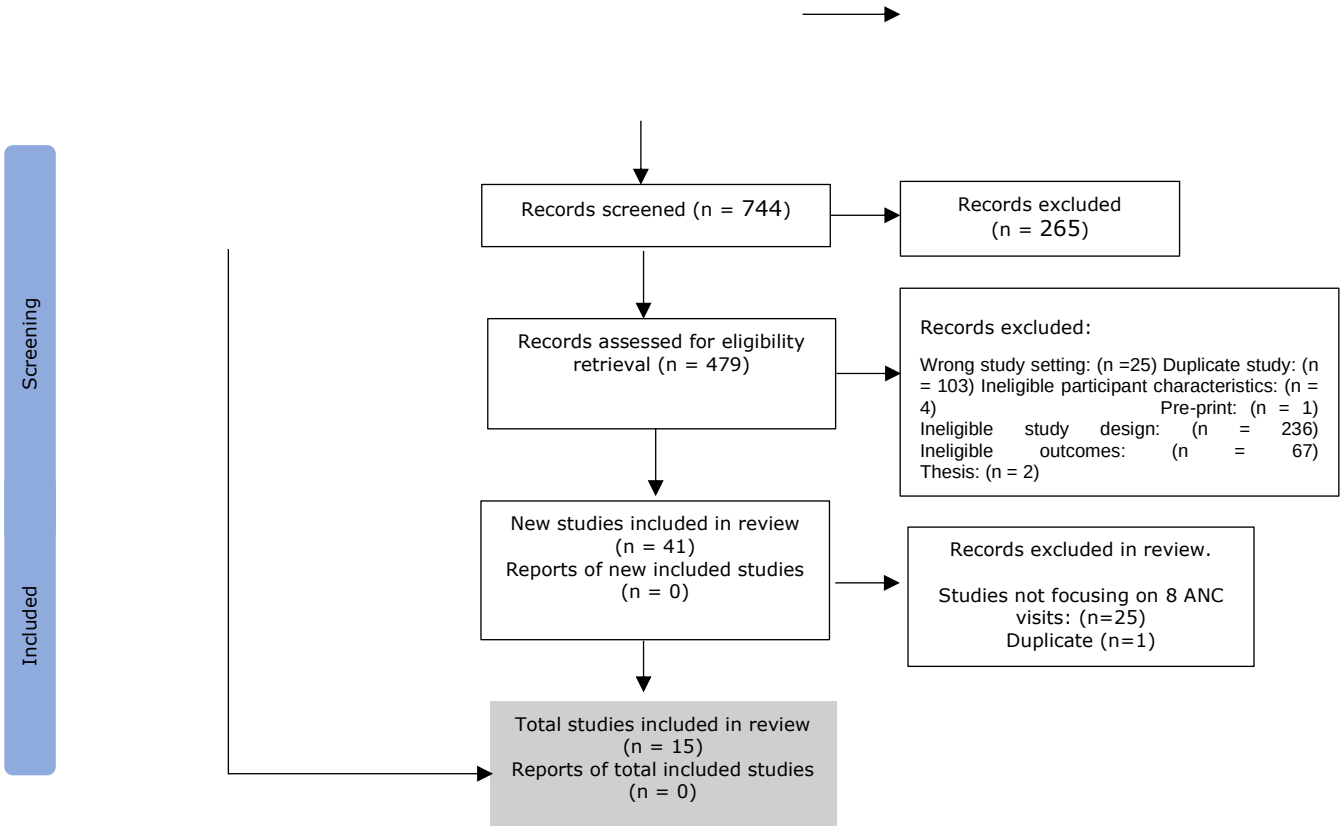


Figure 3. PRISMA flow diagram of the search and study selection process on factors associated with antenatal care utilization among women of reproductive age in sub-Saharan Africa.

3.7. Ethical considerations

Before the commencement of search terms preceding data collection, an application for approval was submitted to the university of the University of the Witwatersrand School of Public Health, Johannesburg and the Faculty of Health Sciences Graduate Studies Committee (GSC). The title approval was obtained on the 17 November 2022. The Ethical clearance weaver was applied from the University of Witwatersrand Human Research Ethics Committee (HREC), Johannesburg and was received on the 17/04/2023, the certificate is appended in this report with reference number **W-CBP-230417-02** Appendix 1 (Page 70). Data collection was conducted using known and high-quality online databases for eligible studies. The results of this study will be shared with the Witwatersrand University School of Public Health and later published.

Chapter 4. Results

The results section aims to answer the research question on what factors are associated with ANC utilization among women of reproductive age in sub-Saharan Africa from 2016-2023 with an aim to describe and determine these factors through systematic review and meta-analysis.

In this section, the results of the extracted studies were presented in detail. These included the characteristics of the studies included in the analysis. The studies for analysis were a total of 15 observational, quantitative studies conducted in Sub-Saharan Africa from to 2016-2023, inclusive of the three studies that met the inclusion criteria published in 2023 as new evidence.

The 15 studies extracted for this systematic review were derived from 6 independent Sub-Saharan African countries and 3 from multi-countries within the sub-Saharan Africa. Most of the studies were from East Africa (Ethiopia=4, Rwanda=2, and Uganda=2), followed by West Africa (Ghana=1, Nigeria=4, and Sierra Leone=1), multi-country=3. Of the 3 multi-country studies, 1 study was conducted for 3 East African countries from which only Tanzania was eligible for inclusion based on the eligibility criteria (59). Another multi-country study was conducted in 4 Sub-Saharan Africa countries namely Nigeria, Mali, Guinea, and Zambia (37).

The last multi-country study was conducted in the 36 Sub-Saharan Africa from which the following countries met the inclusion criteria based on this study eligibility criteria, these were Nigeria, Angola, South Africa, Ethiopia, Malawi, Tanzania, Zambia, Benin, Guinea, Mali (60). It is noteworthy, however, that while this seminal study provided a rich dataset conducive to meta-analytical endeavors, its methodology entailed the aggregation and categorization of estimates at the regional level rather than individual country-specific analyses.

As a consequence of this overarching approach, the discrete estimates for each country were not delineated, precluding their direct utilization within the confines of meta-analysis protocols. Thus, while the study offered invaluable insights into regional trends and patterns across Sub-Saharan Africa, its aggregate nature precluded its incorporation into the meta-analytical framework envisioned for this study.

The eligible studies were predominantly secondary data analyses from various countries' Demographic Health Surveys (DHS) and minorities from cross-sectional study designs. The characteristics of the studies included for analysis are appended in this study Table 2 (Pages

22-24). Incorporated in this table are the extraction details of the included studies upon completion of eligibility criteria and quality assessment processes.

Table 2 Characteristics of the included studies for analysis.

Author_year	Study_ setting	Study_design	Year	Sample_size	Anc_attendance	Analysis	Anc_timing	Anc_visits	Outcome of interest
Ahinkorah et al. 2021	Nigeria	Population based (DHS) Cross-sectional	2018	6857	6761	Descriptive statistics, crude ordinal logistic regression, ordinal logistic regression	1188	1206	Timing of the first ANC visit and the number of ANC visits.
Ahinkorah et al. 2021	Mali	Population based (DHS) Cross-sectional	2018	2049	1973	Descriptive statistics, crude ordinal logistic regression, ordinal logistic regression	701	69	Timing of the first ANC visit and the number of ANC visits.
Ahinkorah et al. 2021	Guinea	Population based (DHS) Cross-sectional	2018	1708	1690	Descriptive statistics, crude ordinal logistic regression, ordinal logistic regression	445	48	Timing of the first ANC visit and the number of ANC visits.
Ahinkorah et al. 2021	Zambia	Population based (DHS) Cross-sectional	2019	1637	1570	Descriptive statistics, crude ordinal logistic regression, ordinal logistic regression	1245	23	Timing of the first ANC visit and the number of ANC visits.
Anaba et al. 2022	Ghana	Population based (Ghana Malaria Indicator Survey) Cross-sectional	2019	2163	952	Descriptive statistics, tabulation statistics, binomial logistic	1472	942	Late initiation of ANC visits and underutilization of the recommended eight or more ANC visits.

						regression analysis			
Belay et al. 2021	Ethiopia	Population based (DHS) Cross-sectional	2016	10184	7445	Multilevel binary logistic regression, spatial analysis, Bernoulli model	1541		Delayed first ANC.
Birhanu et al. 2020	Ethiopia	Health facility based Cross-sectional	2017	531	373	Logistic regression	290		Satisfaction
Ekholuenetale et al. 2020	Nigeria	Population based (DHS) Cross-sectional	2018	7936	5895	Multilevel multivariable binary logistic regression mode		1300	The frequency of ANC contacts.
Ekholuenetale et al. 2021	Ghana	Population based (Ghana Malaria Indicator Survey) Cross-sectional	2019	1404	588	Univariate analysis, the lorenz curve and concentration index	905	588	Number of antenatal care visits.
Fagbamigbe et al. 2021	Nigeria	Population based (DHS) Cross-sectional	2018	41821	21785	Multivariable, multinomial logistic regression		4357	Number of ANC contact visits.
Mlandu et al. 2022	Tanzania	Population based (DHS) Cross-sectional	2016	42719	3411	Descriptive analysis, multivariate logistic regression	1712		Late ANC initiation.
Mulungi et al. 2023	Rwanda	Population based (DHS) Cross-sectional	2020	6039	2476	Descriptive analysis and multivariable	3563		Delayed ANC.

						logistic regression			
Negash et al. 2022	Ethiopia	Population-based (DHS) Cross-sectional	2016	4757	1069	A multilevel mixed-effect logistic	1541	2415	Quality of antenatal care (ANC)
Nxiweni et al. 2022	South-Africa	Population based (DHS) Cross-sectional	2016	67645	14205	Summary statistics, frequency tables	11217		Utilization of ANC.
Sserwanja et al. 2022	Uganda	Population based (DHS) Cross-sectional	2016	10152	2954	Descriptive statistics Bivariable logistic regression Multivariable logistic	2953		Early initiation.
Sserwanja et al. 2022	Sierra Leone	Population based (DHS) Cross-sectional	2019	12758	5432	Multivariable logistic regression	2399	1197	Total number of ANC contacts.
Tengera et al. 2023	Rwanda	Population based (DHS) Cross-sectional	2020	6302	6039	Descriptive statistics and multivariable logistic regression		1691	Adequacy of ANC received.

The Figure 4 (Page 35) demonstrates the geographical spread of the included studies to elaborate on the variability of the pooled estimates. The Table 2 (Pages 32-34) above summarizes the findings of the study based on the inclusion criteria demonstrating the geographic spread, and the number of studies conducted per country.

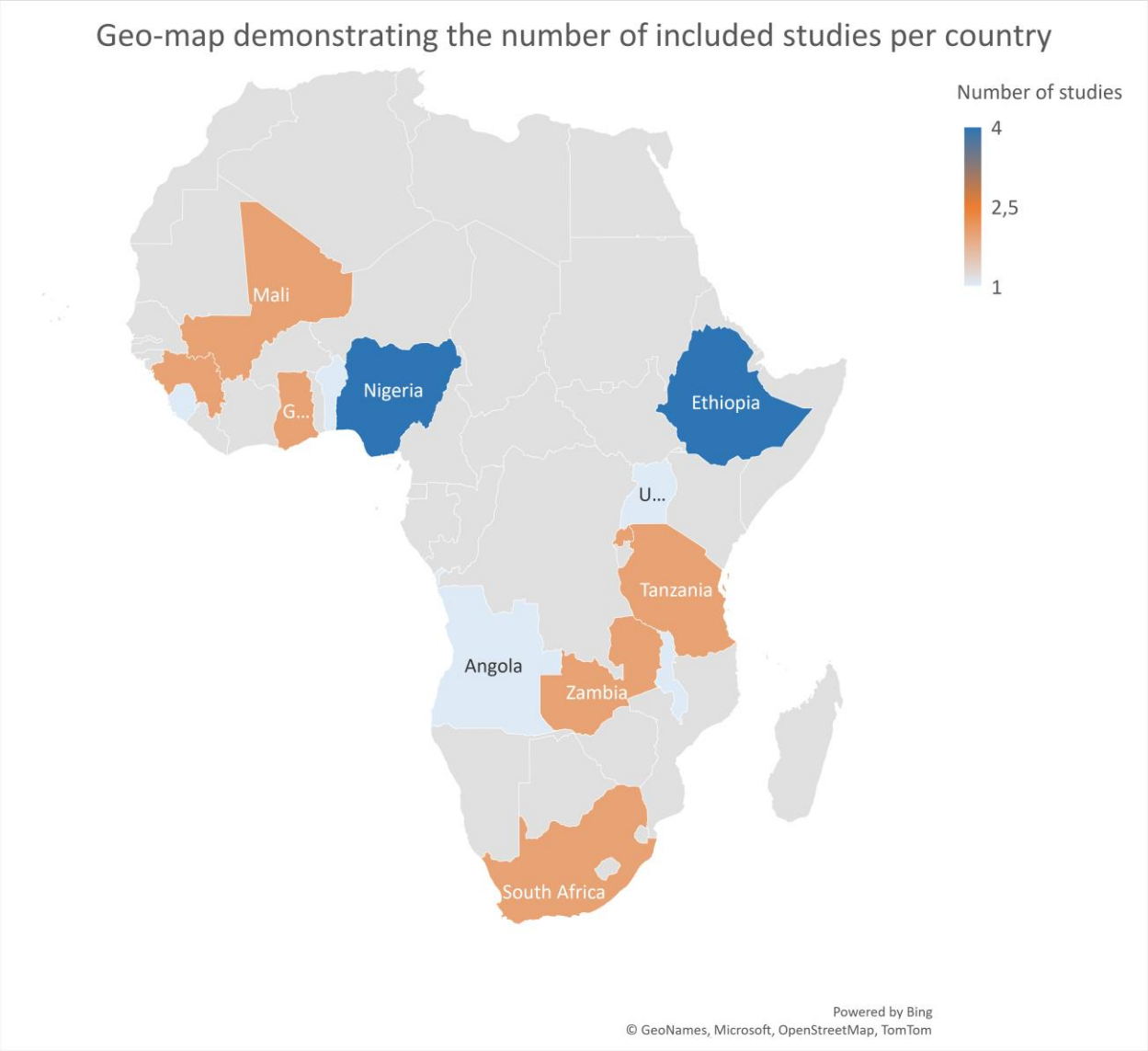


Figure 4. Geographical spread of included studies.

This systematic review of the factors associated with the utilization of ANC revealed a multitude of influencing factors that can be categorized into several themes according to the Andersen's Behavioral Model of Health Service Use. These themes provide insights into various aspects that affect the utilization of ANC services among women of reproductive age in sub-Saharan Africa.

4.1. Meta-analysis for antenatal care attendance

To describe the proportions (presented as percentages) and factors associated with ANC utilization among women of reproductive age in sub-Saharan Africa, meta-analysis using random effects model was conducted. The pooled proportions estimate for ANC utilization by study setting was 59.1% (95% CI:39.0,79.3) with a p-value of less that 0.05 indicative of a high significant level. The heterogeneity level is significantly high I^2 =100% indicating that the included studies were significantly heterogenous methodologically in terms of study setting (Figure 5.)

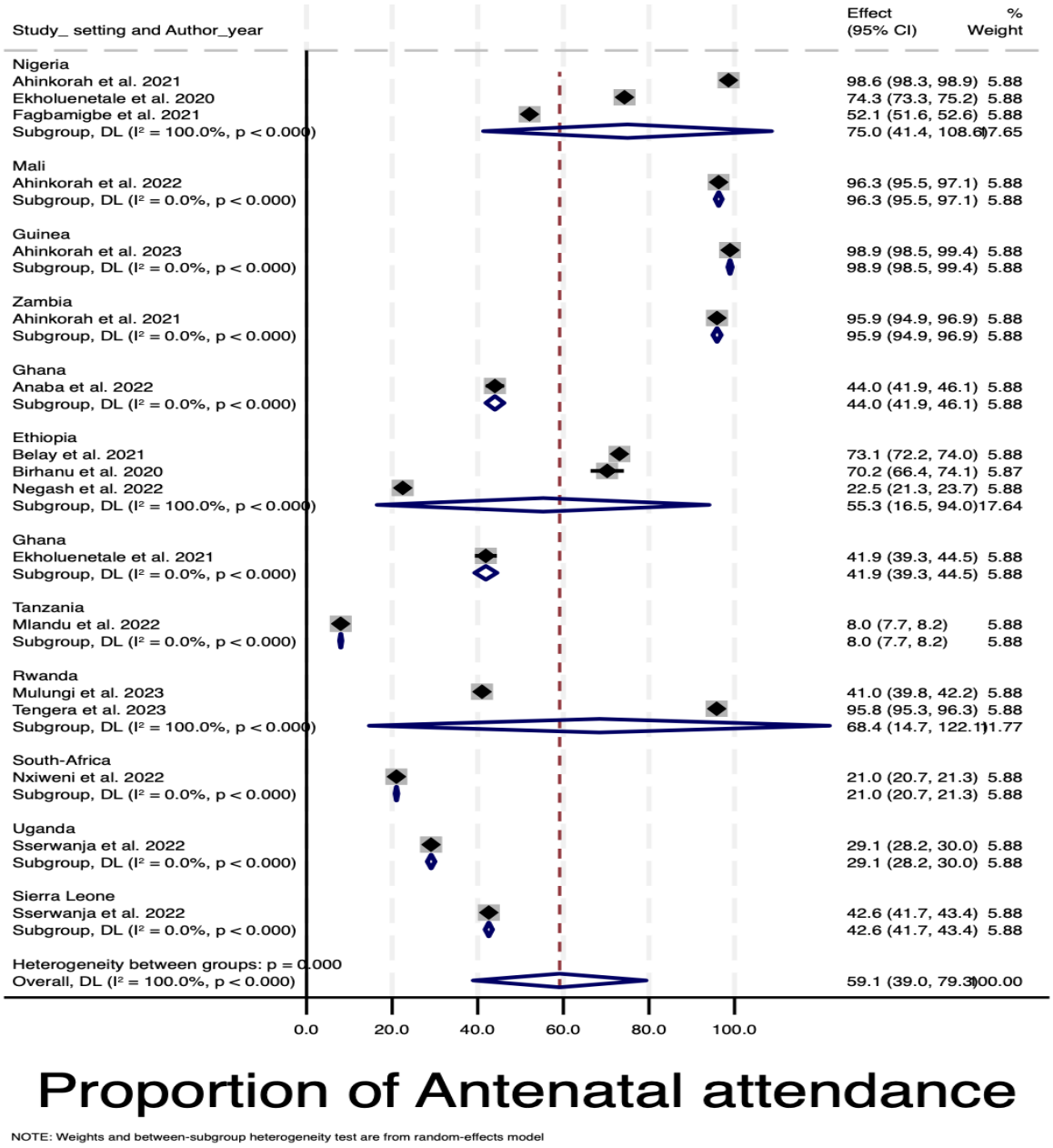


Figure 5. Forest plot illustrating pooled prevalence percentages on the levels of ANC utilization from 2016-2023 by study setting.

Each study contributed valuable insights into the prevalence of ANC utilization and its associated factors, which are crucial for informing healthcare policies and interventions aimed at improving maternal and child health outcomes in the region.

Nigeria: Studies conducted by Ahinkorah et al. (2021) reported 98.6% (95% CI: 98.3, 98.9), Ekholuenetale et al. (2020) reported 74.3% (95% CI:73.3, 75.2), and Fagbamigbe et al. (2021) reported 52.1% (95% CI: 51.6, 52.1) indicating high levels of ANC utilization. These findings underscore the relatively strong ANC attendance in Nigeria, although there are variations across different regions and population groups. Overall p-value <0.001.

Mali: Ahinkorah et al. (2021) found a substantial level of ANC utilization in Mali, with an estimated effect of 96.3% (95% CI: 95.5, 97.1). This suggests a relatively high uptake of ANC services among pregnant women in Mali. Overall p-value <0.001.

Guinea: Similarly, Ahinkorah et al. (2021) reported a high prevalence of ANC utilization in Guinea, with an estimated effect of 98.9% (95% CI: 98.5, 99.4) with a high significant p-value <0.001. These findings highlight optimal ANC utilization among women of reproductive age in Guinea.

Zambia: Ahinkorah et al. (2021) revealed a commendable level of ANC utilization in Zambia, with an estimated effect of 95.9%, (95% CI: 94.9, 96.9) with a statistically significant p-value <0.001. This indicates the effectiveness of ANC programs and initiatives in Zambia in promoting maternal and child health.

Ghana: Anaba et al. (2022) and Ekholuenetale et al. (2021) reported relatively lower levels of ANC utilization in Ghana, with prevalence estimates of 44% (95% CI: 41.9, 46.1) and 41.9% (39.3, 44.5), respectively with the statistically significant p-value<0.001. These findings suggest potential gaps in ANC coverage and underscore the need for targeted interventions to improve access and utilization among pregnant women in Ghana.

Ethiopia: Belay et al. (2021) reported 73.1% (95% CI: 72.2, 74.0), Birhanu et al. (2020) presented 70.2% (95% CI: 66.4%, 74.1%), and Negash et al. (2022) presented 22.5% (95% CI: 21.3, 23.7) with statistically significant p-value<0.001. They presented varying levels of ANC utilization in Ethiopia, with prevalence estimates ranging from 22.47% to 73.12%. These findings reflect the diverse healthcare landscape in Ethiopia and the complex factors influencing ANC attendance among pregnant women.

Tanzania: Mlandu et al. (2022) reported a relatively low level of ANC utilization in Tanzania, with an effect of 8% (95% CI: 7.7, 8.2) and a p-value <0.001. This indicates potential challenges in accessing ANC services in certain regions of Tanzania, necessitating targeted interventions to improve coverage and utilization.

Rwanda: Mulungi et al. (2023) and Tengera et al. (2023) reported moderate to high levels of ANC utilization in Rwanda, with prevalence estimates of 41% (95% CI: 39.8, 42.2) and 95.8% (95% CI: 95.3, 96.3), respectively. These findings underscore the effectiveness of ANC programs and initiatives in Rwanda and highlight the importance of continued efforts to sustain and improve maternal and child health outcomes.

South Africa: Nxiweni et al. (2022) reported prevalence estimates of 21% (95% CI:20.7, 21.3) and a statistically significant p-value<0.001. This demonstrates suboptimal ANC utilization suggesting implemental gaps and a need for strategies to increase access and utilization.

Uganda: Sserwanja et al. (2022) presented prevalence effect estimates of 29.1% (95% CI: 28.2, 30.0) with a significant p-value<0.001. These findings underscore the relatively low ANC attendance suggesting sustainable initiatives towards ANC access and utilization.

Sierra Leone: Sserwanja et al. (2022) reported 42.6% (95% CI: 41.7, 43.4). These ANC prevalence effect estimates reflect the diverse healthcare contexts and challenges faced by pregnant women in different settings within Sierra Leone.

The overall pooled estimate, derived from the random-effects model, indicated a moderate level of ANC utilization across Sub-Saharan Africa, with an effect estimate of 59.1 (95% CI: 39.0, 79.3) and a p-value <0.001. The overall Cochran's Q statistic indicated a significant heterogeneity across all included studies ($p < 0.001$). The I^2 statistic indicated complete heterogeneity ($I^2 = 100\%$), suggesting substantial variability among the effect sizes of the studies.

The between-study variability was quantified by the Cochran's Q statistic, resulting in a statistically significant p-value<0.001, indicating substantial variability among the studies included in the meta-analysis.

The (Figure 6) below demonstrates subgroup analysis of ANC utilization among women of reproductive age in Sub-Saharan Africa by study design of the included studies for analysis.

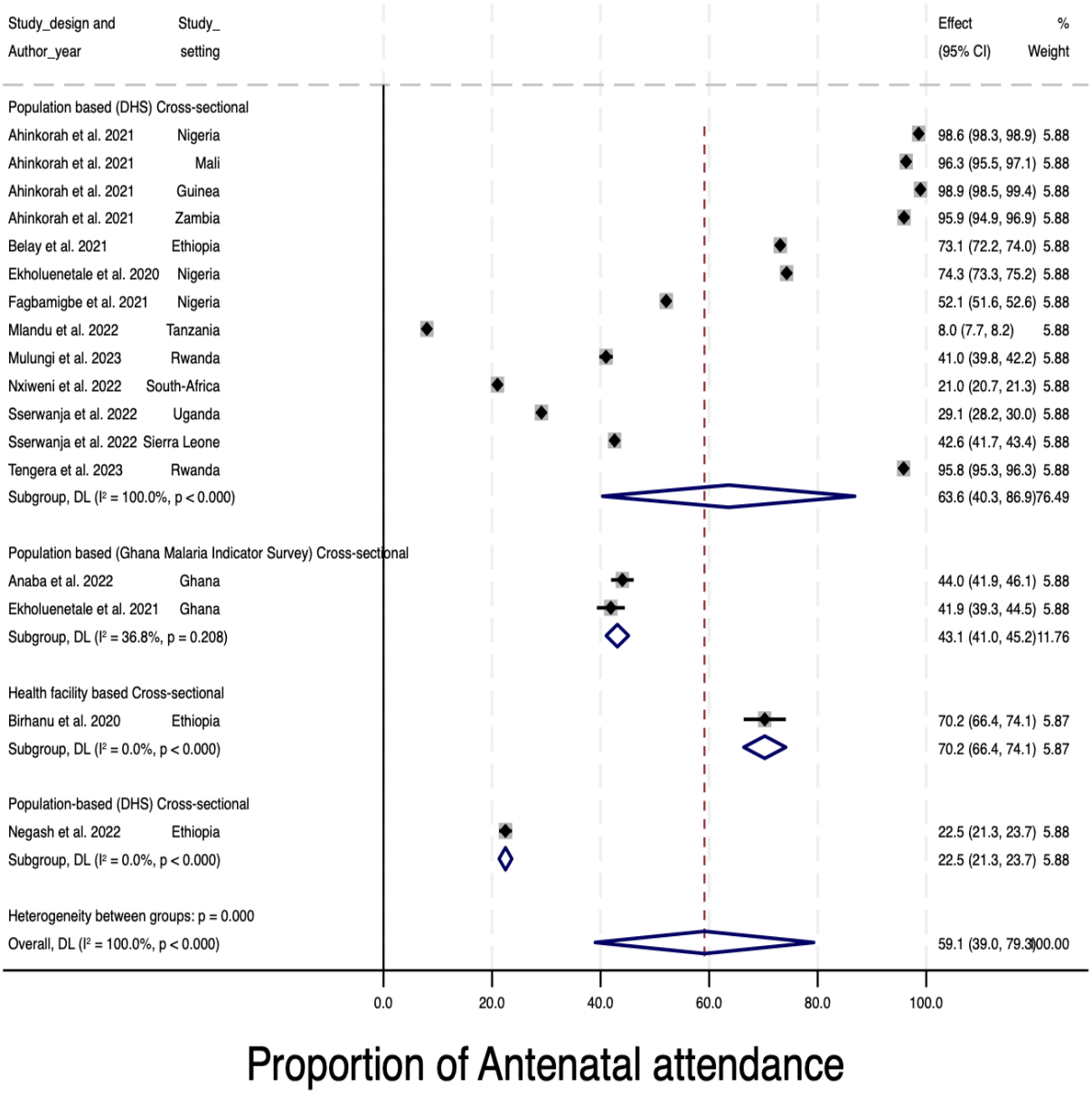


Figure 6 Forest plot on proportions of ANC utilization prevalence percentage estimates among women of reproductive age in Sub-Saharan Africa by study design and publication year.

Population based (DHS) Cross-sectional Studies: The effect estimates from various studies ranged from 7.9% to 98.9%, with confidence intervals indicating the precision of the estimates. The overall effect estimate, when combined, was 59.1% (95% CI: 38.9, 79.3. The studies included in this subgroup were characterized by a substantial level of heterogeneity (I^2 = 100.0%, p < 0.001) indicative of the substantial variability of the included studies.

Population based (Ghana Malaria): Only two studies contributed to this subgroup, reporting effect estimates of 41.9% (95% CI: 39.3, 44.5) and 44% (95% CI: 41.9, 46.1), respectively.

The overall effect estimate for this subgroup was 43.1% (95% CI: 41, 45.2), and the heterogeneity was moderate (I^2 = 36.8%, p = 0.208) which was not statistically significant.

Health facility based Cross-sectional Studies: One study was included in this subgroup, reporting an effect estimate of 70.3%, 95% CI: 66.4, 74.1). The heterogeneity for this subgroup was not statistically significant (I^2 = 0.0%, p = <0.001).

Population-based (DHS) Cross-sectional Studies: Another single study was included in this subgroup, reporting an effect estimate of 22.3% (95% CI: 21.3, 23.7). Similar to the health facility-based subgroup, heterogeneity was not applicable (I^2 = 0.0%, p = <0.0001).

Tests of Subgroup Effect Size

For each subgroup, tests were conducted to assess whether the effect size within the subgroup significantly differed from zero. The results indicated that the effect sizes for all subgroups were significantly different from zero, with p-values < 0.001, except for the population-based (Ghana Malaria) subgroup, with a p-value of 0.208 that was not statistically significant.

Cochran's Q Statistics for Heterogeneity

Cochran's Q statistics were employed to assess the heterogeneity within each subgroup.
For the population-based (DHS) Cross-sectional Studies and the overall analysis, substantial heterogeneity was observed (I^2 = 100.0%, p < 0.001). The population-based (Ghana Malaria) subgroup exhibited moderate heterogeneity (I^2 = 36.8%, p = 0.208). Heterogeneity was not statistically significant for the health facility based and population-based (DHS) Cross-sectional subgroups due to the inclusion of only one study in each subgroup.

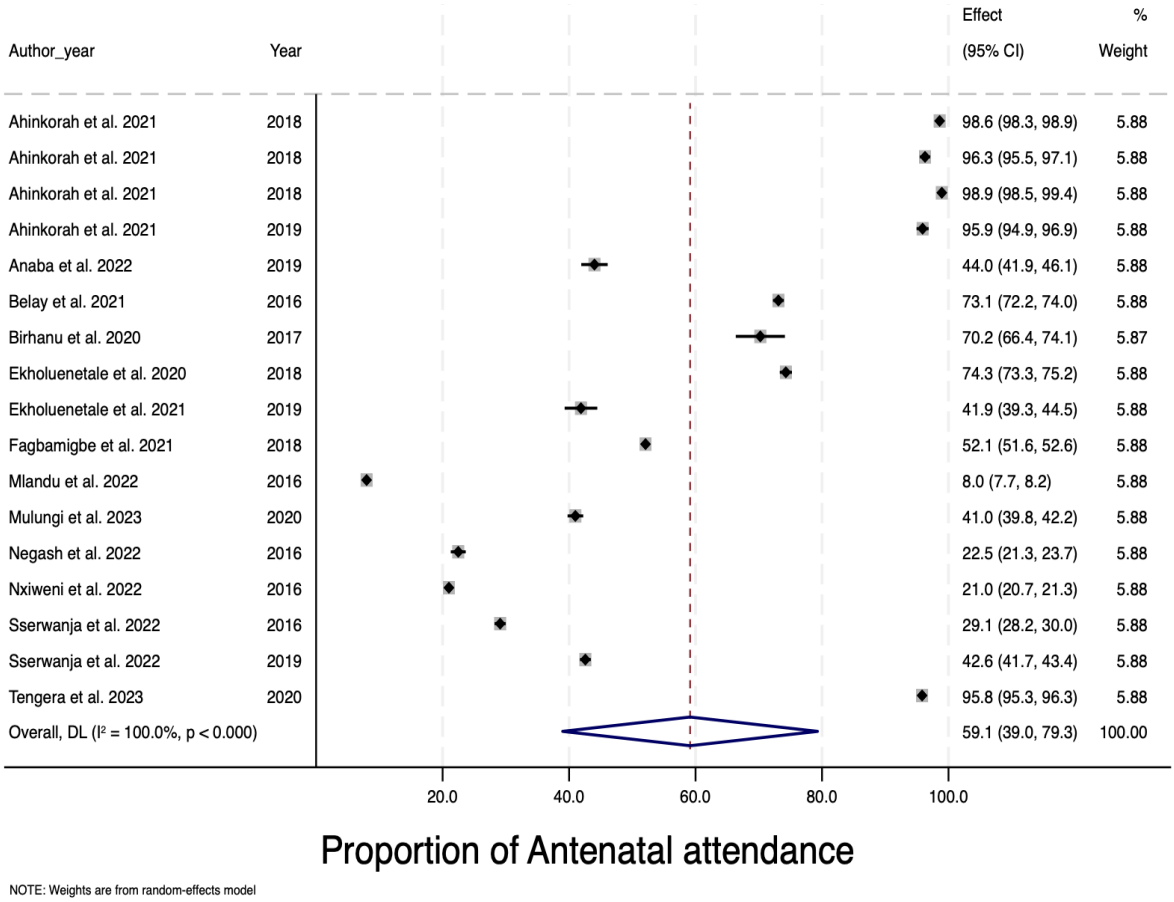


Figure 7 Forest plot on proportions of ANC utilization prevalence percentage estimates among women of reproductive age in Sub-Saharan Africa by year of study.

The effectiveness of interventions varied across studies. Ahinkorah et al. (2021) reported high ANC utilization with effect estimates ranging from 95.91% (95% CI: 94.9, 96.9), to 98.95% (95% CI: 98.3, 98.9), indicating a significant impact on ANC utilization. However, other studies, such as Nxiweni et al. (2022) and Sserwanja et al. (2022), reported lower utilization, with effect estimates around 21% (95% CI: 20.7, 21.3) to 42.6% (95% CI: 41.7, 43.4).

The pooled estimate of the intervention's effectiveness across all included studies, calculated using the DerSimonian-Laird (DL) method, is 59.1% (95% CI: 39.0, 79.3). This suggests a moderate overall ANC utilization and utilization of the interventions in promoting ANC utilization.

The test of overall effect yielded a z-value of 5.8 and a p-value= <0.001, indicating that the overall effect estimate is statistically significant. This implies that there is a true difference in ANC utilization between the years the studies were conducted across SSA.

Significant heterogeneity was observed among the included studies, as indicated by Cochran's Q statistic with a statistically significant p-value<0.001 and the I^2 statistic (100%). This suggests substantial variability in the effect sizes of ANC utilization across studies beyond what would be expected by chance.

4.1.1. Sensitivity analysis for ANC attendance meta-analysis

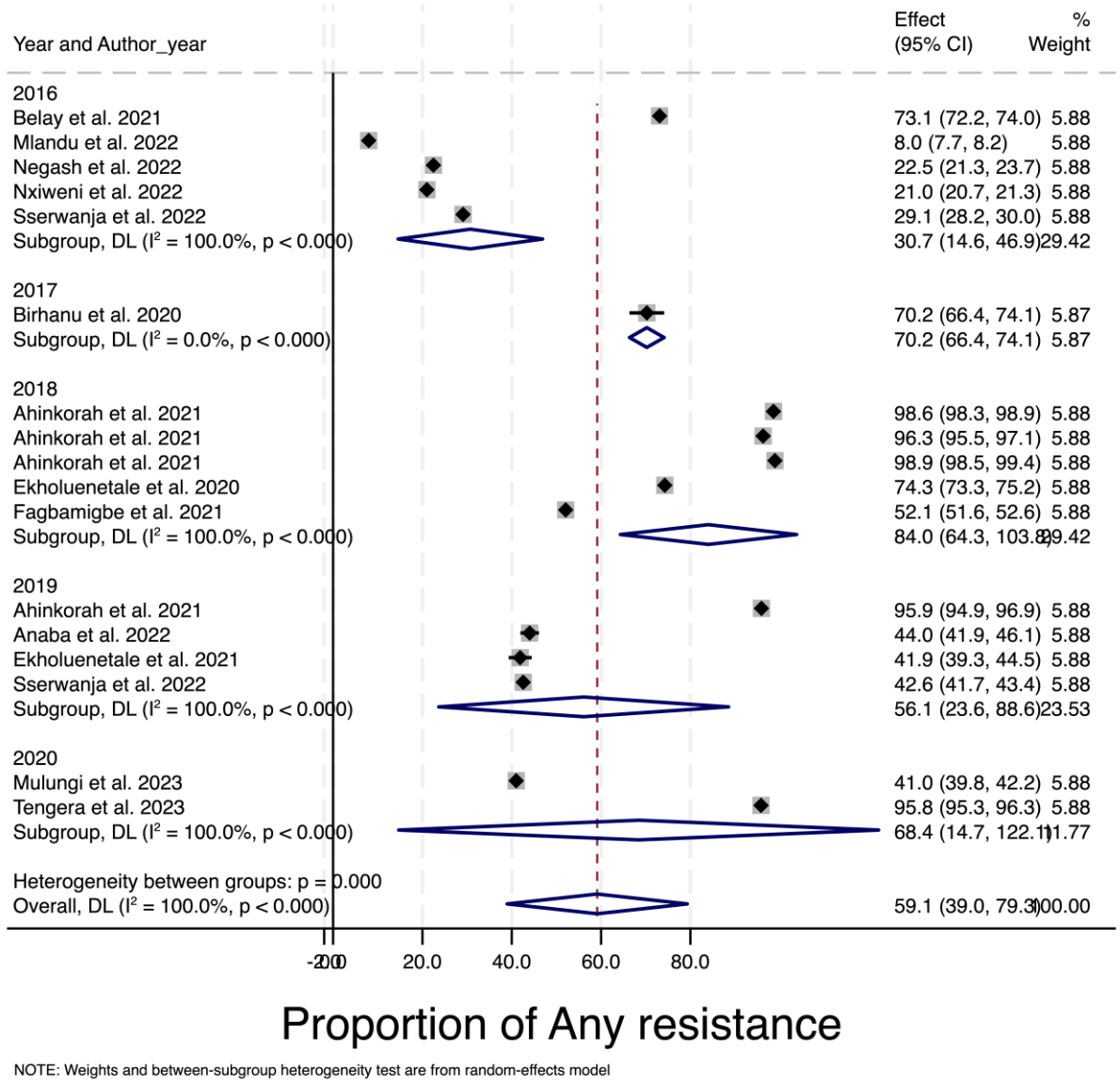


Figure 8 Sensitive analysis on antenatal care utilization among women of reproductive age in Sub-Saharan Africa.

The figure above presents the proportion of any resistance towards ANC utilization across different years, along with subgroup analyses and measures of heterogeneity.

Several studies conducted in 2016 showed varying ANC utilization, with effect estimates ranging from 8% (95% CI: 7.7, 8.2) to 73.1% (95% CI: 72.2, 72.4) The subgroup analysis

revealed a significant subgroup effect (z = 3.725, p-value<0.001), indicating variability in the ANC utilization within this year.

Only one study from 2017, conducted by Birhanu et al. (2020), reported an effect estimate of 70.3% (95% CI: 66.4, 74.1), suggesting a substantial impact on ANC utilization. Since there is only one study for this year, no heterogeneity statistics are reported.

Studies conducted in 2018 reported effect estimates ranging from 52.1% (95% CI: 51.6%, 52.5%) to 98.9% (95% CI: 98.3, 98.9) indicating a wide range of effectiveness in promoting ANC utilization. The subgroup analysis revealed a significant subgroup effect (z = 8.345, p <0.001), suggesting variability in ANC utilization within this year.

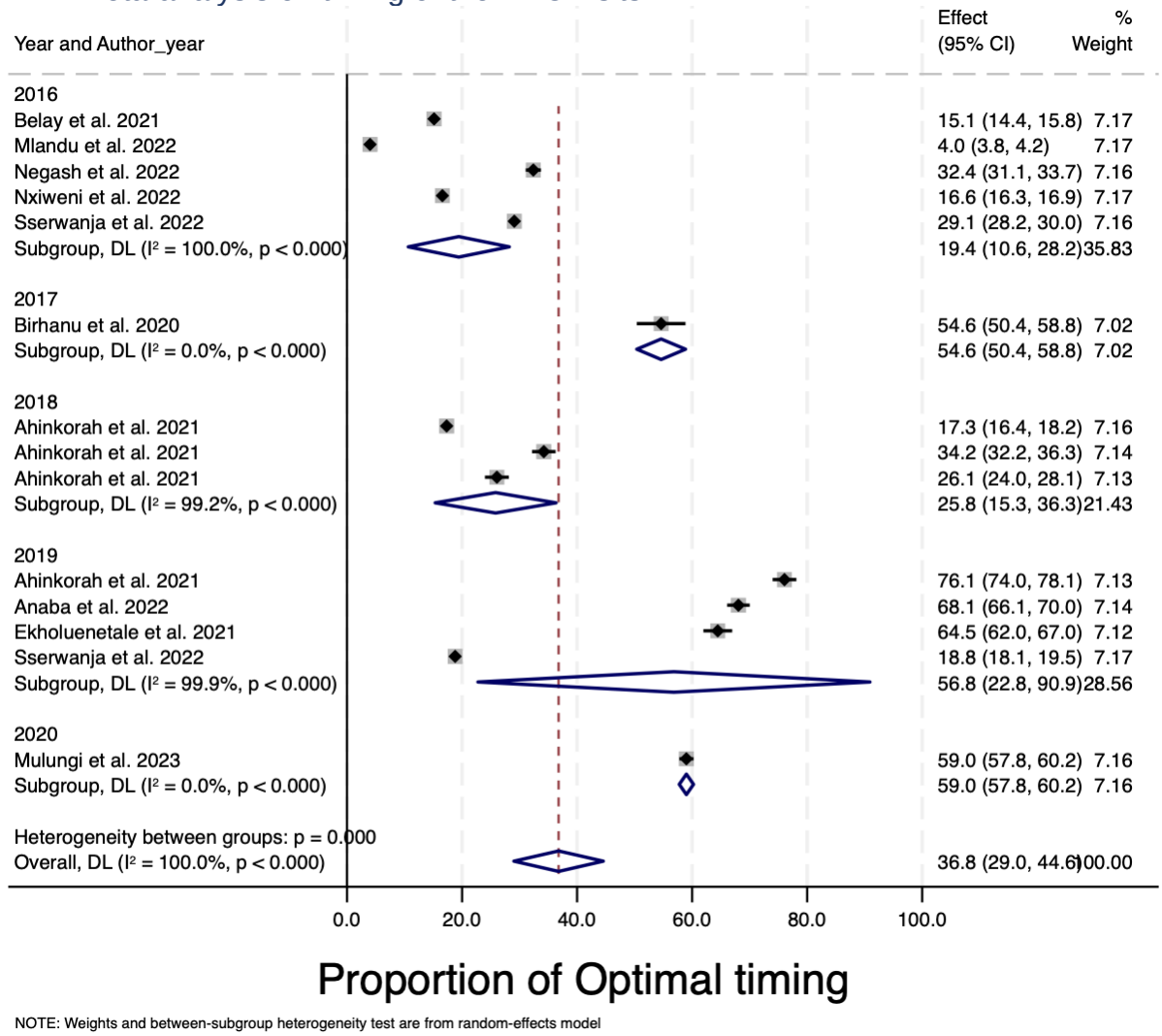
Studies from 2019 showed prevalence effect estimates ranging from 41.9% (95% CI: 39.3, 44.5) to 95.91% (95% CI: 94.9, 96.9), indicating varying utilization. The subgroup analysis also revealed a significant subgroup effect (z = 3.388, p = <0.001), indicating variability in ANC utilization within this year.

Studies from 2020 reported effect estimates ranging from 41% (95% CI: 39.8, 42.2) to 95.8% (95% CI: 95.3, 96.3), indicating varying ANC utilization. The subgroup analysis showed a significant subgroup effect (z = 2.496, p = 0.013), suggesting variability in utilization within this year.

The overall effect estimate, calculated across all years, is 59.1% (95% CI: 39.0, 79.3), indicating a moderate impact of interventions on ANC utilization. Significant heterogeneity is observed across all years, as evidenced by Cochran's Q statistics and an I^2=100%, indicating substantial variability in effect sizes among studies.

The funnel plot for visual assessment of the presence of publication bias or other sources of systematic error that may affect the validity of the meta-analysis results was done as demonstrated by Figure 13 (Page 92).

4.1.2. Meta-analysis on timing of the ANC visits



NOTE: Weights and between-subgroup heterogeneity test are from random-effects model

Figure 9 Forest plot on proportion of ANC timing (<3months or <12weeks of pregnancy) among women of reproductive age in Sub-Saharan Africa by year of the study.

The studies were categorized based on the year studies were conducted, and each study's prevalence effect size estimates along with their confidence interval and percentage weight within the subgroup was provided. Each subgroup represents studies conducted in a specific year. Within each subgroup, the aggregated effect size and confidence interval are calculated based on the individual study results. The "DL" (DerSimonian-Laird) method was used to estimate the pooled effect size within each subgroup.

The overall effect size across all years was reported as 36.8% (95% CI: 29.0, 44.6). This overall effect size provides an aggregate estimate of the impact of ANC utilization across different years. Tests of subgroup effect size for each year were conducted to assess whether the effect size differs significantly from zero within each subgroup. Significant z-values with p-

values <0.05 at 95% significance level, indicate that the effect sizes within each specific year subgroup were statistically significant. Although statistically significant based on the p-value, the prevalence effect estimates for ANC utilization were suboptimal.

Cochran's Q statistics for heterogeneity were reported for each year subgroup, indicating the degree of variability in effect sizes across studies within the same year. Heterogeneity measures were also reported for the overall dataset, showing substantial variability in effect sizes across different years. The meta-analysis reveals significant variation in effect sizes across different years. Despite the heterogeneity, the overall effect size remains significant, suggesting a consistent impact of the factor or intervention across different years.

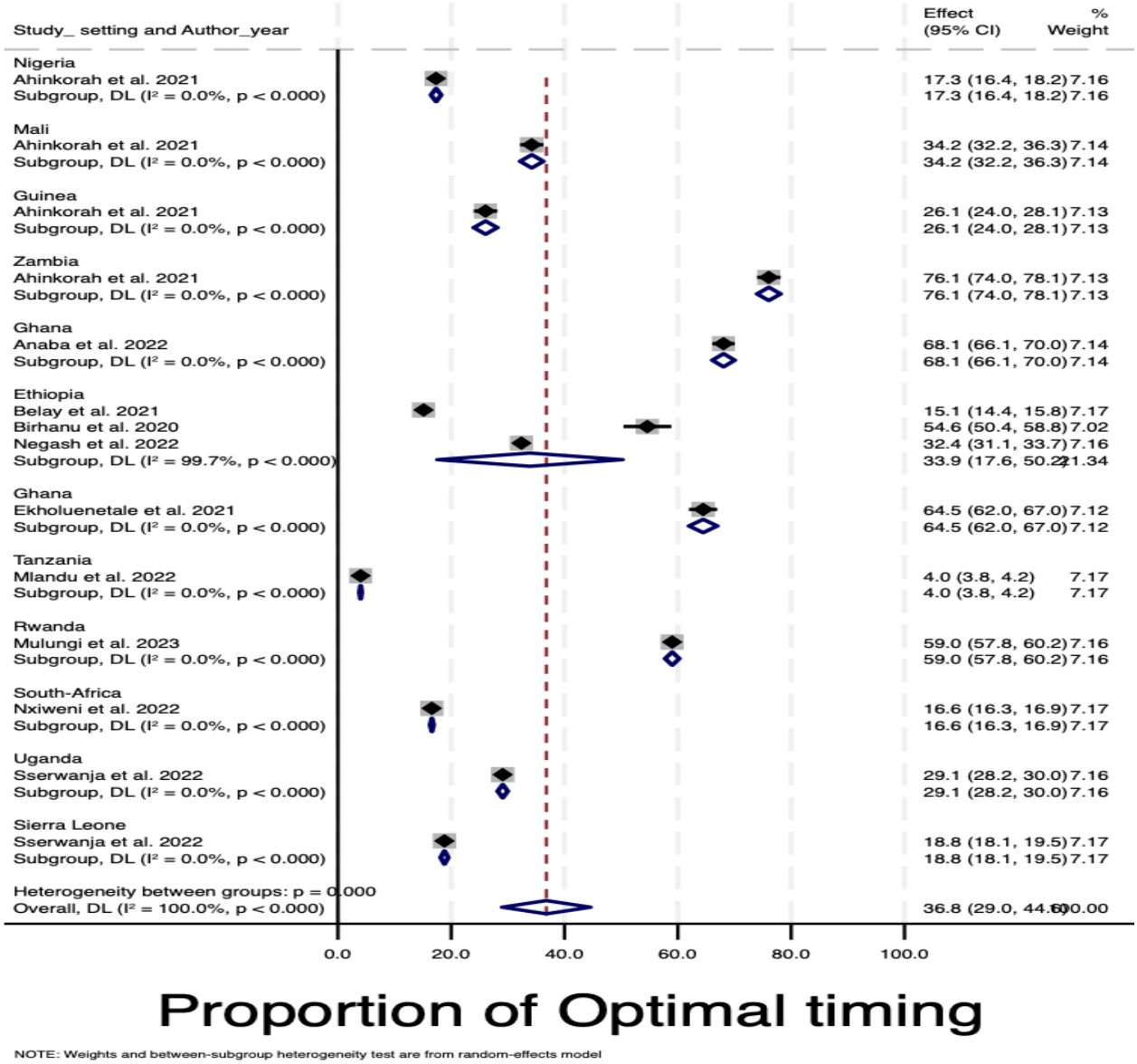


Figure 10 Forest plot on proportion of antenatal care timing (<3months or <12weeks of pregnancy) among women of reproductive age in Sub-Saharan Africa by study setting.

The proportion of women who were found to have booked ANC within the first 3months of pregnancy based on the year of study was 36.8% (95% CI: 29.0, 44.6) with I^2 =100% indicative of the variations between the results of per year of the study.

The data were categorized based on the study setting and the respective authors and publication years. Each subgroup (study setting) presented the effect size and their significance level at 95% confidence interval and percentage weight within the subgroup. The effect size represented the estimated impact of ANC utilization within each study setting.

The overall effect size, calculated across all study settings, is reported as 36.8% (95% CI: 29, 44.6). This overall effect size provides an aggregate estimate of the impact of ANC utilization across different settings. Tests of subgroup effect size for each study setting were conducted to assess whether the effect size differs significantly from zero within each subgroup. For all study settings, the z-values were significant with p-values less than 0.05, indicating that the effect sizes within each subgroup were statistically significant.

Cochran's Q statistics for heterogeneity were reported for each study setting, indicating the degree of variability in effect sizes across studies within the same subgroup. Heterogeneity measures (I^2=100%) were also reported for the overall dataset, showing substantial variability in effect sizes across different study settings.

The results suggest that the study setting examined in the research significantly influences the ANC utilization across diverse settings, including Nigeria, Mali, Guinea, Zambia, Ghana, Ethiopia, Tanzania, Rwanda, South Africa, Uganda, and Sierra Leone. However, there is considerable heterogeneity in effect sizes across studies within each subgroup, indicating potential differences in study methodologies, population characteristics, or other contextual factors. Despite this heterogeneity, the overall effect size remains significant, suggesting a consistent impact of the study setting on the ANC utilization across various settings.

4.1.3. Meta-analysis on optimal number (8 or >) of ANC visits.

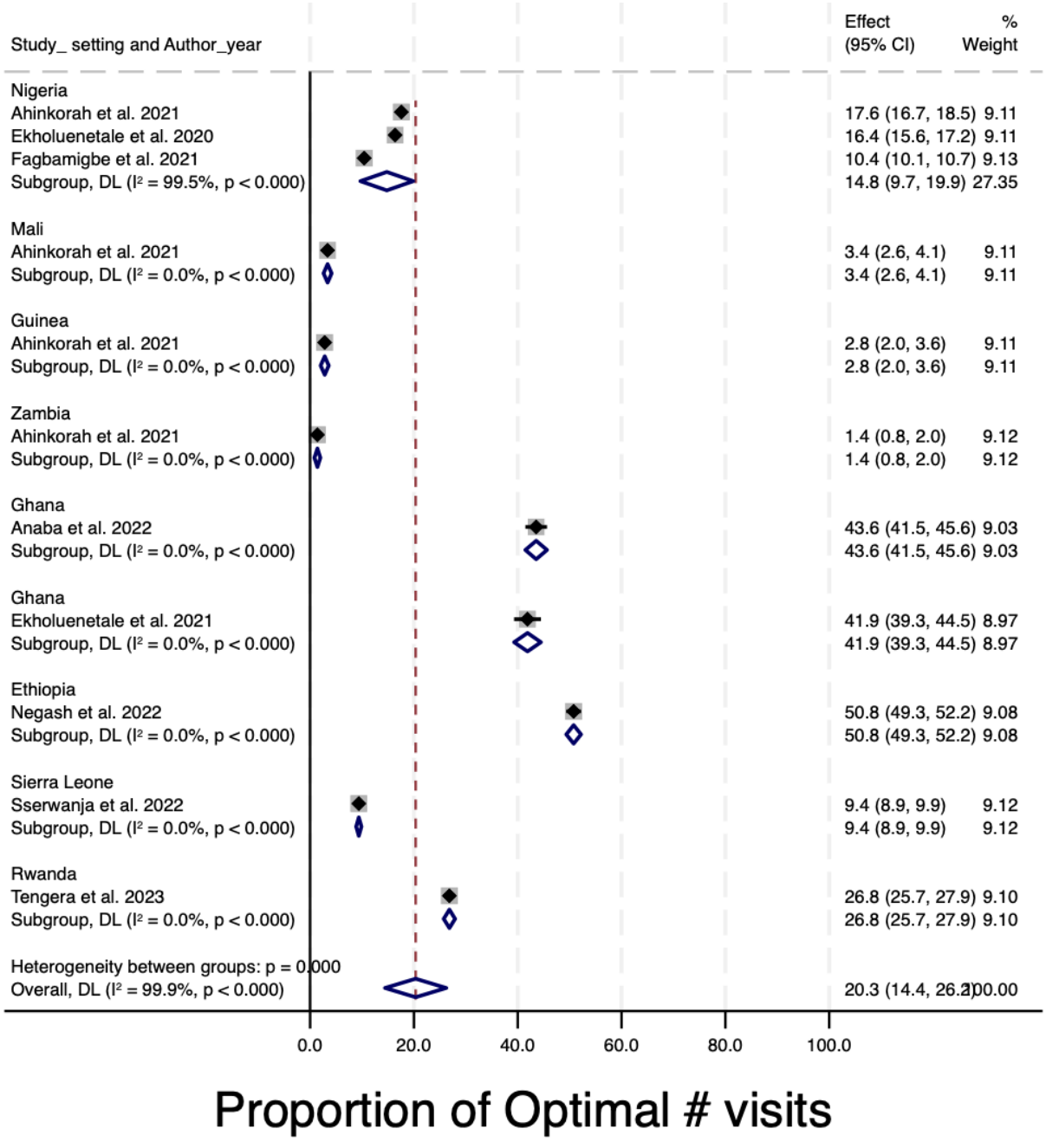


Figure 11 Forest plot on proportion of ANC visits (8 or ANC visits during pregnancy) among women of reproductive age in Sub-Saharan Africa by study setting.

The proportion of women who attained 8 or more ANC visits during pregnancy was 20.3% (95% CI: 14.4,26.2). The I^2=99.9% with a p-value=0.001 with significance level of 0.05 as reference. There is significant variation among the studies included on the proportion of women who attained 8 or more ANC visits by study setting.

The investigation revealed that the proportion of women who initiated ANC (ANC) within the first three months of pregnancy varied significantly depending on the year of study, with an estimated rate of 20.3% (95% CI: 14.4, 26.2). This finding was accompanied by a high level of heterogeneity (I^2 = 99.9%), indicating substantial variations in the results among the different study settings.

The data were organized according to the study settings, including the respective authors and publication years. Each subgroup, representing a distinct study setting, presented the effect size alongside its associated 95% confidence interval and percentage weight within the subgroup. This effect size reflects the estimated influence of specific factors or interventions on ANC utilization within each study setting.

The aggregated effect size, computed across all study settings, was identified as 20.3% (95% CI: 14.4, 26.2), providing a comprehensive assessment of ANC utilization's impact across diverse settings. Tests of subgroup effect size were conducted for each study setting to determine the statistical significance of the effect size within each subgroup. Notably, all study settings yielded significant z-values with p-values<0.001, indicating the statistical significance of the effect sizes within each subgroup.

Cochran's Q statistics for heterogeneity were reported for each study setting, elucidating the extent of variability in effect sizes across studies within the same subgroup. Additionally, heterogeneity measures were provided for the overall dataset, demonstrating substantial variability in effect sizes across different study settings.

The findings suggest that the study setting significantly influences ANC utilization across various settings. Notably, Nigeria exhibited the highest heterogeneity, implying potential disparities in study methodologies, population characteristics, or other contextual factors. Conversely, Mali, Guinea, Zambia, Ghana, Ethiopia, Tanzania, Rwanda, South Africa, Uganda, and Sierra Leone reported no heterogeneity due to the inclusion of only one study in each country.

Despite the observed heterogeneity, the overall effect size remained statistically significant, underscoring the consistent impact of the study setting on ANC utilization across diverse settings.

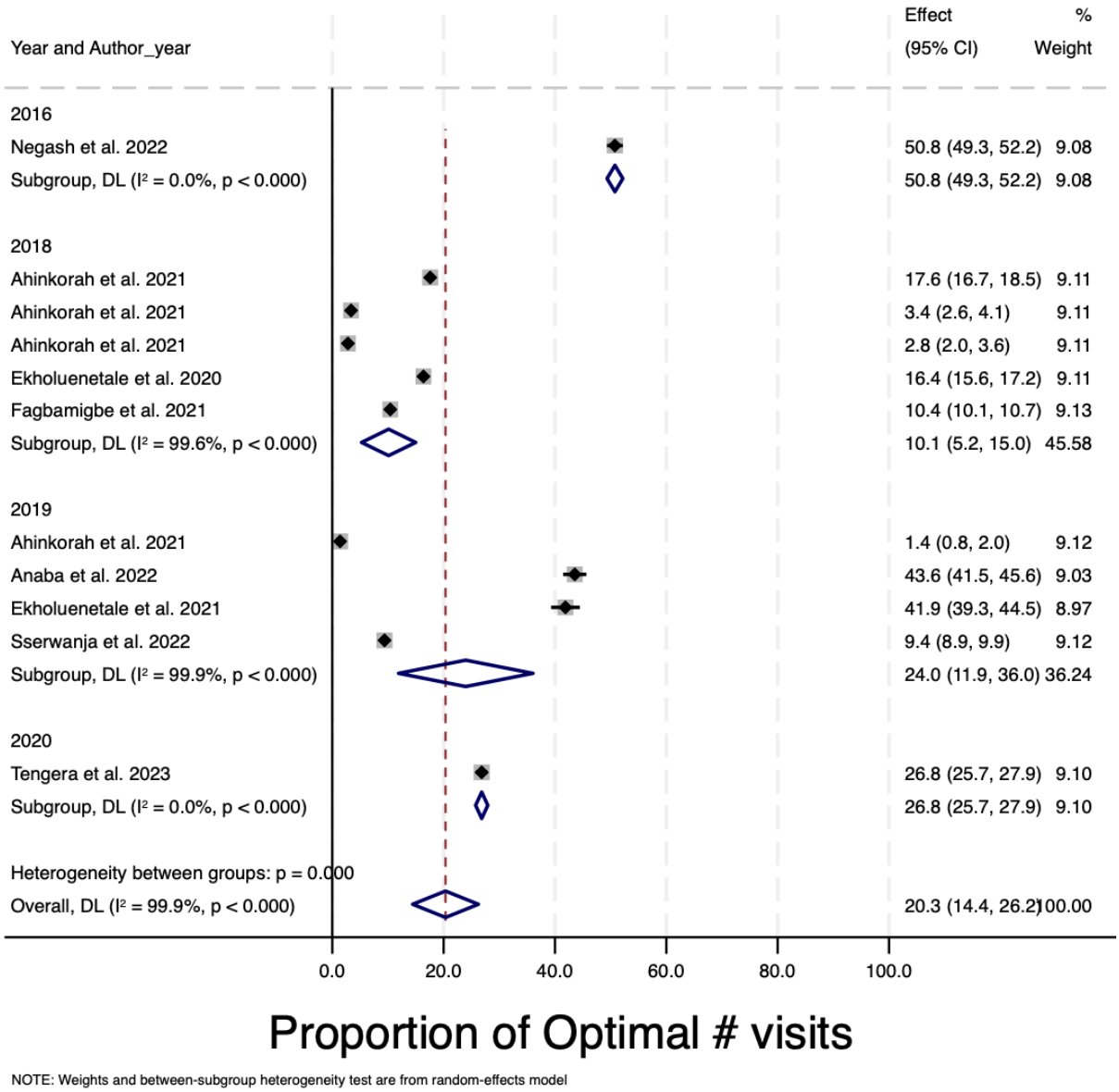


Figure 12 Forest plot on proportion of ANC visits (8 or ANC visits during pregnancy) among women of reproductive age in Sub-Saharan Africa by year of study.

The studies were organized according to the years in which they were conducted, with each study's effect size, confidence interval, and percentage weight within its respective subgroup provided. These subgroups represented studies conducted in distinct years, with the aggregated effect size and confidence interval calculated within each subgroup using the DerSimonian-Laird (DL) method.

The overall effect size, computed across all years, was documented as 20.3% (95% CI: 14.4, 26.2). This overarching effect size offers a comprehensive estimation of the impact of ANC (ANC) utilization across varying years. To scrutinize the significance of the effect size within each year subgroup, tests of subgroup effect size wre conducted. Significant z-values with

corresponding p-values <0.001 indicate the statistical significance of effect sizes within each specific year subgroup.

Cochran's Q statistics for heterogeneity were presented for each year subgroup, delineating the extent of variation in effect sizes among studies within the same year. Additionally, heterogeneity measures for the overall dataset were reported, revealing substantial variability in effect sizes across different years. The meta-analysis elucidated notable variation in effect sizes across various years. Despite this observed heterogeneity, the overall effect size retains significance, suggesting a consistent influence of the recommended number of ANC visits across diverse years.

4.2. Factors associated with ANC utilization.

This section summarizes factors associated with ANC (ANC) utilization, categorized into predisposing, enabling, and need factors based on the Andersen's Behavioral Model of Health Service Use Figure 1 (Page 12).

Table 3 Number of studies reporting the factors associated with ANC utilization in included studies.

Factors associated with ANC utilization	Number of studies (n)	Frequency (%)
Predisposing factors		
Maternal age	15	100.0%
Maternal education	14	93.3%
Partner's education	6	40.0%
Employment status	8	53.3%
Marital status	12	80.0%
Household size	4	26.7%
Religion	7	46.7%
Ethnicity	3	20.0%
Household headship	3	20.0%
Birth order	6	40.0%
Media exposure	7	46.7%
Enabling factors		
Access/distance:	7	46.7%
Patient management/satisfaction:	1	6.7%
Residence/Location	15	100.0%
Wealth index/quintile	11	73.3%
Women's autonomy	2	13.3%
Need factors.		
Health insurance	7	46.7%
Parity	9	60.0%

4.2.1. Predisposing factors

These encompass demographic and sociocultural attributes predisposing individuals to seek ANC services. Maternal age emerged as a prominent predisposing factor across all studies, exhibiting a prevalence of 100.0%. Maternal education followed closely, with 93.3% prevalence across 14 studies, underscoring its significance in influencing ANC utilization. Partner's education, though observed in a lesser proportion of studies (40.0%), still demonstrated a noteworthy impact on ANC attendance. Employment status, marital status, and religion were also influential, with prevalence rates of 53.3%, 80.0%, and 46.7%, respectively. Conversely, household size, ethnicity, household headship, and birth order exhibited lower prevalence rates, indicating varying degrees of influence on ANC utilization.

4.2.2. Enabling factors

Those that encompass elements facilitating or hindering ANC access. Access/distance emerged as a significant enabling factor, with a prevalence of 46.7% across seven studies, highlighting the pivotal role of geographical proximity in ANC utilization. Similarly, residence/location exhibited ubiquitous influence, with a prevalence of 100.0%, accentuating the importance of geographic context in ANC access. Wealth index/quintile was also identified as a critical enabling factor, prevalent in 73.3% of studies, suggesting socioeconomic status as a determinant of ANC utilization. However, patient management/satisfaction and women's autonomy exhibited lower prevalence rates, suggesting relatively lesser impact on ANC utilization compared to other enabling factors.

4.2.3. Need factors.

Encompasses elements reflecting individuals' perceived or actual need for ANC services. Health insurance and parity emerged as salient need factors, with prevalence rates of 46.7% and 60.0%, respectively, across seven and nine studies. These findings underscore the interplay between healthcare financing mechanisms and individuals' reproductive histories in shaping ANC utilization patterns.

4.3. Factors associated with ANC utilization by regions.

Most studies were conducted in both the Western and Eastern parts of sub-Sahara with all studies reporting on maternal age as a leading factor in utilization of ANC. This was followed by maternal education marked by the magnitude of studies reporting it as a predisposing factor. The (Table 4) below summaries the identified factors by regions in the sub-Saharan Africa.

Table 4 Summary of factors identified by region in sub-Saharan Africa based on the included studies.

Factors	Number of studies and frequency (%) by regions of SSA			
	(C)	(W)	(E)	(S)
Predisposing factors				
Maternal age	1 (6.67%)	12 (80%)	12 (80%)	2 (13.33%)
Maternal education	1 (6.67%)	8 (53.3%)	11 (73.3%)	2 (13.33%)
Partner's education	1 (6.67%)	8 (53.3%)	9 (60%)	1 (6.67%)
Employment status	1 (6.67%)	6 (40%)	8 (53.3%)	2 (13.33%)
Marital status	0 (0%)	3 (20%)	6 (40%)	1 (6.67%)
Religion	0 (0%)	8 (53.3%)	2 (13.33%)	0 (0%)
Ethnicity	0 (0%)	2 (13.3%)	1 (6.67%)	0 (0%)
Household headship	0 (0%)	4 (26.67%)	2 (13.33%)	0 (0%)
Household size	0 (0%)	1 (6.67%)	3 (20%)	0 (0%)
Birth order	1 (6.67%)	8 (53.3%)	8 (53.3%)	1 (6.67%)
Media exposure	1 (6.67%)	7 (46.67%)	5 (33.33%)	2 (13.33%)
Enabling factors				
Access/distance:	1 (6.67%)	6 (40%)	8 (53.3%)	2 (13.33%)
Satisfaction	0 (0%)	0 (0%)	1 (6.67%)	0 (0%)
Residence	1 (6.67%)	11 (73.33%)	12 (80%)	2 (13.33%)
Wealth index/quintile	1 (6.67%)	10 (66.67%)	11 (73.3%)	2 (13.33%)
Women's autonomy	0 (0%)	3 (20%)	0 (0%)	0 (0%)
Need factors.				
Parity	0 (0%)	5 (33.33%)	2 (13.33%)	1 (6.67%)
Health insurance	0 (0%)	7 (46.67%)	4 (26.67%)	0 (0%)

***SSA regions:** **C=central.** **W=west.** **E=east** **S=south**

4.3.1. Predisposing Factors

In exploring predisposing factors across sub-Saharan Africa (SSA), notable variations were observed among different regions. Maternal age emerged as a commonly investigated factor across the Western (W), Eastern (E), and Southern (S) regions, with prevalence rates of 80%, 80%, and 13.3% respectively, while it was less frequently studied in the Central (C) region, with only one study representing 6.7% of the total. Maternal education exhibited a similar trend, being extensively examined in the Western, Eastern, and Southern regions, with prevalence rates of 53.3%, 73.3%, and 13.3% respectively. Partner's education, employment status, and media exposure displayed parallel patterns, with varying degrees of emphasis across the regions.

4.3.2. Enabling Factors

Regarding enabling factors, access/distance and residence emerged as pivotal aspects investigated across all regions, with prevalence rates of 6.67% to 80%. Similarly, wealth index/quintile was a recurring theme in studies across Western, Eastern, and Southern regions, indicating its significance in understanding ANC utilization. However, satisfaction and women's autonomy were less commonly explored, warranting further investigation to elucidate their roles in facilitating or hindering access to ANC services.

4.3.3. Need Factors

Parity and health insurance were less consistently examined across the regions, indicating potential variations in their perceived importance or availability across different contexts within SSA. While health insurance was more frequently studied in the Western and Southern regions, parity exhibited higher prevalence rates in the Western and Eastern regions. These findings underscore the need for nuanced approaches to address diverse needs and challenges in promoting ANC utilization across SSA.

Overall, the results underscore the multifaceted nature of factors influencing ANC utilization, encompassing demographic, sociocultural, economic, and healthcare-related dimensions. These findings provide valuable insights for policymakers and healthcare practitioners aiming to enhance ANC uptake and maternal health outcomes.

Chapter 5. Discussion

This systematic review and meta-analysis aimed to describe the levels of ANC utilization and determine factors associated with ANC utilization among women of reproductive age in sub-Saharan Africa from 2016-2023. In this study, the overall pooled ANC utilization prevalence estimates based on attendance, timing of the first ANC visit within the first 3months of pregnancy and the number of 8 or more ANC visits were 59.1, 36.8% and, 20.3% respectively.

The ANC utilization was influenced by predisposing factors such as (maternal age, maternal education, Partner's education**,** employment status**,** marital status**,** religion, ethnicity**,** household headship**,** media exposure), enabling factors were (access/distance, patient management/satisfaction, residence/Location, wealth index/quintile**,** health insurance**,** women's autonomy/healthcare decision) and a need factor (parity).

The identified studies included for analysis were cross-sectional studies and secondary data analysis from the national demographic health surveys (DHS). This review highlights the complex interplay between these themes in determining the utilization of ANC services. This underscores the importance of addressing these factors when designing interventions and policies aimed at improving ANC utilization rates and maternal healthcare outcomes.

The discussion chapter delves into the multifaceted factors influencing ANC utilization in Sub-Saharan Africa, as highlighted in the preceding sections. Predisposing, enabling, and need factors collectively shape the landscape of ANC attendance, reflecting a complex interplay of demographic, sociocultural, and healthcare-related determinants.

Maternal age and parity are critical factors influencing ANC utilization, reflecting distinct dynamics in maternal health-seeking behaviors. Younger mothers often encounter obstacles such as lack of awareness and financial constraints, impeding their access to ANC services despite their need (35–37,59,61–71). Conversely, older mothers, benefiting from maturity and previous childbirth experiences, are more inclined to prioritize ANC to safeguard maternal and fetal well-being (28,48,72).

These findings underscore the necessity for targeted interventions aimed at adolescents and young adults promoting ANC awareness and dispelling misconceptions through education campaigns and community-based healthcare initiatives (73,74) Additionally, recognizing parity as a determinant, multiparous women demonstrate heightened maternal health literacy and

assertiveness in seeking ANC, suggesting tailored approaches that accommodate their specific needs and preferences are crucial (75). Efforts addressing socioeconomic disparities and enhancing healthcare access are pivotal in ensuring equitable ANC utilization across diverse maternal demographics (76–78)

Despite the positive association observed in this study, it is essential to recognize the potential limitations and contextual nuances surrounding the relationship between parity and ANC utilization. Factors such as cultural beliefs, socioeconomic status, and access to healthcare resources may modulate the influence of parity on ANC attendance, warranting further investigation into the underlying mechanisms driving this association.

The prevalence of maternal education as a determinant of ANC attendance as reported by 14 studies (35–37,59,63–65,67–71,79) echoes the profound impact of educational attainment on health literacy, awareness, and empowerment. Educated mothers are more likely to possess the knowledge and understanding of the importance of ANC in ensuring maternal and fetal well-being, thereby exhibiting higher rates of ANC utilization (78,80,81). The prevalence rate of maternal education as a predisposing factor underscores its significance in influencing ANC utilization, emphasizing the need for targeted interventions aimed at improving educational opportunities for women in underserved communities.

Furthermore, the observed association between maternal education and ANC attendance highlights the intricate interplay between socio-economic status and healthcare access. Maternal education serves as a proxy for socio-economic status, with higher educational attainment often associated with improved access to healthcare services, including ANC (36,37,59,70). By equipping women with the knowledge and skills necessary to navigate the healthcare system, education empowers them to make informed decisions regarding their health and that of their unborn child, thereby enhancing ANC utilization rates (82).

However, it is imperative to recognize that the association between maternal education and ANC utilization is not devoid of challenges. Disparities in educational opportunities and access persist, particularly in resource-constrained settings, where socio-economic factors intersect to create barriers to education (81). Addressing these barriers requires a multifaceted approach that encompasses not only educational interventions, but also structural reforms aimed at promoting gender equality and socio-economic empowerment.

Moreover, while maternal education emerges as a prominent predictor of ANC utilization, it is essential to acknowledge the presence of other contextual factors that may influence

healthcare-seeking behaviors. Sociocultural norms, geographical accessibility, and healthcare infrastructure play pivotal roles in shaping ANC utilization patterns, necessitating a holistic approach to address the complex web of determinants.

This study illustrated that age influenced the healthcare seeking behavior and utilization in that younger girls aged 15-19years had reduced odds of timely ANC booking and underutilized the services with the same pattern observed among women aged 35-49years compared to women aged 20-34 years (35). This finding is corroborated by another study on prevalence and factors influencing early ANC booking among women of reproductive age in Tanzania (28,72). Those aged 20-34 years significantly utilized ANC more optimally compared to women of age groups 15-19 and 35-49 years.

There is existing literature that consistently demonstrated the impact of marital status on maternal healthcare-seeking behavior, with married women often exhibiting higher rates of ANC attendance compared to their unmarried counterparts (83,84). This was reported by this review where 80% of the included studies reported marital status as a significant factor associated with ANC utilization (36,62,63,65,67–71,79). This trend underscores the role of marital status as a facilitator of ANC access, providing married women with a support system that encourages and enables healthcare-seeking behaviors during pregnancy.

Being married renders partner support and awareness of the ANC benefit to both the mother and the child, whereas single mothers would likely lack support (71). This study found that being married positively influenced ANC utilization with 64% increased odds relative to being single, unmarried or without a partner. Furthermore, being married entails a guaranteed social support and resources where married women or those in stable partnerships often have better access to social support and resources (85,86). They may have a partner who can provide emotional and financial support, making it easier for them to seek and afford ANC services.

Additionally, having a partner can reduce feelings of isolation during pregnancy especially where spouse escorts is mandatory. Single or unpartnered pregnant women may lack the same level of social support and resources. They may face financial constraints, as well as challenges in arranging transportation to healthcare facilities. These barriers can result in delayed or inadequate ANC utilization. Bedaso et al, reported that non-partnered women had 4times more odds of delayed ANC utilization as opposed to married women, due to low social support (87) while another qualitative study by Tanner et al., demonstrated the importance of partner involvement in maternal health to improve utilization (85) and Phiri et al., found similar results (86).

The association between marital status and ANC utilization is not well established as there is conflicting evidence in their correlation. Research shows that married or partnered women may have more autonomy and decision-making power when it comes to their healthcare choices (84). They can collaborate with their partners in making decisions about ANC and have someone to accompany them to appointments. Single pregnant women may face challenges in decision-making, especially if they lack support from family or friends. They may have to navigate the healthcare system on their own, which can be daunting and discouraging (88).

In some cultures, or communities, there may be social norms that promote ANC among married women as it is seen as a responsible and expected behavior. These norms can positively influence utilization rates (83,89). In contrast, single women may face stigma or judgment, especially in communities where premarital pregnancy is stigmatized. This stigma can deter them from seeking ANC, as they may fear discrimination or negative reactions from healthcare providers and society.

Women in stable marriages or partnerships may be more financially stable, which can facilitate access to ANC services. They are more likely to have consistent income and insurance coverage, reducing financial barriers to care (74,90,91). Single pregnant women may struggle financially, making it difficult to afford ANC. The cost of medical appointments, tests, and transportation can pose significant challenges, leading to delayed or irregular care.

Additionally, emotional well-being can positively impact ANC utilization. Women with supportive partners tend to experience lower stress levels during pregnancy, which can encourage them to seek and attend appointments. In contrast, single pregnant women may experience higher levels of stress or emotional challenges due to the absence of a partner or support system. This can affect their motivation to engage in ANC.

In this study, Christianity religious group was positively associated with optimum ANC utilization with almost 1 in 3 women compared to other religious groups such as Muslims and traditionalists. Religion can have a significant influence on antenatal as noted from the results of this study. In a study by Fagbamigbe et al., similar results were reported, although Muslim women were the majority of the participants, majority (37.1%) of Christian women attained 8+ ANC as recommended by the WHO (66) while Ekholuenetale et al., reported 41.5% of Christian women attended 8+ ANC visits (62).

This influence can be both positive and negative, and it varies depending on the specific religious beliefs, practices, and cultural contexts. In many religious traditions, the sanctity of life and the well-being of children are highly emphasized. These values can encourage expectant mothers to seek ANC as a means of ensuring the health and safety of the unborn child (92). Religious teachings often promote care for the vulnerable, and this includes pregnant women and their babies.

Moreover, some religious beliefs may emphasize faith-based healing or divine intervention over medical care (93). In such cases, expectant mothers might be hesitant to seek conventional ANC, believing that their faith will protect them and their child. This can potentially lead to delayed or inadequate prenatal care.

Religious communities often provide strong social support networks (94). Expectant mothers who are part of religious communities may receive emotional and practical support during pregnancy, which can include encouragement to attend ANC appointments. In some cases, religious communities may exert pressure on women to conform to certain practices or beliefs, which could discourage them from accessing ANC if it conflicts with religious teachings.

In regions where, religious organizations are actively involved in healthcare delivery, they can provide ANC services that align with religious and cultural values (80). This can make expectant mothers more comfortable seeking care from these facilities. Conversely, religious health facilities may prioritize faith-based practices over evidence-based medicine, potentially leading to suboptimal care (95). Additionally, access to care may be limited to those who share the same religious affiliation.

Wealth index is a significant socioeconomic factor that can strongly influence ANC utilization as yielded by the results of this systematic review (35,37,60,63,66–69,71). In this study, the rich had a positive association with 1 in 3 rich women of the higher social class exuding optimum ANC utilization. This is corroborated by other studies noting that wealthier individuals typically have better access to healthcare services, including ANC and quality care.

They are more likely to afford the costs associated with prenatal visits, transportation to healthcare facilities, and medical tests (96–98). On the other hand, individuals with lower wealth may struggle to access healthcare due to financial constraints. This can result in delayed or inadequate ANC, as they may prioritize basic needs over healthcare expenses (99). This may further exacerbate suboptimal ANC utilization.

Wealthier individuals tend to have higher levels of education and health literacy. This can lead to greater awareness of the importance of ANC, making them more likely to seek and utilize these services (78). Those with lower wealth may have limited access to education and health information. Lack of awareness about the benefits of ANC and the potential risks of not seeking care can deter them from utilizing these services.

The concept of "family headship" which in this context refers to the traditional or cultural norm in many societies where one individual, often the male in African culture, assumes the role of the family's primary decision-maker and provider. The concept of family headship was associated with ANC utilization as noted in 6 studies included for synthesis (62,65,66,69,100,101). Majority of women, accounting to almost 3 in 5 were observed to utilize the ANC services were from male lead households in this study.

The family headship plays a crucial role in decision making towards healthcare utilization which was reported to be associated with ANC. The head of the family may play a responsible and supportive role in ensuring that pregnant women receive proper ANC while prioritizing the health and well-being of both a pregnant woman and her unborn baby, encouraging timely ANC seeking.

Family heads who are more conversant and healthcare literate among men may actively promote and facilitate healthcare-seeking behaviors among pregnant women, however 1 qualitative study conducted in Ghana on male involvement in maternal healthcare cited that health seeking behavior among women was influenced by male skepticism and lack of support during ANC, resulted in delayed ANC booking (102). This may be true where the male household lead bares the financial responsibilities.

Ethnicity is a significant factor that can influence ANC utilization, and its impact on maternal healthcare outcomes is complex and multifaceted. Ethnicity can affect ANC utilization through various mechanisms, including cultural beliefs and practices, socioeconomic factors, discrimination, and access to healthcare services. In this study, ethnicity was found to be associated with the number of ANC visits (35,64,66,68) with the black ethnic group showing a positive association with 7 in 10 of black women observed to adequately utilize ANC.

Similar results were found from a cross-sectional study conducted in Togo on socioeconomic and cultural factors associated with maternal healthcare (77) and 1 in Ethiopia (103). This may be since ethnic communities often have unique cultural beliefs and practices related to pregnancy and childbirth. Often, cultural beliefs may sometimes hinder ANC utilization. Some

ethnic communities may have traditional healers or alternative medicine practices that conflict with Western medical approaches.

Ethnic minority women and those below the socio-economic gradient may experience discrimination, racism, or bias within the healthcare system which may create mistrust and deter them from seeking ANC (104). Fear of judgment or unequal treatment can be significant barriers to optimum ANC utilization. Coupled with language and geographical barriers, these factors can have detrimental health outcomes on pregnant women. Culturally competent healthcare providers and policies that aim to reduce healthcare disparities are critical steps in improving maternal health outcomes across diverse ethnic populations.

Another important factor which was found to be associated with ANC utilization was parity (35,47,59,60,62,63,65–67,69,100,101), which refers to the number of pregnancies a woman has experienced, is a significant factor that can influence ANC utilization. It plays a crucial role in shaping a woman's decision to seek and engage in ANC during her pregnancy. In this study, women with less than 5 children had higher odds of ANC utilization with the majority observed among women of parity 1-2, with 1 in 3 women reported from the results of this review. This is consistent with the correlates study that was conducted in sub-Saharan Africa (76)

This may be due to resource limitations secondary to the size of the of the family (65,69). High-parity women may face resource constraints, such as time and financial limitations, which can influence their decision to seek ANC. They might balance the need for care with their existing family and work responsibilities.

Conversely, a recent study conducted in Rwanda on predictors for achieving adequate ANC in pregnant women (105) found that women with 5 and more children attained adequate ANC compared to other women of different parity groups. This may be because women with multiple pregnancies may have a heightened awareness of potential pregnancy complications based on their past experiences. This awareness can lead to increased ANC utilization, particularly if they have encountered issues such as preterm birth or gestational diabetes in previous pregnancies.

Furthermore, women with high parity may have diverse attitudes toward ANC. Some may become more self-reliant and confident in managing their pregnancies without frequent medical visits, while others may continue to prioritize regular care, especially if they have experienced complications in previous pregnancies. In essence, parity is a complex factor that influences ANC utilization. Women's decisions regarding when and how often to seek ANC

are influenced by their previous pregnancy experiences, risk awareness, cultural factors, societal norms, and healthcare system factors.

Media exposure, including television, radio, social media, and other forms of communication, can play a significant role in influencing ANC utilization. The impact of media exposure on ANC can be both positive and negative, depending on the content, accessibility, and credibility of the information conveyed. This study found that media exposure was positively associated with ANC uptake (47,65,68,100,106). According to the results of this review, about 3 in 5 women has access to media. This finding was similar to a study from Nepal (107).

Occasionally, media may perpetuate social stigma around pregnancy, especially for unmarried or teenage mothers who are observed to underutilize maternal healthcare (45). This stigma can deter women from seeking ANC due to fear of judgment or discrimination. Moreover, Media can reinforce cultural and social pressures on women to conform to certain beauty standards during pregnancy (108). This can lead to body image concerns and reluctance to engage with healthcare providers.

Maternal education was reported in 16 studies to have a direct correlation with ANC (ANC) utilization and its impact on ANC attendance is multifaceted (35,47,59,60,62–69,71,100,101,109). This association was widely shown in various studies, of note are (81,110) conducted in sub-Saharan Africa with similar findings from the included studies in this review. Maternal education increases awareness and knowledge about the importance of ANC. This study found that women with formal education using secondary level and above showed positive correlation with ANC utilization. It showed that 1 in 3 women accessing ANC and adequately utilizing the services had formal education.

According to the results of this review, educated mothers often have more decision-making autonomy, which facilitates informed choices about their health-seeking behavior and therefore may independently seek ANC services. Maternal education can enhance economic empowerment and income-earning opportunities. This financial independence can make it easier for women to afford ANC services, including transportation costs and medical expenses as noted from this study (35,67,69,71) on employment status. A multicounty study noted that women with formal education had higher odds of optimum ANC utilization compared to other women with no formal education (78) which aligns with the findings of this study.

Health insurance was found to be associated with ANC utilization in 6 studies included in this review (35,37,62,66,67,71). Women who were insured were reported to access and utilize ANC. The pooled prevalence proportions for insured women from this study were This is a significant factor where health access and affordability can pose grave challenges towards ANC utilization, gravitating towards suboptimal utilization and compromised quality of care. Health insurance can provide women with financial protection, making ANC services more affordable and accessible. With insurance coverage, women are more likely to seek care early in pregnancy and attend the recommended number of ANC visits.

In many Sub-Saharan African countries, out-of-pocket payments for healthcare services, including ANC, can be a significant barrier to access (111). Health insurance can help reduce these financial barriers by covering the costs of ANC services, such as consultations, laboratory tests, and medications. Health insurance coverage often promotes a culture of regular healthcare utilization. These findings were similar with a study on migrant workers in China (112) . In a nutshell, women with insurance are more likely to view ANC as an essential component of their pregnancy care and are, therefore, more likely to attend ANC visits as recommended.

Although access to health insurance has been proven to have a positive impact on healthcare utilization, those without access may be reluctant to comply with the recommended ANC visits. A scoping review on barriers and facilitators to healthcare conducted in sub-Saharan Africa agrees with this notion (111). This therefore impacts on uptake of ANC and results in sub-optimal utilization of ANC.

The association between health insurance and ANC utilization in Sub-Saharan Africa is generally positive, as insurance coverage can reduce financial barriers and promote timely and regular care. However, it is essential to consider variations in insurance schemes, quality of care, and socioeconomic factors that can influence how health insurance affects ANC utilization in different contexts within the region.

The distance and access to healthcare services are critical factors associated on the utilization of ANC (ANC) in Sub-Saharan Africa. This significant factor was reported from 7 studies included in this review (60,65–67,71,101,109). The region faces unique challenges related to geographical barriers, infrastructure, and healthcare delivery, which can impact the use of ANC services. In many parts of Sub-Saharan Africa, particularly in rural areas, health facilities may be far away with challenging terrain from the homes of pregnant women (113). According

to the results of this review, 1 in 3 women utilizing ANC reported a big problem in health care access.

The long distances and lack of transportation infrastructure can deter pregnant women from seeking ANC services (114). This inevitably imposes undesirable health outcomes for pregnant women and their unborn children. Afaya et al, reported that majority of women with distance challenges had heightened odds of underutilization of ANC (27). Another study conducted in Nigeria reported similar findings (26) and another in Tanzania (115). This is consistent with the findings of this study.

In remote areas, health facilities may offer limited ANC services, which can discourage women from seeking care if they believe that the services provided are insufficient. This was reported in a study conducted on barriers to suing ANC services in the rural parts of Zimbabwe (116). Perceptions of the quality of care at healthcare facilities is multifaceted and can positively or negatively influence ANC utilization.

Lower socioeconomic status and limited education are associated with decreased ANC utilization. These factors can intersect with distance and access challenges, making it more difficult for disadvantaged women to access care. To improve healthcare access and utilization, community-based interventions should be prioritized where women are serviced closer to their homes. The concept of mobile clinics and transport subsidies may assist in ensuring services are offered to pregnant women at their footsteps.

The place of residence is a significant factor associated with ANC (ANC) utilization in Sub-Saharan Africa, where access to healthcare services varies widely between urban and rural areas (35,65–69,100,101). These findings were consistent with the findings of these studies (26,33) while Yaya et al, reported that although rural women reported late for ANC, they were less likely to attain inadequate visits (29). In general, urban areas tend to have better access to healthcare facilities, including clinics and hospitals.

Subsequently, women living in urban areas are more likely to have greater access to ANC services. The results of this review showed that 1 in 2 women from rural areas utilized ANC optimally. In hindsight, rural areas often face significant challenges in terms of healthcare infrastructure, transportation, and healthcare workforce shortages. Women in rural areas may have limited access to ANC services, leading to lower utilization rates. The physical distance between a woman's residence and the nearest healthcare facility offering ANC services can greatly impact her likelihood of seeking care.

In rural areas with few healthcare facilities, women may need to travel long distances to access care, which can be a barrier. In many rural areas of Sub-Saharan Africa, poor road infrastructure and limited availability of public transportation can make it difficult for pregnant women to reach healthcare facilities for ANC appointments. Lack of reliable transportation can discourage utilization.

Rural healthcare facilities may also face challenges, including inadequate staffing, equipment, and supplies, which can affect the quality of ANC services and influence utilization (113,114). Rural areas in Sub-Saharan Africa often have higher poverty rates, and poverty can be a significant barrier to ANC utilization. Poor households may struggle to afford transportation costs, and women may delay or avoid care due to financial constraints. Rural populations may have lower levels of education, which can contribute to limited awareness of the importance of ANC and a lack of understanding about its benefits.

The place of residence significantly influences ANC utilization, with rural areas often facing more significant challenges in access to and utilization of ANC services. Addressing these disparities requires a multifaceted strategy incorporating improvement in unfractured, awareness and education, and addressing socioeconomic and cultural factors that impact health seeking behavior.

The timing and frequency of ANC (ANC) visits are crucial factors associated with ANC utilization in sub-Saharan Africa (SSA) (60,63,66,69,109). The results of this review showed that 1 in 3 women reported for ANC in the first trimester of their pregnancy (<12 weeks). This is one of the complex factors in this study as there was observed intersectionality between sociocultural, economic, and geographical factors. As cited in a study by Chijioke (117), women below the social gradient underutilized the ANC services.

In many SSA cultures, decisions about healthcare are often made by family members or elders (110). This can affect when a pregnant woman seeks ANC and how frequently she attends which also influences how ANC is utilized. The timing and frequency have been reported in various studies and the associated factors detailed out. The maternal age (29) with older women seeking timely booking as opposed to younger girls, was found to influence ANC timing and frequency.

In rural areas of SSA, long distances to healthcare facilities and lack of transportation options can delay the initiation of ANC and make frequent visits challenging (118). Poverty and the

cost of healthcare services can daunt pregnant women from attending ANC visits, especially if they need to pay for services or transportation where out-of-pocket method of payment remains prevalent.

The availability of healthcare facilities and skilled healthcare providers can affect ANC utilization. In some remote areas, facilities may be scarce or inadequately staffed. Concerns about the quality of care provided at healthcare facilities can discourage women from attending ANC visits. This includes issues related to staff attitudes, waiting times, and perceived neglect.

Differences in national ANC guidelines and policies can influence women's understanding of when and how often they should access ANC visits. The timing and frequency of ANC visits in sub-Saharan Africa are influenced by a complex interplay of cultural, economic, geographic, and healthcare system factors (8,50,77). To improve ANC utilization in the region, it is essential to address these factors through targeted interventions, such as community education, reducing financial barriers, improving healthcare infrastructure, and promoting culturally sensitive care. Ensuring that women have access to early and regular ANC is critical for improving maternal and child health outcomes in SSA.

Subsequently, addressing these multifaceted determinants requires comprehensive, evidence-based interventions tailored to the sociocultural, economic, and geographic contexts of diverse communities. By addressing barriers and enhancing facilitators of ANC access, policymakers and healthcare providers can promote equitable access to quality maternal healthcare services and ultimately improve maternal and neonatal health outcomes across the region.

5.1. Limitations

Language barriers where studies written in languages other than English were excluded from the study synthesis as there was no interpreter. A reduced number of studies (sample size) where articles that did not meet the eligibility criteria were excluded including qualitative studies. One study that met the inclusion criteria could not be used for meta-analysis due to its aggregated data.

5.2. Strengths of the study

The databases used for this review were a considerable number ascertaining the robustness of the studies obtained. This review further incorporated the subgroup analysis based on the outcome definition to highlight the prevalence effect estimates across the different subgroups.

This review is the first after the revision of ANC visits from four to eight or more by the WHO in 2016.

Chapter 5. Conclusion and recommendations

The journey through the intricate landscape of ANC (ANC) utilization has illuminated a myriad of factors shaping maternal healthcare-seeking behavior. From predisposing factors rooted in demographic and sociocultural attributes to enabling factors facilitating ANC access and need factors reflecting individuals perceived or actual healthcare needs, the discourse surrounding ANC utilization has been rich and multifaceted.

This study based on existing research has highlighted the pivotal role of maternal age, education, marital status, and socioeconomic status as influential determinants of ANC utilization. These factors, intertwined with broader social dynamics and cultural norms, paint a complex picture of maternal healthcare-seeking behavior, emphasizing the need for targeted interventions that address the diverse needs of women across different socioeconomic strata and cultural contexts.

It is imperative to recognize that the quest for improved ANC utilization transcends mere statistical analyses and prevalence rates. It is a call to action from the direct service delivery partners, implementing partner ministers and their District Health Management Teams-a call to dismantle the barriers that impede access to essential maternal healthcare services and to build bridges that foster inclusivity, equity, and empowerment for all women, regardless of their social, economic, or cultural backgrounds.

In light of these findings and insights gleaned from this study on ANC utilization and its associated factors, the Ministers of Health, in collaboration with the District Health Management Teams and supporting partners need to develop and implement culturally sensitive education and awareness campaigns aiming at promoting the importance of ANC utilization, particularly among marginalized and underserved communities. These campaigns should emphasize the benefits of early and regular ANC attendance for positive maternal and child health outcomes.

Sub-Saharan African countries should invest in strengthening healthcare infrastructure and human resources to improve the availability, accessibility, and quality of ANC services. They should foster community engagement and empowerment initiatives that empower women to make informed decisions about their maternal healthcare. This can involve establishing

community-based support groups, engaging community leaders as advocates for maternal health, and addressing social determinants of health that impact ANC utilization.

The countries should leverage on the country's domestic funds and provide financial support, incentives to mitigate the economic barriers that hinder ANC utilization, such as transportation costs, out-of-pocket expenses, and lost wages. This can include cash transfer programs, vouchers for ANC services, and incentives for healthcare providers who deliver quality ANC services.

Furthermore, SSA should prioritize research and evaluation efforts to continuously monitor and evaluate ANC utilization patterns, identify emerging trends and barriers, and inform evidence-based interventions. This includes conducting longitudinal studies, implementing rigorous monitoring and evaluation frameworks, and fostering collaboration between researchers, policymakers, and healthcare providers.

By embracing these recommendations and forging a collective commitment to maternal health, we can pave the way for a future where every woman has equitable access to high-quality ANC services, where every pregnancy is nurtured with care and compassion, and where every child has the opportunity to thrive from the very beginning of life. Together, let us embark on this transformative journey towards a brighter, healthier future for mothers and their children.

References

1. Adedokun ST, Yaya S. Correlates of antenatal care utilization among women of reproductive age in sub-Saharan Africa: evidence from multinomial analysis of demographic and health surveys (2010–2018) from 31 countries. Archives of Public Health. 2020;78(1):1–10.
2. Huck W. Goal 3 Ensure healthy lives and promote well-being for all at all ages. Sustainable Development Goals. 2022;153–81.
3. Andegiorgish AK, Elhoumed M, Qi Q, Zhu Z, Zeng L. Determinants of antenatal care use in nine sub-Saharan African countries: a statistical analysis of cross-sectional data from Demographic and Health Surveys. BMJ Open. 2022;12(2):1–13.
4. Moller AB, Petzold M, Chou D, Say L. Early antenatal care visit: a systematic analysis of regional and global levels and trends of coverage from 1990 to 2013. Lancet Glob Health. 2017;5(10):e977–83.
5. World Health Organization. WHO recommendations for antenatal care for positive experience. 2016;
6. Yaya S, Zegeye B, Ahinkorah BO, Seidu AA, Ameyaw EK, Adjei NK, et al. Predictors of skilled birth attendance among married women in Cameroon : further analysis of 2018 Cameroon Demographic and Health Survey. Reprod Health [Internet]. 2021;1–12. Available from: https://doi.org/10.1186/s12889-022-13037-8
7. Girum T, Wasie A. Correlates of maternal mortality in developing countries: an ecological study in 82 countries. Matern Health Neonatol Perinatol. 2017;3(1):1–6.
8. Okedo-Alex IN, Akamike IC, Ezeanosike OB, Uneke CJ. Determinants of antenatal care utilisation in sub-Saharan Africa: A systematic review. BMJ Open. 2019;9(10).
9. Duodu PA, Bayuo J, Mensah JA, Aduse-Poku L, Arthur-Holmes F, Dzomeku VM, et al. Trends in antenatal care visits and associated factors in Ghana from 2006 to 2018. BMC Pregnancy Childbirth [Internet]. 2022;22(1). Available from: https://doi.org/10.1186/s12884-022-04404-9
10. UNICEF. The State of the World's Children 2009 [Internet]. State of the World's Children. UN; 2009 [cited 2024 Jul 1]. (State of the World's Children). Available from: https://www.un-ilibrary.org/content/books/9789210597555
11. STANDARDS FOR IMPROVING QUALITY OF MATERNAL AND NEWBORN CARE IN HEALTH FACILITIES.
12. Makuta CM, Du Toit HS. Factors influencing the utilisation of maternal and child health care services in Balaka District of Malawi. Afr J Nurs Midwifery. 2016;18(1):61–77.
13. Miller S, Abalos E, Chamillard M, Ciapponi A, Colaci D, Comandé D, et al. Beyond too little, too late and too much, too soon: a pathway towards evidence-based, respectful maternity care worldwide. The Lancet. 2016;388(10056):2176–92.
14. Helleringer S, Duthé G, Kanté AM, Andro A, Sokhna C, Trape JF, et al. Misclassification of pregnancy-related deaths in adult mortality surveys: Case study in Senegal. Tropical Medicine and International Health. 2013;18(1):27–34.
15. Raatikainen K, Heiskanen N, Heinonen S. Under-attending free antenatal care is associated with adverse pregnancy outcomes. BMC Public Health. 2007;7.
16. Bauserman M, Lokangaka A, Thorsten V, Tshefu A, Goudar SS, Esamai F, et al. Risk factors for maternal death and trends in maternal mortality in low- and middle-income countries: A prospective longitudinal cohort analysis. Reprod Health [Internet]. 2015;12(2):S5. Available from: http://www.reproductive-health-journal.com/content/12/S2/S5

17. Raïssa Kourouma K, Agbre-Yacé ML, Doukouré D, Tano-Kamelan A, Soltié Coulibaly-Koné A, Félix N'dia A, et al. Feasibility of the eight or more contacts of the WHO new antenatal care model in Cote d'Ivoire: an antenatal care providers' perspective. Afr J Reprod Health. 2021;25(5):150.
18. Horning R. Monitoring the situation of children and women. The New Inquiry [Internet]. 2012;19. Available from: http://thenewinquiry.com/blogs/marginal-utility/dumb-bullshit/
19. Tekelab T, Chojenta C, Smith R, Loxton D. Factors affecting utilization of antenatal care in Ethiopia: A systematic review and metaanalysis. PLoS One. 2019;14(4):1–24.
20. Manjavidze T, Rylander C, Egil Skjeldestad F, Kazakhashvili N, Anda EE. The impact of antenatal care utilization on admissions to neonatal intensive care units and perinatal mortality in Georgia. PLoS One [Internet]. 2020;15(12 December):1–14. Available from: http://dx.doi.org/10.1371/journal.pone.0242991
21. Peahl AF, Howell JD. The evolution of prenatal care delivery guidelines in the United States. Vol. 224, American Journal of Obstetrics and Gynecology. Mosby Inc.; 2021. p. 339–47.
22. Peahl AF, Smith RD, Moniz MH. Prenatal care redesign: creating flexible maternity care models through virtual care. Am J Obstet Gynecol. 2020 Sep 1;223(3):389.e1-389.e10.
23. Mohamed H, Sutan R, Rahman RA, Juval K. A Scoping Review of Digital Technologies in Antenatal Care: Recent Progress and Applications of Digital Technologies. 2023; Available from: https://doi.org/10.21203/rs.3.rs-3492596/v1
24. Nwosu CO, Ataguba JE. Socioeconomic inequalities in maternal health service utilisation: A case of antenatal care in Nigeria using a decomposition approach. BMC Public Health [Internet]. 2019;19(1). Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85074717588&doi=10.1186%2fs12889-019-7840-8&partnerID=40&md5=dd54159ea433e22e73f8bce378437ea3
25. Khatri RB, Durham J, Assefa Y. Utilisation of quality antenatal, delivery and postnatal care services in Nepal: An analysis of Service Provision Assessment. Global Health [Internet]. 2021;17:1–16. Available from: https://www.proquest.com/scholarly-journals/utilisation-quality-antenatal-delivery-postnatal/docview/2574441183/se-2
26. El-Khatib Z, Odusina EK, Ghose B, Yaya S. Patterns and Predictors of Insufficient Antenatal Care Utilization in Nigeria over a Decade: A Pooled Data Analysis Using Demographic and Health Surveys. Int J Environ Res Public Health [Internet]. 2020;17(21):8261. Available from: https://www.proquest.com/scholarly-journals/patterns-predictors-insufficient-antenatal-care/docview/2630515904/se-2
27. Afaya A, Azongo TB, Dzomeku VM, Afaya RA, Salia SM, Adatara P, et al. Women's knowledge and its associated factors regarding optimum utilisation of antenatal care in rural Ghana: A crosssectional study. PLoS One [Internet]. 2020;15(7). Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85087806072&doi=10.1371%2fjournal.pone.0234575&partnerID=40&md5=a3b9e3121bd0db80bed79c0a3134ccbd
28. Moshi F V. Prevalence and factors which influence early antenatal booking among women of reproductive age in Tanzania: An analysis of data from the 2015-16 Tanzania Demographic Health Survey and Malaria Indicators Survey. PLoS One. 2021;16(4):e0249337.
29. Yaya S, Bishwajit G, Ekholuenetale M, Shah V, Kadio B, Udenigwe O. Timing and adequate attendance of antenatal care visits among women in Ethiopia. PLoS One. 2017;12(9):e0184934.

30. Akowuah JA, Agyei-Baffour P, Awunyo-Vitor D. Determinants of antenatal healthcare utilisation by pregnant women in third trimester in peri-urban Ghana. J Trop Med. 2018;2018.
31. Kuuire VZ, Kangmennaang J, Atuoye KN, Antabe R, Boamah SA, Vercillo S, et al. Timing and utilisation of antenatal care service in Nigeria and Malawi. Glob Public Health. 2017;12(6):711–27.
32. Yadav AK, Nag S, Jena PK, Paltasingh KR. Determinants of Antenatal Care Utilisation in India: A Count Data Modelling Approach. Journal of Development Policy and Practice. 2021;6(2):210--230.
33. Imo CK. Influence of women's decision-making autonomy on antenatal care utilisation and institutional delivery services in Nigeria: evidence from the Nigeria Demographic and Health Survey 2018. BMC Pregnancy Childbirth. 2022;22(1):141.
34. Bintabara D, Basinda N. Twelve-year persistence of inequalities in antenatal care utilisation among women in Tanzania: a decomposition analysis of population-based cross-sectional surveys. BMJ Open. 2021;11(4):e040450.
35. Anaba EA, Afaya A. Correlates of late initiation and underutilisation of the recommended eight or more antenatal care visits among women of reproductive age: insights from the 2019 Ghana Malaria Indicator Survey. BMJ Open. 2022;12(7):e058693.
36. Sserwanja Q, Mutisya LM, Musaba MW. Exposure to different types of mass media and timing of antenatal care initiation: insights from the 2016 Uganda Demographic and Health Survey. BMC Womens Health. 2022 Dec 1;22(1).
37. Ahinkorah BO, Ameyaw EK, Seidu AA, Odusina EK, Keetile M, Yaya S. Examining barriers to healthcare access and utilization of antenatal care services: evidence from demographic health surveys in sub-Saharan Africa. BMC Health Serv Res. 2021 Dec 1;21(1).
38. Adedokun ST, Yaya S. Correlates of antenatal care utilization among women of reproductive age in sub-Saharan Africa: evidence from multinomial analysis of demographic and health surveys (2010--2018) from 31 countries. Archives of Public Health. 2020;78(1):1--10.
39. Ariani N. Antenatal care services utilization during COVID-19 second wave attack in Pasuruan, Indonesia. J Med Life. 2022;15(1):7–14.
40. Abbasi-Kangevari M, Amin K, Kolahi AA. Antenatal care utilisation among Syrian refugees in Tehran: a respondent driven sampling method. Women and Birth. 2020;33(2):e117--e121.
41. Okedo-Alex IN, Akamike IC, Ezeanosike OB, Uneke CJ. Determinants of antenatal care utilisation in sub-Saharan Africa: a systematic review. BMJ Open. 2019;9(10):e031890.
42. Afaya A, Azongo TB, Dzomeku VM, Afaya RA, Solomon MS, Adatara P, et al. Women's knowledge and its associated factors regarding optimum utilisation of antenatal care in rural Ghana: A cross-sectional study. PLoS One [Internet]. 2020 Jul;15(7). Available from: https://www.proquest.com/scholarly-journals/women-s-knowledge-associated-factors-regarding/docview/2422009740/se-2
43. Worku AG, Yalew AW, Afework MF. Availability and components of maternity services according to providers and users perspectives in North Gondar, northwest Ethiopia. Reprod Health. 2013;10(1).
44. Sserwanja Q, Mukunya D, Nabachenje P, Kemigisa A, Kiondo P, W, et al. Continuum of care for maternal health in Uganda: a national cross-sectional study. PLoS One. 2022;17(2):e0264190.

45. Chikako TU, Bacha RH, Hagan Jr JE, Seidu AA, Kuse KA, Ahinkorah BO. Multilevel Modelling of the Individual and Regional Level Variability in Predictors of Incomplete Antenatal Care Visit among Women of Reproductive Age in Ethiopia: Classical and Bayesian Approaches. Int J Environ Res Public Health. 2022;19(11):6600.
46. Sibanda EL, Bernays S, Weller I V.D., Hakim JG, Cowan FM. "Well, not me, but other women do not register because."- Barriers to seeking antenatal care in the context of prevention of mother-to-child transmission of HIV among Zimbabwean women: A mixed-methods study. BMC Pregnancy Childbirth. 2018 Jun 28;18(1).
47. Ekholuenetale M, Benebo FO, Idebolo AF. Individual-, household-, and community-level factors associated with eight or more antenatal care contacts in Nigeria: Evidence from Demographic and Health Survey. PLoS One. 2020;15(9):e0239855.
48. Okedo-Alex IN, Akamike IC, Ezeanosike OB, Uneke CJ. Determinants of antenatal care utilisation in sub-Saharan Africa: a systematic review. BMJ Open. 2019;9(10):e031890.
49. Khan REA, Ahmad TI, Noreen S, Ejaz A. Factors associated with the quality of Antenatal Care (ANC) services use in Bahawalpur. J Pak Med Assoc. 2020;70:1--8.
50. Alibhai KM, Ziegler BR, Meddings L, Batung E, Luginaah I. Factors impacting antenatal care utilization: a systematic review of 37 fragile and conflict-affected situations. Confl Health [Internet]. 2022;16:1–16. Available from: https://www.proquest.com/scholarly-journals/factors-impacting-antenatal-care-utilization/docview/2678221485/se-2
51. Baron JC, Kaura D. Perspectives on waiting times in an antenatal clinic: A case study in the western cape. Health SA Gesondheid. 2021;26.
52. Hussen MA, Worku BT. Quality of Antenatal Care Service and Factors Associated with Client Satisfaction at Public Health Facilities of Bele Gasgar District. J Patient Exp. 2022 Mar 1;9.
53. Arefaynie M, Kefale B, Yalew M, Adane B, Dewau R, Damtie Y. Number of antenatal care utilization and associated factors among pregnant women in Ethiopia: zero-inflated Poisson regression of 2019 intermediate Ethiopian Demography Health Survey. Reprod Health. 2022;19(1):1--10.
54. Babitsch B, Gohl D, Von Lengerke T. Re-revisiting Andersen's Behavioral Model of Health Services Use: a systematic review of studies from 1998-2011 Das Verhaltensmodell der Inanspruchnahme gesundheitsbezogener the retrieved articles for possible inclusion using a three-step selection process (1. title/author, 2. abstract, 3. full text) with pre-defined inclusion OPEN ACCESS. Vol. 9, GMS Psycho-Social-Medicine. 2012.
55. Azanaw MM, Gebremariam AD, Dagnaw FT, Yisak H, Atikilt G, Minuye B, et al. Factors Associated with Numbers of Antenatal Care Visits in Rural Ethiopia. J Multidiscip Healthc [Internet]. 2021;14:1403–11. Available from: https://www.proquest.com/scholarly-journals/factors-associated-with-numbers-antenatal-care/docview/2542096254/se-2
56. PRISMA-P Group. PRISMA-P 2015: elaboration and explanation. PRISMA-P (Preferred Reporting Items for Systematic review and Meta-Analysis Protocols) 2015 checklist: recommended items to address in a systematic review protocol* Section and topic Item No Checklist item. 2016.
57. JBIMANUAL FOR EVIDENCE SYNTHESIS. 2021.
58. David OO, Iretiayo AR, Abiodun OO, Aborode AT, Ayodele TI. Effects of Pandemic on Economy in Sub-Saharan Africa: A Case of Coronavirus (COVID-19). Journal of Economics, Management and Trade. 2020 Aug 28;47–59.

59. Mlandu C, Matsena-Zingoni Z, Musenge E. Trends and determinants of late antenatal care initiation in three East African countries, 2007--2016: A population based cross-sectional analysis. PLOS Global Public Health. 2022;2(8):e0000534.
60. Tessema ZT, Tesema GA, Yazachew L. Individual-level and community-level factors associated with eight or more antenatal care contacts in sub-Saharan Africa: evidence from 36 sub-Saharan African countries. BMJ Open. 2022;12(3):e049379.
61. Ekholuenetale M, Benebo FO, Idebolo AF. Individual-, household-, and community-level factors associated with eight or more antenatal care contacts in Nigeria: Evidence from Demographic and Health Survey. PLoS One. 2020 Sep 1;15(9 September).
62. Ekholuenetale M, Nzoputam CI, Barrow A. Prevalence and socioeconomic inequalities in eight or more antenatal care contacts in Ghana: findings from 2019 population-based data. Int J Womens Health. 2021;349--360.
63. Negash WD, Fetene SM, Shewarega ES, Fentie EA, Asmamaw DB, Teklu RE, et al. Multilevel analysis of quality of antenatal care and associated factors among pregnant women in Ethiopia: a community based cross-sectional study. BMJ Open. 2022;12(7):e063426.
64. Birhanu S, Demena M, Baye Y, Desalew A, Dawud B, Egata G. Pregnant women's satisfaction with antenatal care services and its associated factors at public health facilities in the Harari region, Eastern Ethiopia. SAGE Open Med. 2020;8:2050312120973480.
65. Belay DG, Aragaw FM, Anley DT, Tegegne YS, Gelaye KA, Tessema ZT. Spatiotemporal distribution and determinants of delayed first antenatal care visit among reproductive age women in Ethiopia: a spatial and multilevel analysis. BMC Public Health. 2021;21:1--18.
66. Fagbamigbe AF, Olaseinde O, Setlhare V. Sub-national analysis and determinants of numbers of antenatal care contacts in Nigeria: assessing the compliance with the WHO recommended standard guidelines. BMC Pregnancy Childbirth. 2021;21(1):1--19.
67. Mulungi A, Mukamurigo J, Rwunganira S, Njunwa K, Ntaganira J. Prevalence and risk factors for delayed antenatal care visits in Rwanda: an analysis of secondary data from Rwanda demographic health survey 2019-2020. Pan Afr Med J. 2023;44.
68. Nxiweni PZ, rina, Oladimeji KE, Nanjoh M, B, a L, et al. Factors Influencing the Utilization of Antenatal Services among Women of Childbearing Age in South Africa. Women. 2022;2(3):285--303.
69. Sserwanja Q, Musaba MW, Kamara K, Mutisya LM, Mukunya D. Status of the latest 2016 World Health Organization recommended frequency of antenatal care contacts in Sierra Leone: a nationally representative survey. BMC Health Serv Res. 2022;22(1):1208.
70. Tessema ZT, Tesema GA, Yazachew L. Individual-level and community-level factors associated with eight or more antenatal care contacts in sub-Saharan Africa: Evidence from 36 sub-Saharan African countries. BMJ Open. 2022;12(3):1–8.
71. Tengera O, Nyirazinyoye L, Meharry P, Rutayisire R, Rulisa S, Haile ZT. Factors associated with receipt of adequate antenatal care among women in Rwanda: A secondary analysis of the 2019--20 Rwanda Demographic and Health Survey. PLoS One. 2023;18(4):e0284718.
72. Dlamini LP, Shongwe MC, Simelane MS, Chemhaka GB, Magagula FN. Factors associated with poor maternal health care services utilization in Eswatini: A secondary analysis of a nationally representative household survey. Midwifery. 2022;106:103250.
73. Mangeli M, Sc ; M, Rayyani M, Cheraghi MA, Tirgari B. Exploring the Challenges of Adolescent Mothers From Their Life Experiences in the Transition to Motherhood: A

Qualitative Study [Internet]. Vol. 11, 4 Journal of Family and Reproductive Health. 2017. Available from: http://jfrh.tums.ac.ir
74. Tekelab T, Chojenta C, Smith R, Loxton D. Factors affecting utilization of antenatal care in Ethiopia: A systematic review and metaanalysis. PLoS One. 2019 Apr 1;14(4).
75. Onyeonoro U, Ukegbu A, Emelumadu O, Ezeama N, Ifeadike C, Okezie O. Perception of quality of maternal healthcare services among women utilising antenatal services in selected primary health facilities in Anambra State, Southeast Nigeria. Nigerian Medical Journal. 2014;55(2):148.
76. Adedokun ST, Yaya S. Correlates of antenatal care utilization among women of reproductive age in sub-Saharan Africa: evidence from multinomial analysis of demographic and health surveys (2010–2018) from 31 countries. Archives of Public Health. 2020 Dec 1;78(1).
77. Kota K, Chomienne MH, Geneau R, Yaya S. Socio-economic and cultural factors associated with the utilization of maternal healthcare services in Togo: a cross-sectional study. Reprod Health. 2023 Dec 1;20(1).
78. Raru TB, Ayana GM, Zakaria HF, Merga BT. Association of Higher Educational Attainment on Antenatal Care Utilization Among Pregnant Women in East Africa Using Demographic and Health Surveys (DHS) from 2010 to 2018: A Multilevel Analysis. Int J Womens Health. 2022;14:67–77.
79. Fagbamigbe AF, Olaseinde O, Setlhare V. Sub-national analysis and determinants of numbers of antenatal care contacts in Nigeria: assessing the compliance with the WHO recommended standard guidelines. BMC Pregnancy Childbirth. 2021 Dec 1;21(1).
80. Swihart DL, Siva ;, Yarrarapu NS, Martin RL. Cultural Religious Competence in Clinical Practice Continuing Education Activity. 2023.
81. Wang H, Frasco E, Takesue R, Tang K. Maternal education level and maternal healthcare utilization in the Democratic Republic of the Congo: an analysis of the multiple indicator cluster survey 2017/18. BMC Health Serv Res. 2021 Dec 1;21(1).
82. Winters S, Pitchik HO, Akter F, Yeasmin F, Jahir T, Huda TMN, et al. How does women's empowerment relate to antenatal care attendance? A cross-sectional analysis among rural women in Bangladesh. BMC Pregnancy Childbirth. 2023 Dec 1;23(1).
83. Sakala D, Kumwenda MK, Conserve DF, Ebenso B, Choko AT. Socio-cultural and economic barriers, and facilitators influencing men's involvement in antenatal care including HIV testing: a qualitative study from urban Blantyre, Malawi. BMC Public Health. 2021 Dec 1;21(1).
84. Belachew TB, Negash WD, Bitew DA, Asmamaw DB. Prevalence of married women's decision-making autonomy on contraceptive use and its associated factors in high fertility regions of Ethiopia: a multilevel analysis using EDHS 2016 data. BMC Public Health. 2023 Dec 1;23(1).
85. Tanner Stapleton LR, Schetter CD, Westling E, Rini C, Glynn LM, Hobel CJ, et al. Perceived partner support in pregnancy predicts lower maternal and infant distress. Journal of Family Psychology. 2012 Jun;26(3):453–63.
86. Phiri TM, Nyamaruze P, Akintola O. Perspectives about social support among unmarried pregnant university students in South Africa. PLoS One. 2023 Apr 1;18(4 APRIL).
87. Bedaso A, Adams J, Peng W, Sibbritt D. Prevalence and determinants of low social support during pregnancy among Australian women: a community-based cross-sectional study. Reprod Health. 2021 Dec 1;18(1).
88. Shroder M, Anders SH, Dorst M, Jackson GP. Communication Technology Use and Preferences for Pregnant Women and Their Caregivers. 2018; Available from: https://www.ahrq.gov/research/data/hcup/index.html.

89. Namasivayam A, Schluter PJ, Namutamba S, Lovell S. Understanding the contextual and cultural influences on women's modern contraceptive use in East Uganda: A qualitative study. PLOS Global Public Health. 2022 Aug 15;2(8):e0000545.
90. Mbuagbaw L, Medley N, Darzi AJ, Richardson M, Habiba Garga K, Ongolo-Zogo P. Health system and community level interventions for improving antenatal care coverage and health outcomes. Vol. 2015, Cochrane Database of Systematic Reviews. John Wiley and Sons Ltd; 2015.
91. Seid A, Ahmed M. Association between health insurance enrolment and maternal health care service utilization among women in Ethiopia. BMC Public Health. 2021 Dec 1;21(1).
92. Ala SH, Husain S, Husain S. Reasons for presenting to antenatal care clinics in a sample of Pakistani women and their knowledge of WHO antenatal care package. Eur J Midwifery. 2021;5:1–6.
93. Sharma D, Gupta V, Saxena K, Shah U, Singh U. Role of Faith healers: A barrier or a support system to medical care- a cross sectional studyRole of faith healers: A barrier or a support system to medical care, a cross sectional study. J Family Med Prim Care. 2020;9(8):4298.
94. Holt CL, Roth DL, Huang J, Clark EM. Role of religious social support in longitudinal relationships between religiosity and health-related outcomes in African Americans. J Behav Med. 2018 Feb 1;41(1):62–73.
95. Nicol JU, Iwu-Jaja CJ, Hendricks L, Nyasulu P, Young T. The impact of faith-based organizations on maternal and child health care outcomes in Africa: taking stock of research evidence. Vol. 43, The Pan African medical journal. NLM (Medline); 2022. p. 168.
96. Binyaruka P, Borghi J. An equity analysis on the household costs of accessing and utilising maternal and child health care services in Tanzania. Health Econ Rev. 2022 Dec 1;12(1).
97. Shibre G, Zegeye B, Ahinkorah BO, Idriss-Wheeler D, Keetile M, Yaya S. Sub-regional disparities in the use of antenatal care service in Mauritania: findings from nationally representative demographic and health surveys (2011–2015). BMC Public Health. 2021 Dec 1;21(1).
98. Jonah CMP. Persistence of the inverse care law in maternal health service utilization: An examination of antenatal care and hospital delivery in ghana. J Public Health Afr. 2019;10(2).
99. Haddrill R, Jones GL, Mitchell CA, Anumba DOC. Understanding delayed access to antenatal care: A qualitative interview study. BMC Pregnancy Childbirth. 2014 Jun 16;14(1).
100. Sserwanja Q, Mutisya LM, Musaba MW. Mass Media Exposure and Timing of Antenatal Care Initiation among Women in Uganda. 2022;
101. Sserwanja Q, Mutisya LM, Musaba MW. Exposure to different types of mass media and timing of antenatal care initiation: insights from the 2016 Uganda Demographic and Health Survey. BMC Womens Health. 2022;22(1):1--8.
102. Aborigo RA, Reidpath DD, Oduro AR, Allotey P. Male involvement in maternal health: Perspectives of opinion leaders. BMC Pregnancy Childbirth. 2018 Jan 2;18(1).
103. Azanaw MM, Gebremariam AD, Dagnaw FT, Yisak H, Atikilt G, Minuye B, et al. Factors associated with numbers of antenatal care visits in rural ethiopia. J Multidiscip Healthc. 2021;14:1403–11.
104. Hamed S, Bradby H, Ahlberg BM, Thapar-Björkert S. Racism in healthcare: a scoping review. BMC Public Health. 2022 Dec 1;22(1).

105. Dusingizimana T, Ramilan T, Weber JL, Iversen PO, Mugabowindekwe M, Ahishakiye J, et al. Predictors for achieving adequate antenatal care visits during pregnancy: a cross-sectional study in rural Northwest Rwanda. BMC Pregnancy Childbirth. 2023 Dec 1;23(1).
106. Sserwanja Q, Mutisya LM, Musaba MW. Mass Media Exposure and Timing of Antenatal Care Initiation among Women in Uganda. Available from: https://doi.org/10.21203/rs.3.rs-396658/v1
107. Acharya D, Khanal V, Singh JK, Adhikari M, Gautam S. Impact of mass media on the utilization of antenatal care services among women of rural community in Nepal. BMC Res Notes. 2015 Aug 12;8(1).
108. Steube F, Löwe B, Weigel A. "Belly Only Pregnancy" content on social media and in internet blogs: a qualitative analysis on its definition and potential risks and benefits. Eating and Weight Disorders. 2022 Oct 1;27(7):2435–45.
109. Ahinkorah BO, Ameyaw EK, Seidu AA, Odusina EK, Keetile M, Yaya S. Examining barriers to healthcare access and utilization of antenatal care services: evidence from demographic health surveys in sub-Saharan Africa. BMC Health Serv Res. 2021;21(1):1--16.
110. Ngowi AF, Mkuwa S, Shirima L, Ngalesoni F, Frumence G. Determinants of Focused Antenatal Care Utilization Among Women in Simiyu Region Tanzania. SAGE Open Nurs. 2023 Jan 1;9.
111. Adugna MB, Nabbouh F, Shehata S, Ghahari S. Barriers and facilitators to healthcare access for children with disabilities in low and middle income sub-Saharan African countries: A scoping review. BMC Health Serv Res. 2020 Jan 6;20(1).
112. Zhang F, Shi X, Zhou Y. The impact of health insurance on healthcare utilization by migrant workers in China. Int J Environ Res Public Health. 2020 Mar 2;17(6).
113. Essendi H, Johnson FA, Madise N, Matthews Z, Falkingham J, Bahaj AS, et al. Infrastructural challenges to better health in maternity facilities in rural Kenya: Community and healthworker perceptions. Reprod Health. 2015 Nov 9;12(1).
114. Amungulu ME, Nghitanwa EM, Mbapaha C. An investigation of factors affecting the utilization of antenatal care services among women in post-natal wards in two Namibian hospitals in the Khomas region. J Public Health Afr. 2023 Mar 1;14(3).
115. Hanson C, Cox J, Mbaruku G, Manzi F, Gabrysch S, Schellenberg D, et al. Maternal mortality and distance to facility-based obstetric care in rural southern Tanzania: A secondary analysis of cross-sectional census data in 226 000 households. Lancet Glob Health. 2015 Jul 1;3(7):e387–95.
116. Mutowo J, Yazbek M, van der Wath A, Maree C. Barriers to using antenatal care services in a rural district in Zimbabwe. Int J Afr Nurs Sci. 2021 Jan 1;15.
117. Nwosu CO, Ataguba JE. Socioeconomic inequalities in maternal health service utilisation: A case of antenatal care in Nigeria using a decomposition approach. BMC Public Health. 2019 Nov 8;19(1).
118. Atuoye KN, Dixon J, Rishworth A, Galaa SZ, Boamah SA, Luginaah I. Can she make it? Transportation barriers to accessing maternal and child health care services in rural Ghana. BMC Health Serv Res. 2015 Aug 20;15(1).

Table 5 Egger's test for small-study effects.

Number of studies = 17				Root MSE	=	151.7
Std_Eff	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
slope	43.88702	17.44569	2.52	0.024	6.702422	81.07162
bias	42.62538	64.69772	0.66	0.520	-95.27455	180.5253

Small studies test

Egger’s statistical test

metabias p se, egger

Note: data input format theta se_theta assumed.

Egger's test for small-study effects:
Regress standard normal deviate of intervention
effect estimates against its standard error.

Test of H0: no small-study effects P = 0.520

There is not enough evidence to reject the null hypothesis.

Appendices

Appendix 1. Ethical weaver certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

Human Research Ethics Committee (Medical)

Research Office Secretariat:
Faculty of Health Sciences, Phillip Tobias Health Sciences Building, 3rd Floor, Office 301/2/4, 29 Princess of Wales Terrace, Parktown, 2193
Private Bag 3, Wits 2050
Office email: HREC-Medical.ResearchOffice@wits.ac.za
Website: https://www.wits.ac.za/research/researcher-support/research-ethics/ethics-committees/

Ref: W-CBP-230417-02 17/04/2023

TO WHOM IT MAY CONCERN:

Waiver:	This certifies that the following research does not require clearance from the Human Research Ethics Committee (Medical)
Investigator:	Mrs Marethabile N.M. Mariti (Student No.: 2014166)
Supervisor:	Dr Juliana Kagura
Department:	Epidemiology and Biostatistics
Project title:	*Factors associated with antenatal care utilization among women of reproductive age in sub-Saharan Africa- A systematic review*
Reason:	*A review of information in the public domain*. No human participants will be involved in the study.

Dr CB Penny

Chairperson: Human Research Ethics Committee (Medical)

Copy – HREC (Medical) Secretariat: Ms Zanele Ndlovu, Ms Mapula Ramaila and Mr Rhulani Mkansi

Appendix 2. Plagiarism declaration form



PLAGIARISM DECLARATION TO BE SIGNED BY ALL HIGHER DEGREE STUDENTS

SENATE PLAGIARISM POLICY: APPENDIX ONE
I Marethabile Nthabiseng Mariti Student number: (2014166) am a student registered for the degree of MSc Epidemiology in Implementation Science in the academic year 2

I hereby declare the following:

- - I am aware that plagiarism (the use of someone else's work without their permission and/or without acknowledging the original source) is wrong.
- - I confirm that the work submitted for assessment for the above degree is my own unaided work except where I have explicitly indicated otherwise.
- - I have followed the required conventions in referencing the thoughts and ideas of others.
- - I understand that the University of the Witwatersrand may take disciplinary action against me if there is a belief that this is not my own unaided work or that I have failed to acknowledge the

  source of the ideas or words in my writing.

- - I have included as an appendix a report from "Turnitin" (or other approved plagiarism detection)

software indicating the level of plagiarism in my research document.

Signature: _____ Date: 22/07/2024

Appendix 3. Turnit in report

Signed 29 February 2024 J Kagura 

MM_2014166_turnit in.docx

ORIGINALITY REPORT

11%	8%	9%	%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	jbi.global Internet Source	1%
2	reproductive-health-journal.biomedcentral.com Internet Source	1%
3	www.researchsquare.com Internet Source	1%
4	Ling, Yeoh Ping. "Adequacy of Antenatal Care: Associated Factors and Pregnancy Outcomes among Women Attending Public Health Clinics in Selangor, Malaysia", University of Malaya (Malaysia), 2023 Publication	1%
5	www.ncbi.nlm.nih.gov Internet Source	1%
6	ir-library.ku.ac.ke Internet Source	<1%
7	www.omicsdi.org Internet Source	<1%

Appendix 4. Studies included for factors determination based on regions of the SSA

Author_year	Regional_subgroup	Study_design	Year	Outcome of interest	Sample_size
Tessema et al. 2022	South-Africa	Population based (DHS) Cross-sectional	2016	Number of ANC visits in sub-Saharan Africa	3036
Tessema et al. 2022	Angola	Population based (DHS) Cross-sectional	2016	Number of ANC visits in sub-Saharan Africa	14 379
Tessema et al. 2022	Ethiopia	Population based (DHS) Cross-sectional	2016	Number of ANC visits in sub-Saharan Africa	7590
Tessema et al. 2022	Malawi	Population based (DHS) Cross-sectional	2016	Number of ANC visits in sub-Saharan Africa	13 515
Tessema et al. 2022	Tanzania	Population based (DHS) Cross-sectional	2016	Number of ANC visits in sub-Saharan Africa	7078
Tessema et al. 2022	Zambia	Population based (DHS) Cross-sectional	2018	Number of ANC visits in sub-Saharan Africa	7324
Tessema et al. 2022	Benin	Population based (DHS) Cross-sectional	2017	Number of ANC visits in sub-Saharan Africa	9030
Tessema et al. 2022	Guinea	Population based (DHS) Cross-sectional	2018	Number of ANC visits in sub-Saharan Africa	5487
Tessema et al. 2022	Mali	Population based (DHS) Cross-sectional	2018	Number of ANC visits in sub-Saharan Africa	6622
Tessema et al. 2022	Nigeria	Population based (DHS) Cross-sectional	2018	Number of ANC visits in sub-Saharan Africa	21 911

Appendix 5. Data search strategy

Data bases	Exact search strategy	Month and yr the search was run	Any limits applied such as publication date, language	# of references retrieved for each database
PubMed	"Prenatal Care" OR “ante*natal care”[tw] OR “pre*natal care”[tw] AND utili?ation* [tw] OR use*[tw] AND "Women" OR women*[tw] OR female*[tw] AND “sub*Saharan Africa”[tw] OR Africa*[tw]	April, 2023	Language (English) Date-01/01/2010 to 31/12/2022 study design (Quantitative) age (15years-49years) region (SSA)	7
Scopus	"Prenatal Care" OR “ante*natal care”[tw] OR “pre*natal care”[tw] AND utili?ation* [tw] OR use*[tw] AND "Women" OR women*[tw] OR female*[tw] AND “sub*Saharan Africa”[tw] OR Africa*[tw]	April, 2023	Language (English) Date-01/01/2010 to 31/12/2022 study design (Quantitative) age (15years-49years) region (SSA)	30
ProQuest	(fulltext(women of reproductive age) OR fulltext(childbearing women) AND fulltext(Antenatal) OR fulltext(care prenatal) OR fulltext(Prenatal Care) OR fulltext(prenatal care) AND fulltext(non-antenatal attendees) AND fulltext(utilisation antenatal care) OR fulltext(prenatal care utilisation) AND fulltext(prenatal health care utilization)) AND ((fulltext(women of reproductive age) OR fulltext(childbearing women) AND fulltext(Antenatal) OR fulltext(care prenatal) OR fulltext(Prenatal Care) OR fulltext(prenatal care) AND fulltext(non-antenatal attendees) AND fulltext(utilisation antenatal care) OR fulltext(prenatal care utilisation) AND fulltext(prenatal health care utilization)) AND pd(20100101-20221231))	April, 2023	Language (English) Date-01/01/2010 to 31/12/2022 study design (Quantitative) age (15years-49years) region (SSA)	263

Google Scholar	“women of reproductive age” OR “childbearing women” OR “child bearing women” AND "antenatal care" OR "prenatal care" OR "antepartum care" AND "antenatal care utilisation" OR "prenatal care utilisation" AND "Sub-Saharan Africa"	April, 2026	Language (English) Date-01/01/2010 to 31/12/2022 study design (Quantitative) age (15years-49years) region (SSA)	176
SABINET	“wom*n of reproductive age” OR “childbearing women” OR “child bearing women” AND "antenatal care" OR "prenatal care" OR "antepartum care" OR "during pregnancy care" AND "antenatal care utili#ation" OR "prenatal care utili#ation" AND Sub-Saharan Africa”	April, 2023	Language (English) Date-01/01/2010 to 31/12/2022 study design (Quantitative) age (15years-49years) region (SSA)	201
EBSCO-Host	“wom*n of reproductive age” OR “childbearing women” OR “child bearing women” AND "antenatal care" OR "prenatal care" OR "antepartum care" OR "during pregnancy AND “antenatal care non-attendees” OR “prenatal care non-attendees” AND "antenatal care utili#ation" OR "prenatal care utili#ation"	April, 2023	Language (English) Date-01/01/2010 to 31/12/2022 study design (Quantitative) age (15years-49years) region (SSA)	9
Total retrived				686
duplicates removed				14
imported				505

Appendix 6. JBI Cross-sectional quality assessment results

Citation	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Ekholuenetale M, Benebo FO, Idebolo AF. 2020.	Y	Y	Y	Y	U	Y	Y	Y
Negash WD, Fetene SM, Shewarega ES, Fentie EA, Asmamaw DB, Teklu RE, et al. 2022.	Y	Y	Y	Y	U	U	Y	Y
Belay DG, Aragaw FM, Anley DT, Tegegne YS, Gelaye KA, Tessema ZT. 2021.	Y	Y	Y	Y	U	Y	Y	Y
Sserwanja Q, Musaba MW, Kamara K, Mutisya LM, Mukunya D. 2022.	Y	Y	Y	Y	U	Y	Y	Y
Sserwanja Q, Mutisya LM, Musaba MW. 2022.	Y	N	Y	Y	N	Y	Y	Y
Nxiweni PZ, rina, Oladimeji KE, Nanjoh M, B, a L, et al. 2022.	Y	Y	Y	Y	Y	Y	Y	Y
Mulungi A, Mukamurigo J, Rwunganira S, Njunwa K, Ntaganira J. 2023.	Y	Y	Y	Y	U	Y	Y	Y
Tengera O, Nyirazinyoye L, Meharry P, Rutayisire R, Rulisa S, Haile ZT. 2023.	Y	Y	Y	Y	U	Y	Y	Y
Fagbamigbe AF, Olaseinde O, Setlhare V. 2021.	Y	Y	Y	Y	U	Y	Y	Y
Ahinkorah BO, Ameyaw EK, Seidu A-A, Odusina EK, Keetile M, Yaya S. 2021.	Y	Y	Y	Y	U	Y	Y	Y
Ekholuenetale M, Nzoputam CI, Barrow A. 2021.	Y	Y	Y	Y	U	U	Y	Y
Ml, u C, Matsena-Zingoni Z, Musenge E. 2022.	Y	Y	Y	Y	U	Y	Y	Y
Anaba EA, Afaya A. 2022.	Y	Y	Y	Y	U	Y	Y	Y
Birhanu S, Demena M, Baye Y, Desalew A, Dawud B, Egata G. 2020.	Y	Y	Y	Y	U	Y	Y	Y
Tessema ZT, Tesema GA, Yazachew L. 2022.	Y	Y	Y	Y	N	Y	Y	Y
Ekholuenetale M, Nzoputam CI, Barrow A. 2021.	Y	Y	Y	Y	U	U	Y	Y

Sserwanja Q, Mutisya LM, Musaba MW. 2022.	Y	Y	Y	Y	U	Y	Y	Y
%	100.0	94.44	100.0	100.0	5.55	83.33	100.0	100.0

Additional table 1. Analytical Cross-Sectional studies included for analysis.

Study	Country	Setting/context	Participant characteristics	Groups	Outcomes measured	Main description of results
Ekholuenetale M, Nzoputam CI, Barrow A. 2021 (62) http://doi.org/10.2147/IJWH.S306302	Ghana	The Ghana Malaria Indicator Survey of 2019 (GMIS)	women's educational achievement, income quintiles, age (year): 15–24, 25–34, 35+; residential status: urban, rural; religion: Christianity, Islam, traditional/no religion; timing to antenatal care booking: late (after 1st trimester), early (within 1st trimester); health insurance coverage: not covered, covered; household headship: male, female; pre-ceding birth interval: first born, <2years, 2–3years, 4 +years; parity: 1–2, 3–4, 5+;	A total sample of 1404 women of reproductive age who had given birth following the criteria of eight or more ANC contacts was initiated by WHO, considering 9 months of gestation.	Uptake of eight or more ANC contacts. "Number of antenatal visits during pregnancy?"	The weighted prevalence of eight or more ANC contacts was 41.9% (95% CI: 37.9–45.9%). Similarly, 33.0%, 37.7% and 42.6% prevalence of eight or more ANC contacts were estimated among women with no formal education, primary, secondary, or higher, respectively. In addition, women from rich household had greater coverage of eight or more ANC contacts (Conc. Index= 0.089; SE= 0.019) and educated women had greater coverage of eight or more ANC contacts in Ghana (Conc. Index= 0.053; SE= 0.017) (all p<0.001)
Ekholuenetale M, Benebo FO, Idebolo AF. 2020 (47) https://doi.org/10.1371/journal.pone.0239855	Nigeria	Nigeria Demographic and Health Survey—2018	Family mobility (internal immigrant vs Native), Religious background (Christianity, Islam and African Traditional Religion (ATR)/others), Total number of children ever born:1–2,3–4 and over 4 children, Maternal educational attainment: no formal education, primary and secondary or higher education,	A total sample of 7,936 women of reproductive age who became pregnant and had given birth after the new guideline of eight ANC contacts was endorsed were included in this study.	The frequency of ANC contacts with doctors, nurses, and midwives	The prevalence of eight or more ANC contacts in Nigeria was approximately 17.4% (95%CI:16.1%-18.7%). Women with at least secondary education were 2.46 times as likely to have eight or more ANC contacts, when compared with women with no formal education. Women who use media were 2.37 times as likely to have eight or more ANC contacts,

			Maternal age: 15–19, 20–24, 25–29, 30–34, 35–39, 40–44, 45–49. Marital status: never in union, currently married/living with a partner and formerly in union. Maternal residential status (urban vs rural)			when compared with women who do not use media. For every unit increase in the time (month) of ANC initiation, there was 53% reduction in the odds of eight or more ANC contacts. Rural women had 60% reduction in the odds of eight or more ANC contacts, when compared with their urban counterparts.
Tengera O, Nyirazinyoye L, Meharry P, Rutayisire R, Rulisa S, Haile ZT. 2023. (71) *https://doi.org/10.1371/journal.pone.0284718*	Rwanda	Rwanda Demographic and Health Survey(RDHS) 2019-2020	age (15–24,25–34,35–44,45 years and above), marital status (never married, married/living together, and divorced/separated/widowed), education (none, primary, and secondary or higher), household wealth index (poor, middle, rich), employment (no, yes), health insurance (no, yes), residence (rural, urban), pregnancy intention (wanted then, wanted later, wanted no more), distance to nearest health care facility (big problem, not a big problem), birth order (1st, 2nd, 3rd, 4th child and above) and ANC provider (doctor, nurse or midwife, auxiliary midwife).	The final sample for the analysis comprised of 6,039 women, aged 15–49 years who had a live birth within the five years preceding the 2019–20RDHS	The receipt of adequate ANC	Overall, 27.6% of participants received adequate ANC. The odds of receiving adequate ANC were higher among those in the middle household wealth index (AOR1.24;1.04,1.48 and rich index (AOR1.37;1.16,1.61) compared to those in the poor wealth index category. Similarly, having health insurance was positively associated with receiving adequate ANC (AOR1.33;1.10,1.60). The odds of receiving adequate ANC were lower among urban dwellers compared to rural (AOR0.74;0.61,0.91); for women who wanted pregnancy later (AOR0.60;0.52,0.69) or never wanted pregnancy (AOR0.67;0.55,0.82) compared to those who wanted pregnancy; for women who perceived distance to a health facility as a big problem (AOR0.82;0.70,0.96) compared to those that did

						not; and for women whose ANC was provided by nurses and midwives (AOR0.63;0.47,0.8), or auxiliary midwives (AOR0.19;0.04,0.82) compared to those who received ANC from doctors
Tessema ZT, Tesema GA, Yazachew L. 2022. (60) http://dx.doi.org/10.1136/bmjopen-2021-049379	Sub-Saharan African countries	sub-Saharan African countries' recent DHS data set from 2006 to 2018.	Maternal current age (15–24, 25–34, 35 and above), maternal level of education (no education, primary, secondary, and above), husband's level of education (no education, primary, secondary, and above) and marital status (currently married, cohabitating) were the individual-level factors. Working status (working vs not working), healthcare access (major problem vs minor problem), media exposure (no vs yes), desired pregnancy (yes vs no), contraceptive use (yes vs no) and birth order (1, 2–4 and 5+)	This study comprised 300 575 women from 36 SSA countries who had at least one child 5 years before the survey.	Number of ANC visits in sub-Saharan Africa	The pooled magnitude of eight or more ANC visits in sub-Saharan African countries was 6.8% (95% CI 6.7% to 6.9%). Residence, maternal education, husband's education, maternal occupation, wealth index, media exposure, contraceptive use and desired pregnancy were all positively associated with eight or more ANC visits in the multilevel logistic regression analysis, whereas birth order was negatively associated with eight or more ANC visits
Ahinkorah BO, Ameyaw EK, Seidu A-A, Odusina EK, Keetile M, Yaya S. 2021. (109) http://doi.org/10.1136/bmjopen-2022-	sub-Saharan Africa	Demographic and Health Survey data collected in 2018 in sub-Saharan Africa	Age of women at childbirth (≤19, 20–24, 25–29, 30–34, 35–39,≥40), residence (urban vs rural), religion (Christians,Muslims and others), birth order (1–2, 3–4,≥5), pregnancy intention (no vs yes) and polygyny	A sample of 6761 from Nigeria, 1973 from Mali, 1690 from Guinea and 1570 from Zambia currently married women, who gave birth in the last 0–12	Timing of ANC visits and number of ANC visits	Most of thewomen had < 8 ANC visits that ranged from 82.2% in Nigeria to 98.5% in Zambia as well as first ANC visit > 3months of gestation, with variations ranging from 61.5%in Zambia to 82.4% in Nigeria.

063426			(monogamous, polygamous as first wife, polygamous as second wife orlatter). Health insurance coverage (no vs yes), wealth quintile (poorest,poorer, middle, richer, richest), husband's highest educational level (no education, primary, secondary, tertiary)and the difference in age between husband and wife(wife older or same age with husband, husband 1–5years older, husband 6–10 years older, husband more than 10 years older)	months prior to the month of interview		With timing of antenatal care visits, getting money needed for treatment (aOR = 1.38, 95% CI = 1.03–1.92)influenced early timing of antenatal care visits in Mali whereas getting permission to visit the health facility (aOR =1.62, 95% CI = 1.15–2.33) motivated women to have early timing of antenatal care visits in Guinea. We found thatwomen who considered getting money needed for treatment as not a big problem in Nigeria were more likely tohave the recommended number of antenatal care visits (aOR = 1.38, 95% CI= 1.11–1.73). On the contrary, inGuinea, Zambia and Mali, getting permission to visit health facilities, getting money for treatment, distance to thehealth facility and not wanting to go alone were not barriers to having≥8 antenatal care visits
Fagbamigbe AF, Olaseinde O, Setlhare V. 2021. (66) https://doi.org/10.1186/s12884-021-03837-y	Nigeria	2018 Nigeria Demographic Health Survey	Maternal age (15–19,20–24,25–29, 30–39, 40–49 years), education (no education,primary, secondary and higher), spouse education (noeducation, primary, secondary and higher), employmentstatus (currently employed or not), spouse employmentstatus (currently employed or	A totalof 41,821 women aged 15–49 years were interviewed	The number of ANC contacts	About 25 % of the women had no ANC contact, 58 % had at least 4 contacts while only 20 % had 8 or more ANC contacts. The highest rate of 8 or more ANC contacts was in Osun (80.2 %), Lagos (76.8 %), and Imo(72.0 %) while the lowest rates were in Kebbi (0.2 %), Zamfara (1.1 %) and Yobe (1.3 %). Respondents with higher education were

			not), access to media (atleast one of radio, television, or newspaper), householdwealth index (low, middle, and high), women's auton-omy using who decides respondents health care accessas a proxy (respondent alone, respondent/spouse, andspouse alone). Others are birth interval (firstborn, < 36months, and > = 36 months), birth order (1, 2, 3, 4 and5+), children ever born (1–2, 3–4, 4+), current maritalstatus (currently married or living together (living inunion), divorced/separated/widowed, never married),place of residence (rural/urban), religion (Islam, Chris-tianity, others), and ethnicity (Hausa/Fulani, Igbo, Ibibio,Yoruba and others). Family mobility (had stayed less than five years at residence or not), wantedchild when became pregnant (then, later or not more),household headship (male or female), health insurancecoverage (yes or no), acceptance			twelve times (adjusted relative risk (aRR): 12.46, 95 % CI: 7.33–21.2), having secondary education was thrice (aRR: 2.91, 95 % CI: 2.35–3.60), and having primary education was twice (aRR: 2.17, 95 % CI: 1.77–2.66) more likely to make at least 8 contacts than those with no education. Respondents from households in the richest and middle wealth categories were 129 and 67 % more likely to make 8 or more ANC contacts compared to those from households in the lowest wealth category respectively. The likelihood of making 8 ANC contacts was 89 and 47 %higher among respondents from communities in the least and middle disadvantaged groups, respectively,compared to the most disadvantaged group. Other significant variables were spouse education, health caredecision making, media access, ethnicity, religion, and other community factors.

			of wife-beating (yes or no)			
Negash WD, Fetene SM, Shewarega ES, Fentie EA, Asmamaw DB, Teklu RE, et al. 2022. (63) *http://dx.doi.org/10.1136/bmjopen-2022-063426*	Ethiopia	2016 Ethiopian Demographic and Health Survey.	Age of the women (15–24, 25–34 and 35–49). Resident (Rural, urban).Women education level (No formal education, primary education and secondary and higher education). Women occupation (Not employed, employed). Partner education level (No formal education, primary education, and secondary education and higher). Wealth index, Timing of first ANC in months, Number of ANC visits (≤3, >3.<4, ≥4). Birth order 1, 1–4 and ≥5). Marital status (Married, unmarried)	A total of 4757 weighted sample of pregnant women from 18 January 2016 to 27 June 2016	Quality of antenatal care (ANC)	The magnitude of quality of ANC in Ethiopia was 22.48% (95% CI: 21.31% to 23.69%). Educational status; primary (AOR=1.34; 95%CI: 1.06 to 1.68) and secondary (AOR=2.46; 95%CI: 1.76 to 3.45), middle (AOR=1.31; 95%CI: 1.01 to 1.72) and rich (AOR=2.08; 95%CI: 1.59 to 2.72) wealth status, being married (AOR=2.34; 95%CI:1.08 to 5.10) and four or more ANC (AOR=2.01; 95%CI:1.67 to 2.40) were statistically significant associated factors of quality ANC in Ethiopia.
Belay DG, Aragaw FM, Anley DT, Tegegne YS, Gelaye KA, Tessema ZT. 2021. (65) *https://doi.org/10.1186/s12889-021-11614-x*	Ethiopia	Ethiopia's nine regions and two city administrations	maternal age, marital status, maternal education, household size, household head, and house-hold wealth, parity, ever had terminated pregnancy, insurance coverage, and pregnancy desirability, media exposure, place of residence, region, perception of distance from the health facility,	A total of 10,184 women (2061 in 2005, 3366 in 2011, and 4757 in 2016) All reproductive age women (15–49) who had given birth in the 5 years before to each survey and had ANC follow-up for the most recent birth	Delayed first ANC visit	Overall, 77.69, 73.95, and 67.61% of women had delayed their first ANC visit in 2005, 2011, and 2016 EDHSs respectively. Women education [AOR = 0.71; 95%CI; 0.60, 0.84], unwanted pregnancy [AOR = 1.41;95%CI; 1.04, 1.89],and rural residence [AOR = 1.68;95%CI; 1.19, 2.38] have significantly associated with delayed first ANC visit. The spatial analysis revealed that delayed first ANC visit varies in each EDHS period. The SaTScan analysis result of

						EDHS2005 data identified 122 primary clusters located between the border of Oromia and Eastern SNNPR regions (RR =1.30, LLR = 32.31,P-value< 0.001), whereas in 2011 EDHS, 145 primary clusters were identified in entire Tigray, B/Gumuz, Amhara western part of Afar and northwest Oromia regions (RR = 1.30, LLR = 40.79,P-value< 0.001). Besidesin 2016 EDHS,198 primary clusters were in the entire SNNPR, Gambella, Northen B/Gumuz, and westernOromia regions. (RR = 1.35, LLR = 83.21,P-value< 0.001)
Birhanu S, Demena M, Baye Y, Desalew A, Dawud B, Egata G. 2020. (64) *https://us.sagepub.com/en-us/nam/open-access-at-sage*	Ethiopia	Public health facilities in the Harari region	Age (15-19, 20-24, 25-29, 30-34, 35-39, 40-44, 45+), religion (Muslim, Orthodox, Protestant), residence (urban, rural), Ethnicity (Oromo, Amhara, Gurage, Others), Educational status (No formal education, Primary,Secondary and above2), Occupation (Housewife, Merchant, Employed,Daily labourer, Farmer, Student), Partner's educational status (No formal education, Primary, Secondary and above, Has no partner), Marital status (Married, Unmarried)	531 Pregnant women who were registered for ANC service during the data collection period	Satisfaction	The magnitude of pregnant women's satisfaction with antenatal care services was 70.3% (95% confidence interval (CI)=66.4%–74.3%). Receiving antenatal care services from the hospital (adjusted odds ratio (AOR)=2.44, 95% CI=1.50–3.98), did not attend formal education (AOR=2.53, 95% CI=1.52–4.20) and attended primary education (AOR=2.17, 95% CI=1.17–4.04), having a repeated visit to antenatal care (AOR=4.62, 95% CI=2.98–7.17), initiating antenatal care services within the first trimester (AOR=1.74, 95% CI=1.12–2.71), having no history of stillbirth (AOR=2.52, 95% CI=1.37–

						4.65), and waiting for no more than 30min in the health facility to get service (AOR=2.31, 95% CI=1.28–4.16) were factors associated with pregnant women's satisfaction with antenatal care services Region-Orthodox 113 Muslims 384 Protestant 19
Sserwanja Q, Musaba MW, Kamara K, Mutisya LM, Mukunya D. 2022. (69) *https://doi.org/10.1186/s12913-022-08594-y*	Sierra Leone	Sierra Leone Demographic and Health Survey (UDHS) 2019	Maternal age, wealth index, level of education, place of residence, region, marital status, working status, ANC timing of first contact, sex of household head, household size, woman's religion, parity, exposure to newspapers, exposure to television (TV), exposure to radio, internet use, having problems with getting permission to seek help, having problems with distance to the nearby health facility and being visited by a field-worker.	5,432 women aged 15 to 49years who had a live birth, within three years preceding the survey	The total number of ANC contacts	Out of 5,432 women, 2,399 (44.8%) (95% CI: 43.1–45.7) had their first ANC contact in the first trimester and 1,197 (22.0%) (95% CI: 21.2–23.4) had eight or more ANC contacts. Women who had their first ANC contact after first trimester (adjusted odds ratio, aOR, 0.58, 95% CI 0.49–0.68) and women aged 15 to 19years had less odds of having eight or more contacts (aOR 0.64, 95% CI 0.45 to 0.91). Working (aOR 1.33, 95%CI 1.10 to 1.62) and wealthier women had higher odds of having eight or more contacts compared to poorer ones and those not working respectively. Women residing in the southern region, those using internet and less parous (less than five) women were associated with higher odds of having eight or more ANC contacts. Women

						who had no big problem obtaining permission to go health facilities also had higher odds of having eight or more ANC contacts compared to those who had big problems
Sserwanja Q, Mutisya LM, Musaba MW. 2021. (100) *https://doi.org/10.1186/s12905-022-01594-4*	Uganda	2016 Uganda Demographic and Health Survey (UDHS	Exposure to media (newspaper, magazine, radio, TV), place of residence (rural and urban), and the region of residence (Central, East, West and North). household size (less than six and six), sex of household head (male and female), and above, age (15–24, 25–34 and 35–49), parity (less than 4 and above 4), work-ing status (yes and no), marital status (married and not married), education level of the women and the partner (no education, primary, secondary, and tertiary)	10,152 women aged 15–49 years who had a live birth within five years preceding the survey	Early initiation of ANC	Almost a third of the women (2953/10,152, 29.1%, 95% CI 27.9–29.6) initiated their first ANC contact in the first trimester. Women who listened to radio at least once a week (adjusted OR (aOR 1.14, 95% CI 1.01–1.30) and those who watched television less than once a week (aOR 1.28, 95% CI 1.07–1.53) had higher odds of initiating ANC earlier compared to their counterparts not exposed to radio and television respectively.
Nxiweni PZ, rina, Oladimeji KE, Nanjoh M, B, a L, et al. 2022. (68) *https://doi.org/10.3390/women2030027*	South Africa	South African Demographic Health Survey (DHS) conducted from 1998 to 2016.	Age, marital status, educational status, ethnicity, provinces, place of residence, wealth index,	67,645 women across South Africa	Utilization of Antenatal Care Services	In South Africa, 21.0% of mothers had used ANC services. Higher odds of seeking prenatal care were found in women aged 35 years and older (cOR = 1.26, 95% CI; 1.08–1.47, p = 0.003), married or cohabiting (cOR = 1.13, 95% CI; 1.004–1.27) observed, p = 0.043), higher level of education (tertiary education: cOR = 0.55, p =

						0.001), female residents in urban areas (cOR = 1.35, 95% CI; 1.20–1.52, p = 0.001), higher wealth index (cOR = 1.32, 95% CI; 1.15–1.51, p = 0.001), employed (cOR = 1.48, 95% CI; 1.29–1.70, p = 0.001) and media exposure (cOR = 1.27, 95% CI; 1.12–1.44), p = 0.001). Ethnicity Black African-58,172; white 2256; coloured 5692; Indians 1261
Mulungi A, Mukamurigo J, Rwunganira S, Njunwa K, Ntaganira J. 2023. (67) *https://www.panafrican-med-journal.com//content/article/44/74/full*	Rwanda	Rwanda demographic health survey 2019-2020	Age in years, number of children, place of residence, place of ANC, marital status, pregnancy (wanted or unwanted), woman´s education, problem with distance to health facility, covered by health insurance, wealth quintile, husband´s education, woman´s employment status, partner´s employment status, knowledge of menstrual cycle.	6,039 women that had had a pregnancy in the 5 years preceding the survey.	Delayed ANC	The number of children 4-6 (AOR = 1.4, 95% CI: 1.2-1.6) and 7 or more children (AOR = 1.5, 95% CI: 1.5-2.1) versus less than 3 children, unwanted pregnancy (AOR = 1.7, 95% CI: 1.5-2.0), not covered by health insurance (AOR = 14, 95% CI: 1.2-1.6), woman´s education level: no education (AOR 2.6, 95% CI: 1.6-4.1), primary education (AOR 2.5, 95% CI: 1.6-3.7), secondary education (AOR 2.2, 95% CI: 1.5-3.2), woman´s occupation: informal (AOR 2.3 95% CI: 1.5-3.7) and unemployment (AOR 2.3. 95% CI: 1.4-3.7)
Mlandu C, Matsena-Zingoni Z, Musenge E. 2022. (59) *https://doi.org/10.1371/journal.pgph.0000534*	East African countries (Democratic Republic of Congo,	Demographic Health Surveys data (Democratic Republic of Congo (2007-2013/14), Kenya (2008–2014), and	Residence, mother's education, birth order, household size, and house hold wealth.	A total sample size of 42,719 DRC, Kenyan, and Tanzanian women aged 15 to 49 years, who	Late ANC initiation	The results showed that the odds of late ANC initiation were significantly higher among women with primary or no education in the first survey

	Kenya, and Tanzania)	Tanzania (2010-2015/16)		had a live birth in the five years preceding each DHS survey between 2007 and 2016. Women who attended at least one ANC visit		(AOR:1.26;95%CI:1.10–1.44) and second survey (AOR:1.33;95%CI:1.23–1.43). Mothers with birth order of two (AOR:1.33;95%CI:1.20–1.47) and those with birth order of three or more (AOR:1.68;95%CI:1.38–2.06) had significantly greater odds of starting ANC late in the first survey. In the second survey,mothers with birth order of two (AOR:1.22;95%CI:1.14–1.31) and those with birth order of three or more (AOR:1.45;95%CI:1.26–1.66) had significantly higher odds of waiting longer to start ANC.The results also showed that the odds of delayed ANC initiation were significantly higher among women living in households with five or more members in the first survey (AOR:1.21:95%CI:1.08–1.34) and second survey (AOR:1.31;95%CI:1.22–1.40). The study also established that women from poor-income (AOR:1.21;95%CI:1.06–1.39) and middle-income (AOR:1.29;95%CI:1.10–1.50) households had significantly greater odds of initiating ANC late in the first survey. These findings were also observed in the second survey, the odds of delaying ANC initiation were significantly higher among women from

						poor-income (AOR:1.34;95%CI:1.23–1.46) and middle-income (AOR:1.21;95%CI:1.10–1.33 households. The findings also revealed that women residing in rural areas had significantly greater odds of late ANC initiation (AOR:1.21;95%CI:1.12–1.31) in the secondsurvey.
Anaba EA, Afaya A. 2022. (35) *http://dx.doi.org/10.1136/bmjopen-2021-058693*	Ghana	2019 Ghana Malaria Indicator Survey	Age, educational status, religion, ethnicity, wealth index, region, type of place of residence, health insurance coverage and parity.	2163 women in the 2019 Ghana Malaria Indicator Survey among women of reproductive age across the previous 10 regions of Ghana.	Late initiation and underutilisation of the recommended eight or more antenatal care visits among women of reproductive age.	About half (49%) of the participants were between the ages of 25 and 34 years; mean (±SD)=30 (±7.10). The majority (57%) of the participants obtained less than eight antenatal care visits, while 32% initiated antenatal care visits after the first trimester. The significant factors associated with the late initiation of antenatal care visits were age, region, and parity ($p<0.05$). Factors associated with underutilisation of the recommended eight or more antenatal care visits were marital status, wealth index, parity, region, and place of residence ($p<0.05$)

Additional table 2. PRISMA-P (Preferred Reporting Items for Systematic review and Meta-Analysis Protocols) 2015 checklist: recommended items to address in a systematic review protocol*

Section and topic	Item No	Checklist item
ADMINISTRATIVE INFORMATION		
Title:		
Identification	1a	Identify the report as a protocol of a systematic review **(YES)**
Update	1b	If the protocol is for an update of a previous systematic review, identify as such **(N/A)**
Registration	2	If registered, provide the name of the registry (such as PROSPERO) and registration number **PROSPERO CRD42024478260**
Authors:		
Contact	3a	Provide name, institutional affiliation, e-mail address of all protocol authors; provide physical mailing address of corresponding author. **Marethabile Nthabiseng Mariti**, **University of The Witwatersrand, 2014166@students.wits.ac.za. Ha-Mabote Thoteng 1, Maseru Lesotho** **Dr. Juliana Kagura, Univeristy of The Witwatersrand, juliana.kagura@wits.ac.za**
Contributions	3b	Describe contributions of protocol authors and identify the guarantor of the review. **Dr. Juliana Kagura, supervisor, and reviewer**
Amendments	4	If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments **(N/A)**
Support:		
Sources	5a	Indicate sources of financial or other support for the review **(Self-funded)**
Sponsor	5b	Provide name for the review funder and/or sponsor **(N/A)**
Role of sponsor or funder	5c	Describe roles of funder(s), sponsor(s), and/or institution(s), if any, in developing the protocol **(N/A)**
INTRODUCTION		
Rationale	6	Describe the rationale for the review in the context of what is already known. **There is an existing literature that is inconsistent in reporting multilevel characteristics influencing antenatal care utilization. These are context-specific and necessitate a systematic review to illuminate which factors influence antenatal care utilization in SSA. This study will highlight areas of focus and inform the government, policymakers on guidelines, and project implementors on the status of maternal health in sub-Saharan Africa, aiding in the direction of limited resource allocation. (pg. 10)**

Objectives	7	Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO) **1. To describe the proportions of antenatal care utilization among women of reproductive age in sub-Saharan Africa from 2016-2023.** **2. To determine factors associated with antenatal care utilization among women of reproductive age in sub-Saharan Africa from 2016-2023. (pg. 10)**
METHODS		
Eligibility criteria	8	Specify the study characteristics (such as PICO, study design, setting, time frame) and report characteristics (such as years considered, language, publication status) to be used as criteria for eligibility for the review. **P=women of reproductive age (15-49years)** **E=determinants of antenatal care (ANC)** **Co=Sub-Saharan Africa**
Information sources	9	Describe all intended information sources (such as electronic databases, contact with study authors, trial registers or other grey literature sources) with planned dates of coverage. **A data search from PubMed, Google Scholar, EBSCO-Host (Global health), ProQuest (Public health), SABINET African Journals and Scopus databases using keywords was conducted**
Search strategy	10	Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated. **PubMed ("Prenatal Care" OR "ante*natal care"[tw] OR "pre*natal care"[tw] AND utili?ation* [tw] OR use*[tw] AND "Women" OR women*[tw] OR female*[tw] AND "sub*Saharan Africa"[tw] OR Africa*[tw])**
Study records:		
Data management	11a	Describe the mechanism(s) that will be used to manage records and data throughout the review. **Studies will be uploaded on Mendeley referencing software for management and duplicate removals after the completion of the search strategy.**
Selection process	11b	State the process that will be used for selecting studies (such as two independent reviewers) through each phase of the review (that is, screening, eligibility and inclusion in meta-analysis) **Two independent reviewers will be working independently of each other for screening of eligible studies and critical appraisal preceding data extraction for meta-analysis.**
Data collection process	11c	Describe planned method of extracting data from reports (such as piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators **Extraction will be conducted by 2 independent reviewers using a reputable software JBI. Disagreements will be discussed, and consensus reached. The primary author will break ties and resolve conflict.**
Data items	12	List and define all variables for which data will be sought (such as PICO items, funding sources), any pre-planned data assumptions and simplifications

		Extracted data will entail the author's name, date of publication, date the study was conducted, sample size, number of women who attended ANC, those who attained the recommended number and timing of ANC visits.
Outcomes and prioritization	13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale. **The outcome of interest for this review is antenatal care utilization which is defined in this context as antenatal care visits of 8 or more with the first visit booked within the first trimester of pregnancy or within the first 12 weeks of pregnancy.**
Risk of bias in individual studies	14	Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis. **The critical appraisal of studies that meet the eligibility criteria will be conducted using the Joanna Briggs Institute (JBI) critical appraisal tools for cross-sectional studies. The primary author MM and reviewer MM will critically appraise the studies for quality and biasness. This assessment tool comprises of 8 questions with 3 options, "yes", "no" and "unclear". Studies that will be included will be those with clear methodology including but not limited to inclusion criteria, study setting and participants characteristics, validity and reliability of results, identification and accounting for confounding variables and the statistical analysis used. Those that will score 8 and above will be considered for the inclusion in the final analysis.**
Data synthesis	15a	Describe criteria under which study data will be quantitatively synthesised **The pooled proportions on effect sizes with 95% confidence interval were calculated. The significance level was at p-value <0.05. Heterogeneity was conducted through Cochran's Q statistics for heterogeneity and it was quantified using I^2 where I^2 of >50% was reported as a significant heterogeneity (pg.16)**
	15b	If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data and methods of combining data from studies, including any planned exploration of consistency (such as I^2, Kendall's τ) **Summary statistics through use of frequency tables and meta-analysis**
	15c	Describe any proposed additional analyses (such as sensitivity or subgroup analyses, meta-regression) **Sensitivity analysis through resistance test of the studies included will be conducted for an outcome**
	15d	If quantitative synthesis is not appropriate, describe the type of summary planned **Thematic synthesis of the associated factors**
Meta-bias(es)	16	Specify any planned assessment of meta-bias(es) (such as publication bias across studies, selective reporting within studies)
		Funnel plots for publication bias
Confidence in cumulative evidence	17	Describe how the strength of the body of evidence will be assessed (such as GRADE)

*** It is strongly recommended that this checklist be read in conjunction with the PRISMA-P Explanation and Elaboration (cite when available) for important clarification on the items. Amendments to a review protocol should be tracked and dated. The copyright for PRISMA-P (including checklist) is held by the PRISMA-P Group and is distributed under a Creative Commons Attribution Licence 4.0.**

Shamseer L, Moher D, Clarke M, Ghersi D, Liberati A, Petticrew M, Shekelle P, Stewart L, PRISMA-P Group. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation. BMJ. 2015 Jan 2;349(jan02 1):g7647.

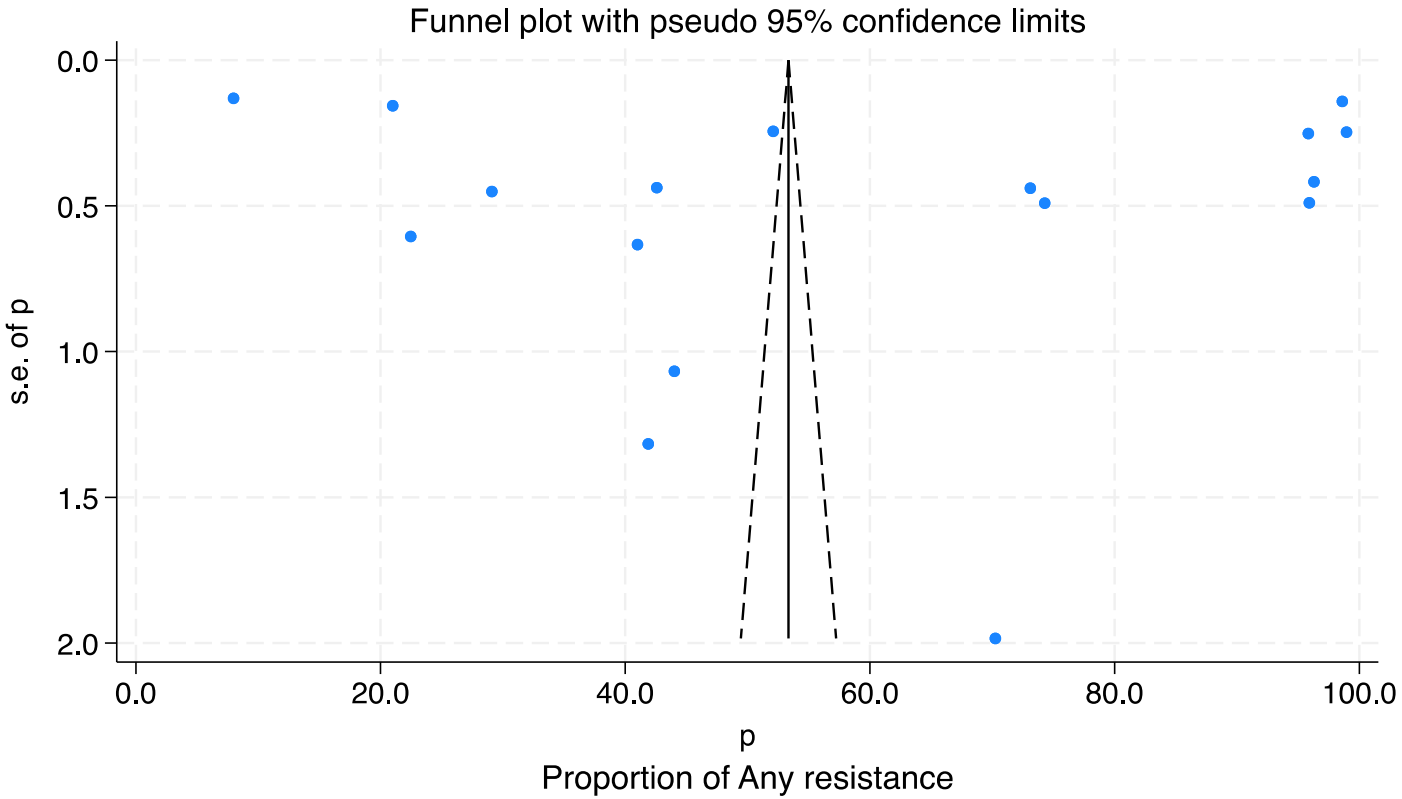


Figure 13. Funnel plot for proportion of any resistance