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Determinants of antenatal care service utilization among pastoralist women in Kiteto District, Tanzania.

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abstract

Utilization of antenatal care services is associated with improved maternal and neonatal health outcomes among pregnant women in Kiteto District. A cross-sectional design was used to examine the association between the independent variables and the outcome variable among targeted population at a single point in time. The Andersen's Behavioral Model of health services utilization was adopted because it explains why individuals use healthcare services through predisposing, enabling and need based factors. Stratified and simple random sampling was used sample 427 women aged between 15-49 years for the study based on inclusion and exclusion criteria. A structured questionnaire which constituted socio-demographic characteristics, number and timing of antenatal care visits, place of delivery and assistance during child birth was used in this study. The data was analyzed using logistic regression to predict key determinants influencing outcome variable. The finding shows that 73.3% of the respondents received antenatal care services; among them only 30% made at least four visits during their last pregnancy. This suggests that while initial ANC access is relatively high, structural barriers like distance, cost, or competing demands likely to hinder consistent care utilization throughout pregnancy. The results further indicate that a small proportion (19.2%) had first antenatal care (ANC) visit during the first trimester of pregnancy. The multivariate regression analysis show that being a small business woman (AOR=1.31, 95% CI=0.738-2.334) and urban residency (AOR=2.19, 95% CI=1.219-3.947) encouraged the antenatal care utilization while higher parity of ≥4 (AOR=0.523, 95% CI=0.264-1.035) was inversely associated with ANC utilization as compared to women who had 1-3 parity. Similarly, women with primary or above education level were more likely to visit ANC services (AOR=5.591, 95% CI=3.050-9.181) as compared to women who had no formal education. The study recommends that mothers should be educated and made to access skilled health providers for antenatal, delivery and postnatal care to enable early detection of pregnancy complications and allow prompt treatment for a mother and the newborn. Similarly, the study recommends a comprehensive policy interventions including mobile clinics and outreach program to improve antenatal care (ANC) utilization among pastoralist communities.

Introduction

Maternal mortality continues to be a critical public health issue, with Sub-Saharan Africa (SSA) recording the highest global incidence. The region accounts for approximately 70% of maternal deaths worldwide, which is an indication that there are deep-seated health inequities and structural barriers to care (WHO, 2023). In SSA, there are big differences between and within countries, with marginalized groups having death rates that are much higher than the national average (Jung, 2023). Most maternal deaths occur during childbirth and 42 days of postpartum, which makes the pregnancy and childbirth periods fundamental for the survival of mothers and their newborn babies (Simona et al., 2022). These deaths are caused by preventable factors that could be reduced by providing adequate and quality prenatal, intrapartum, and postnatal care. However, with the current pace, the world is not on truck in achieving Sustainable Development Goal (SDG) 3, targeting at reducing global maternal mortality to <70 deaths per 100,000 live births and the large disparities in health outcomes between countries and within them (Schriger et al., 2021). Moreover, it is apparent that maternal healthcare (MHC) services such as antenatal care, skilled delivery care, and postnatal check-ups for mothers and babies are some of the most important drivers of maternal and child mortality in the world (Schriger et al., 2021). There are dissimilarities in maternal mortality within the Sub-Saharan Region. Sierra Leone has a high MMR of 1,360/100,000 live births and more than half of home deliveries (Zembe et al., 2022) Rwanda as one of the Eastern African countries, has shown notable progress in reducing MMR from 750 deaths per 100,000 live births in 2005 to 203 deaths per 100,000 live births in 2020 (Bain et al., 2022). Similarly, Uganda has made slight progress in the reduction of maternal mortality as well as facility delivery rose from 42% in 2006 to 74% between 2016 and 2021 (Birabwa et al., 2024; Sserwanja et al., 2022). In Malawi and Ghana, it was observed that poor quality of delivery facilities is associated with a high risk of newborn mortality regardless of other individual factors such as education and place of residence (Boah et al., 2018; Wong et al., 2020). The accessibility of ANC gives a pregnant woman the opportunity to benefit from care services including screening and diagnosis and disease prevention (Vasconcelos et al., 2022). Unfortunately, many of them do not have access to such services. In Sierra Leone, it is reported a high proportion

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of women have received antenatal care at least once, but few of them deliver at a health facility (Dickson et al., 2023). Thus, the high prevalence of ANC usage does not translate into the use of health facilities for child delivery.

Tanzania exemplifies this challenge, with a maternal mortality ratio of 104 deaths per 100,000 live births according to recent national data (Ndaboine et al., 2025). Antenatal care represents a critical intervention in reducing maternal mortality, yet substantial spatial variations in service utilization persist across the country. While national coverage for four or more ANC visits stands at 63%, this figure masks significant inequalities between urban and rural populations, and particularly among remote communities (Macharia et al., 2022; Mwangi, 2023). Among Tanzania's most underserved populations, pastoralist communities experience extreme health disparities. Their nomadic livelihood, characterized by constant mobility in search of pasture and water, creates unique barriers to accessing maternal healthcare (Kariuki, 2025; Muchema, 2023). Recent studies among pastoralist populations in East Africa have demonstrated consistently lower ANC utilization rates compared to national averages, attributed to factors including geographical isolation, socio-cultural barriers, and limited health system responsiveness to mobile populations (Kariuki, 2025; Wulifan et al., 2022).

Despite the notable decrease of the maternal mortality rate in Tanzania, it continues to be a problem in most of the African countries and contributes to 61% of global maternal deaths (Thobias et al., 2022). Previous scholarly work has used maternal health services including antenatal care, delivery care, and postnatal care as a corridor in tracking the progress of Sustainable Development Goals (SDGs) toward maternal mortality reduction (Onambele et al., 2022; Hailemariam et al., 2023; Sserwanja et al., 2022; Tadesse, 2020; Atuoye et al., 2017). The recent survey of Tanzania Demographic Health Survey and Malaria Indicator Survey (TDHS-MIS) of 2022 indicated a considerable proportion of pregnant women (65%) who had 4 or more antenatal care visits during pregnancy in their last live births. Similarly, at the Kiteto District, only 49% of pregnant women gave birth at public health facilities compared to the national level average of 81% (MoH, 2023). Adequate and quality ANC has been documented to contribute towards the reduction of maternal and neonatal mortality (Sserwanja et al., 2022). This demonstrates that there is a need to prioritize ANC programs in order to ensure the successful implementation of at least eight contacts for every pregnant woman towards the reduction of MMR to less than 70 per 100,000 live births by 2030 (Raina et al., 2023) .

The study was guided by Andersen's Behavioral Model of Health Services Utilization to comprehensively understand the predisposing, enabling, and need factors as a framework that influence health-seeking behaviors among pastoralist women in Kiteto District. The model guides all stages of the research, from data collection to discussion of findings. However, few studies in Tanzania have examined the factors which impede the utilization of ANC care, especially to pastoralist societies including the Maasai. This information is key to policymakers and other stakeholders to be able to design and implement some effective strategies to unpin and escalate the utilization of antenatal care across the continuum. Therefore, this study aims to examine the determinants of antenatal care service utilization among pastoralist women in Kiteto District, Tanzania. factors which impede the utilization of antenatal care among women receiving maternal healthcare services in Kiteto District. This objective directly aligns with Andersen's Behavioral Model, which guides the study's design and analysis.

Methods of Research

Study area

The study was conducted in the Kiteto District, Manyara Region. This district is located 220 kilometers away from Manyara regional headquarters in the northern plateau of Tanzania and is one among the five districts in the region. The district was chosen because more than one-third (34%) of women of childbearing age are not able to access health care services as they cannot afford payment for maternal services (MoH, 2023). Furthermore, about 49% of pregnant women gave birth at public health facilities, which is nearly twice less compared to the national average of 81% (*ibid*). Additionally, the region is one among the top ten regions with a high maternal mortality and the majority of the population are pastoralists in nature (Maasai) who reside in isolated zones making the accessibility to health facilities is inadequate.

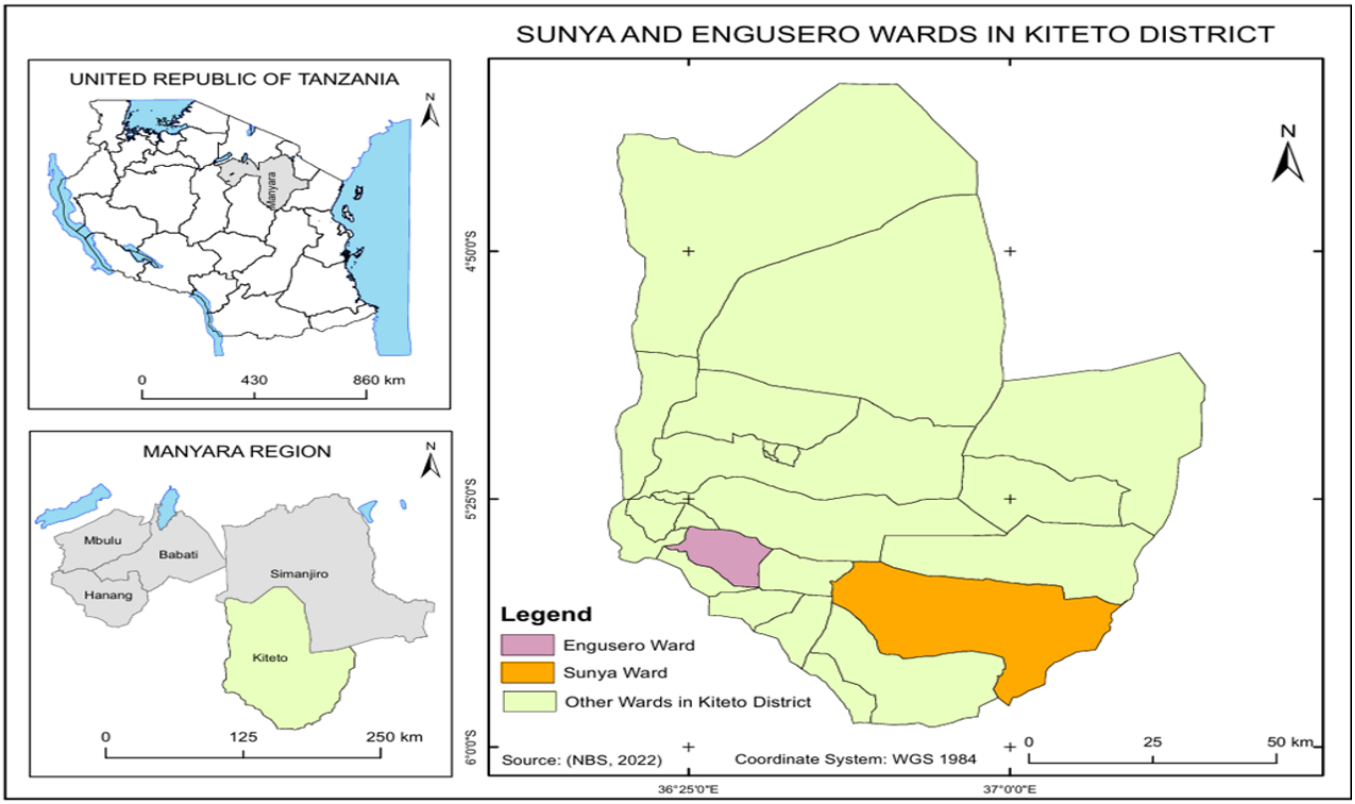

Figure 1: Location of study areas

The study design

The study employed a cross-sectional research design to women who experienced child birth within five years prior to the study. The design was adopted to examine the association between the independent variables and outcome variable among targeted population at a single point in time (Lin, 2022). To obtain the desired sample, data were collected over a defined period from July 2023 to May 2024. The Andersen's Behavioral Model of Health Services Utilization was adopted as foundational conceptual framework for this study, guiding the analysis of factors influencing antenatal care (ANC) utilization among pastoralist women in the Kiteto District (Andersen, 1995; Lin, 2022). This model was selected for its comprehensive approach to categorizing determinants of healthcare access into three components: predisposing characteristics, enabling resources, and need factors to understand health-seeking behaviors (Fisher et al., 2021; Mohd Noh et al., 2022). The study variables align with the model's three key dimensions of predisposing (age, education, residence, marital status, household size) enabling resources (distance to health facilities, income, availability of health professionals, waiting time, transport/mobility) and perceived factors including (parity, pregnancy complications, ANC knowledge including timing and number of ANC visits as well as place of delivery). The outcome variable, adherence to the recommended four or more ANC visits (ANC4+), was operationalized as the health behavior component of the model. By applying the Andersen Model, this study aimed at examining the multifaceted and interacting determinants to ANC service use in a pastoralist context, thereby providing insights that can inform targeted and effective public health interventions.

Sample size and non-response adjustment

The sample size for this study was calculated using a statistical formula for estimating a single population proportion. This method was chosen because the primary objective is to determine the prevalence of ANC utilization and its associated factors within the pastoralist population. The Cochran (1963) formula was adopted in calculating sample size by considering the proportions of the targeted population that used health facility for delivery. The formula assumes tolerable error of 5% and 10% non-response adjustment.

$$n = \frac{z^2 * p(1-p)}{e^2}$$

Where:

n = sample size

z = standard normal deviation from the mean set at 1.96

p= proportion of targeted population 48%=0.48

e = degree of accuracy/tolerable error at 5%

Thus; $n = (1.96)2 \times 0.48 \times (1 - 0.48) = 384.5$

To ensure the target sample size (n=384) was achieved despite an anticipated 10% non-response rate and the initial sample size was adjusted using the standard survey formular (Groves et al., 2011; Stern et al., 2014).

$$n_{adjusted} = \frac{1}{1 - non - response\ rate} = \frac{1}{1 - 0.10} = 427$$

This adjustment accounts for potential non-respondents while maintaining the study's statistical power by yielding an initial sample of 427.

Sampling procedure

The study involved women aged between 15-49 years who had experienced childbirth five years prior to the commencement of the study. A five-year time frame helps to improve the accuracy, reliability and relevance of the data which is crucial for drawing valid and meaningful study conclusions. The district was purposefully selected because it has more pastoralist ethnic group and had signs of low use of antenatal care services in comparison with other districts in the region. The study employed stratified random sampling to ensure representation in the sample across key socioeconomic and mobility-based subgroups (Ntoimo et al., 2022). The participants were stratified by livelihood type, mobility patterns and geographic access zones. Two wards were purposively selected based on the identified stratum. Further, two villages having public health facilities with reproductive and child care (RCH) services were selected respectively. The study employed proportional stratified sampling to select 427 pastoralist women from a total population of 17,381 aged between15-49 years across two wards in Kiteto District. According to the population size of each ward, samples were distributed proportionately and further stratification within wards to make sure that important subgroups were represented.

The study assessed scale reliability through Cronbach's alpha test. The value demonstrated acceptable internal consistency using 30 participants pilot test (n=30; α=0.84) alongside 95% confidence intervals to ensure robust measurement of pastoralist women's ANC utilization determinants. However, the sampling frame was based on Tanzania's 2012 census report because data collection for the study occurred in early 2023 and the 2022 census report was unavailable/unpublished. The potential bias that is likely to be introduced is coverage bias, which includes underrepresentation, age structure, and fertility changes, to name a few. Moreover, the sampling procedure enables the representation, that allowed more meaningful comparisons from all four villages which were selected from two wards. The proportional sampling was employed to obtain the required sample from each village. To obtain the respondents within multi-female households, the Kish grid was used to randomly select one eligible female in the household and 427 women were employed to participate in the study (Kish, 1949).

Variables

The selected independent variables in Table 1 were used in examining the determinants of antenatal care services utilization among women of reproductive age who receives maternal services at the health facilities. The independent variables of interest were mothers' age, age at first birth, education level of mother, parity, place of residence, income, marital status, occupation and household size. The dependent variable was antenatal care (ANC) visits. Since logistic regression was used, the dependent variables were coded into two categories. For the number of antenatal care visits, it is recommended by the World Health Organization (WHO) that to improve the quality of care and increase ANC visits coverage, a pregnant mother should have at least four ANC visits. However, in Tanzania, many studies and health programs still use ≥4 ANC visits as a benchmark as opposed to WHO (2016) recommendations because of historical policy and gradual transition, health system constraints and key interventions mostly covered in 4 visits (Bintabara et al., 2019; MoH, 2017;WHO, 2002). Therefore, for this variable, mothers with at least four ANC visits were coded 1, and 0 for mothers with less than four ANC visits. Statistically significant independent variables were selected for discussion as they are significant in explaining the predictors observed in their respective dependent variables.

Table 1: Description and coding of the set of independent variables

Variable Name	Description
Age	Age of the mother (Number of years)
Education	Mother's level of education (1=None, 2=primary, 3=secondary)
Marital status	State of being married or not (Married=1, 0=Not married)
First age at birth	Age of mother during first pregnancy (Number of years)
Type of occupation	Respondents' daily economic activities categorized as 1=farmers, 2=small business, 3=livestock keeping.
Parity	The number of times that a woman has given birth, whether born alive or stillborn
Residence	Place of living (1=Rural, 0=Semi-urban)
Household size	Number of household members in the household

Data analysis and Model Specifications

The data were collected using Kobo Collect software through sequential sections from consent, demographics (age/education), access factors (distance/transport), ANC use/complications and pastoralist-specific barriers (mobility/TBAs). The skip logic, validation, and GPS were used to efficiently capture Andersen Model domains while adapting to pastoralist contexts. The

structure flow minimizes redundancy and ensures relevance and data accuracy for analysis. The Statistical Package for Social Science (SPSS) was used in sorting and cleaning the data prior to the analysis. Binary logistic regression was used to predict outcome for the binary dependent variable and their respective independent variables. To ensure the reliability of the regression model used, the multicollinearity test was conducted by calculating the Variance Inflation Factor (VIF) which indicated no significant correlation between the independent variables. Model fitness was evaluated using the Nagelkerke Pseudo-R-squared value in confirming the appropriateness of the model. However, the covariates were retained in the final multivariate model based on a dual foundation of statistical thresholds if p-value was less than 0.05. This approach ensured that the final model included only variables with independent explanatory power, such as education, residence, parity and knowledge of ANC services while maintaining a strong basis in behavioral theory. All 427 participants were kept in the final multivariate model after a complete-case analysis was conducted because no missing values were found in the dataset. Taking the natural log of odds makes the variable more suitable for regression, the model was specified as follows;

$$y^* = \ln\left[\frac{p_1}{1-p_1}\right] = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k + \varepsilon_i$$

Whereby:

Y_i = 1 if woman *i* had **≥4 ANC visits**, 0 otherwise.

β_0 = Intercept (baseline log-odds of ≥4 ANC visits).

$\beta_2, \beta_2, \ldots, \beta_k$ = Coefficients for predictor variables $X_1 X_2, \ldots \ldots X_k$

ε_i = error term.

Results

The analysis included 427 women aged between 15-49 years who received maternal health care services in the Kiteto District. The results from Table 2 show that the majority (59.5%) of the respondents were aged 20-34 years, followed by 24.8% who were aged 35-49 years. For the level of education, more than half (56.2%) had never gone to school, only 36.5% had completed primary education and very few (7.3%) had achieved secondary education and above. In the case of marital ties, the majority (76.1%) were married and only 23.9% were not married. Moreover, 72.6% of the respondents came from households with 5-8 members, while 26% came from households with 1-4 members. Further, the results show that the majority (61.1%) of women were living in rural areas and 38.9% were living in urban areas. On the other hand, more than three-quarters (82.2%) of the respondents had their first birth at a young age between 15-19 years and very few (0.7%) gave birth at age 25 years and above. Farming and livestock keeping were the main occupations of the respondents with 38.2% and 36% respectively. Only 25.8% of the respondents were engaging in petty business-like selling beverages including local brew, charcoal selling and brick making. Additionally, 58.8% of the respondents had a parity of 1-3 children while only 41.2% had a parity of 4 or more children.

Utilization of Antenatal Care Services

Antenatal care

Table 3 presents the findings on the extent to which mothers aged 15-49 years utilized antenatal health care services within the study area. The number of antenatal care visits, the timing of antenatal visits, and the place of delivery were used to explain the status of antenatal care services utilization among women receiving maternal care services. The results demonstrate that, nearly three-quarters of the respondents (73.3%) received antenatal services and only 26.7% did not receive the same services. Among women who visited an antenatal care clinic, 33% made at least four visits during their last pregnancy. Approximately, more than two-thirds (67%) of women reported less than four ANC visits during their last pregnancy. Furthermore, a small proportion (19.2%) timely antenatal visit occurred in the first trimester (>4month) of pregnancy. Similarly, more than three-quarters (80.8%) of the respondents attended antenatal clinic in the second trimester (4- 6 months) of pregnancy. This finding reveals a critical disparity between ANC access and quality care among pastoralist women, highlighting a significant missed opportunities to deliver timely, comprehensive ANC services, as most women either started care too late for early interventions or received insufficient visits for adequate monitoring and preventive services.

Table 2: Percentage Distribution by Various Demographic Characteristics (n=427)

Variables	Frequency	Percent (%)
Age (Years)		
15-19	67	15.7
20-34	254	59.5
35-49	106	24.8
Education Level		
Not attended	240	56.2
Primary education	156	36.5
Secondary education	31	7.3
Marital Status		
Married	325	76.1
Not married	102	23.9
Place of Residence		
Rural	261	61.1
Semi-urban	166	38.9
Type of occupation		
Farming	163	38.2
Small business	110	25.8
Livestock keeping	154	36
Age at First Birth (Years)		
15-19	351	82.2
20-24	73	17.1
25+	3	0.7
Parity		
1-3	251	58.8
4 and above	176	41.2
Household size		
1-4 members	111	26
≥5 members	316	74

Delivery care

In total, 50.4% of deliveries occurred in a health facility, with most of deliveries taking place in primary public health facilities. About half (49.6%) of deliveries took place at home. The implication of not giving birth at a health facility might have been associated with factors such as distance to the health facility and the associated cost of travelling and delivery, inadequate attendance of ANC care during pregnancy, socio-cultural perception and ignorance of the benefits of delivering at the health facility. It is believed that, the choice of place of delivery among pregnant women is determined by several reasons including the use of antenatal care clinics. Moreover, the use of institutional delivery services is essential for improving maternal and child health (Maximore et al., 2022). This notwithstanding, about half (49.6%) of the respondents were assisted by unskilled health personnel during childbirth. The implications of this finding might be related with transportation cost, long distance to the nearest health facilities and cultural perceptions. Furthermore, low utilization of skilled birth attendants during childbirth in rural areas in Sub-Saharan Africa is influenced by availability, accessibility, acceptability and existence of quality of care (Konje et al., 2020).

Factors influencing antenatal care attendance among pregnant women

The binary logistic regression analysis presented in Table 4 explains 43% of the variance in antenatal care utilization, indicating a good fit to the data. All categorical variables were analyzed using logistic regression in SPSS (Version 27). Reference categories were explicitly set as follows: education level ('none'), residence ('rural') and occupation ('farming'). Similarly, age was set as categorical variable ('20-34', reference) and parity ('≤3', reference) with dummy coding to compare groups. According to the findings, women who completed primary school and beyond were 5.2 times more likely to use prenatal care than women who did not receive any formal education (AOR= 5.29; 95% CI 3.050-9.181).

Table 3: Parameters of Maternal Care Services Utilization (n=427)

Variables	Frequency (%)
Knowledge ANC services	
Yes	313 (73.3)
No	114 (26.7
Number of ANC visits	
≤ 4 visits	286 (67)
> 4 visits	141(33)
Timing of ANC visits	
1st trimester	82 (19.2)
2nd trimester and above	345 (80.8)
Place of delivery	
Health facility	215 (50.4)
Home	212 (49.6)
Assistance of delivery	
Health personnel	215 (50.4)
TBA	212 (49.6)

The findings indicate a significant association between level of education and antenatal care utilization (p=0.009). This finding underscores that; women education level is profoundly an important determinant of health-seeking behavior. Similarly, women who reside in semi-urban areas were 1.2 times likely to visit antenatal care services during pregnancy compared to those who are living in rural areas (AOR= 2.19; 95% CI 1.219-3.947). The estimation indicates that there is a significant association between place of residence and antenatal care visits (p=0.009). These findings highlight a significant disparity in maternal healthcare access based on geographical location. It implies that systemic barriers such as longer distances to clinics, transportation challenges, fewer available services, or socioeconomic factors prevalent in rural settings are preventing a substantial portion of women from accessing essential prenatal care. Generally, the findings indicate that both geographic location and educational attainment are significant, independent predictors of antenatal care (ANC) utilization. In this study, the variables of education and residence are critically analyzed through the lens of the Andersen Behavioral Model, reflecting distinct yet interconnected dimensions. Variable education is a predisposing factor, influencing knowledge and attitudes towards seeking health-care. Residence is an enabling factor; for pastoralists, remote, nomadic life creates immense geographic and logistical barriers to accessing health care. This interplay shows that even educated women may forego care due to their mobility and distance from services, highlighting a key determinant of low ANC utilization.

Factors influencing the use of health facilities for delivery

The logistic regression model in Table 5 has shown a strong fit to the data. The Cox & Snell R^2 value of 0.443 and the Nagelkerke R^2 value of 0.590 indicate that the predictor variables explain between 44.3% and 59% of the variance in antenatal care utilization among pastoralist women in Kiteto District. The results show that women with at least a primary education were 0.17 times less likely than those without any formal education to give birth in a health facility (AOR=0.17; 95% CI:0.096-0.302). Nonetheless, among women receiving maternal health services in the Kiteto District, the logistic regression reveals a statistically significant relationship between delivery care and educational attainment (p=0.000). This finding presents a counterintuitive and significant public health implication that educational attainment alone is an insufficient lever for improving maternal health outcomes. Moreover, the odds of facility delivery were 0.3 times less among women who were living in semi-urban areas in comparison to their counterparts living in rural areas (AOR=0.3; 95% CI:0.165-0.579). Likewise, the estimation indicates that, there was a significant association between place of residence and delivery care (p=0.000). The fundamental assumption is that more urban equals better healthcare access is not always true, implying a potential semi-urban penalty where these communities may fall into a service gap. In the study, both education (a predisposing characteristic) and residence (an enabling resource) had an Adjusted Odds Ratio (AOR) of less than 1 for delivery care use. This indicates that, contrary to typical findings, higher education and pastoralist residence were associated with significantly lower odds of utilizing skilled delivery services. This setback highlights how structural barriers inherent to the pastoralist lifestyle such as remoteness, mobility and cultural norms override individual knowledge and make residence a key disabling factor.

Table 4: Multivariate logistic estimation results for ANC visits

					95% C.I	
Variables	**B**	**S. E**	**p value**	**Adjusted ORs**	**Lower**	**Upper**
Age (years)						
15-19	0.068	0.374	0.856	1.07	0.514	2.229
20-34 (Ref)				1.00		
35-49	-0.270	0.409	0.509	0.76	0.342	1.702
Education						
None (Ref)				1.00		
Primary level or above	1.666	0.281	0.000***	5.29	3.050	9.181
Residence						
Rural (Ref)				1.00		
Semi-urban	0.785	0.300	0.009***	2.19	1.219	3.947
Occupation						
Farming (Ref)				1.00		
Petty trade	0.272	0.294	0.355	1.31	0.738	2.334
Livestock keeping	-0.112	0.344	0.745	0.89	0.455	1.756
Parity						
1-3 (Ref)				1.00		
4 or above	-0.649	0.349	0.063	0.52	0.264	1.035

Note: ***, ** denote 1%, 5% respectively, OR denote Odds Ratios, 1.00 refers to the reference category

Model fit statistics: Cox & Snell R-square = 0.297, Nagelkerke R^2 = 0.433

Table 5. Multivariate logistic estimation results for health facility delivery care

Variables	B	S. E	p value	Adjusted ORs	95% C.I	
					Lower	Upper
Age (years)						
15-19	0.298	0.402	0.458	1.13	0.613	2.962
20-34 (Ref)				1.00		
35-49	0.421	0.410	0.304	1.52	0.683	3.402
Education						
None (Ref)				1.00		
Primary level or above	-1.773	0.293	0.000***	0.17	0.096	0.302
Residence						
Rural (Ref)				1.00		
Semi-urban	-1.175	0.321	0.000***	0.30	0.165	0.579
Occupation						
Farming (Ref)				1.00		
Petty trade	-0.368	0.363	0.310	0.69	0.340	1.409
Livestock keeping	1.785	0.343	0.000***	5.96	3.043	11.674
Parity						
1-3 (Ref)				1.00		
4 or above	0.626	0.381	0.100	1.870	0.887	3.943

Note: ***, ** denote 1%, 5% respectively, OR denote Odds Ratios, 1.00 refers to the reference category
Model Fit Statistics: Cox & Snell $R^2 = 0.443$, Nagelkerke $R^2 = 0.590$

Discussion

This study sought to identify the determinants of antenatal care (ANC) utilization among pastoralist women in the Kiteto District, Tanzania, using the Andersen Behavioral Model of Health Services Use as a guiding framework. The findings demonstrate the complex interplay of factors that influence care-seeking behavior, largely aligning with the model's constructs of predisposing, enabling, and need factors. In total, 73.3% of targeted respondents reported obtaining ANC from skilled providers, indicating a high use of skilled ANC services. However, among women who visited the ANC clinic, only 30% visited at least four times or more during their last pregnancy. Shockingly, almost 26.7% of the respondents did not attend the antenatal clinic during their last pregnancy. Furthermore, only 19.2% of women reported that their first antenatal visit occurred within the first trimester. Although the use of ANC was somewhat high, many women did not receive at least four ANC skilled assessments similar to arguments made in (Bain et al., 2022; Sserwanja et al., 2022). Equally, the timing of ANC assessments as early as possible during the first trimester was marginal as recommended by World Health Organization (WHO) and Tanzania's Ministry of Health (El-Khatib et al., 2020; Tufa et al., 2020). These findings indicate that, women were not receiving comprehensive and focused ANC services, signifying critical gaps in utilization of antenatal services. However, the study found a substantial utilization of skilled ANC, a relatively low proportion (49.6%) of deliveries occurred at the health facility and only 48.7% were assisted by skilled birth attendants. These findings are inconsistent with several studies conducted in Nigeria and Ethiopia which indicated that receiving ANC from a skilled birth attendant does not itself guarantee that women will seek and receive skilled delivery (Ntoimo et al., 2022; Tiruneh et al., 2022). Similarly, various researches have shown that there is low utilization of skilled attendants, especially during delivery, in most of the developing countries the majority of underdeveloped countries. (Walker et al., 2021). Moreover, literature pointed out that, adequate knowledge provides benefits of ANC services coverage and women become aware of the complications associated with pregnancy (Ftwi et al., 2020).

From the regression analysis, the variables education and residence and type of occupation were significant predictors of antenatal care utilization among pregnant women in Kiteto District. The result found that there is a significant association between the level of education as a predisposing factor and antenatal care services utilization. It demonstrates that women with a primary level of education or above were more likely to utilize antenatal care service unlike women with no formal education. Comparable to this finding, Uwimana et al. (2023) found that women who are more educated receives almost all elements of the continuum of care and have high autonomy in health seeking behavior. Similar to this study's findings, Vasconcelos et al. (2022) also posited that women residing in better socio-economic households had greater access to and utilization of maternal healthcare. Moreover, it was found that women who reside in urban areas were more likely to utilize antenatal care services including ANC visits, delivery care and delivery assisted by skilled birth attendants in comparison to their rural counterparts. This outcome was consistent with previous studies conducted in other developing countries. For example, a study conducted in Nigeria and Ethiopia found that rural women were less likely to attend prenatal clinics four or more times than urban women (Adewuyi et al., 2024; Yemane, 2022). Also, this finding conforms with Simona et al. (2022) who found out that women who were living in urban areas in Sub-Saharan Africa were 3.62 times likely to utilize antenatal care services compared to women living in rural areas. A recent study in sub-Saharan Africa by Ahinkorah et al. (2022) found that higher educational attainment was the single most powerful predictor of achieving both adequate ANC content and frequency. Similarly, a study in Southeast Asia by Aikpitanyi et al. (2024) concluded that educating girls and women remains a fundamental long-term strategy for improving maternal health outcomes, as it directly influences health-seeking behavior.

One unanticipated finding was that women who had a primary level of education or above were less likely to utilize health facility for delivery compared to women who had not attended any formal education. However, this finding contradicts previous research findings by Alatinga et al. (2021) and Mugambe et al. (2021) who found that mothers who had a higher level of education had higher odds of giving birth at a health facility compared to mothers who did not attend formal education. This demonstrates how cultural and occupational considerations may outweigh education's traditional health benefits in nomadic societies. The study also found a significant association between place of residence and facility delivery services utilization which is similar with the study conducted among Ethiopian pastoralists (Gashaye et al., 2021; Hailemariam et al., 2023b). This finding is understandable because of proximity of health facilities in most urban areas and therefore, women tend to opt for hospital deliveries. Moreover, the study revealed that women with high parity (≥4) were more likely to choose facility delivery. This is inconsistent with previous studies (Mugambe et al., 2021; Oyedele, 2023). The consistently low ANC utilization found in this study is in line with earlier research conducted among the pastoralist communities in Kenya and Uganda (Achen et al., 2022; Galgalo et al., 2024) and Somali pastoralists in Ethiopia (Mohamed et al., 2024) who are characterized by limited formal education and geographic mobility. Pastoralists are facing unique challenges compared to other marginalized groups, such as women in urban informal settlements, where barriers are often financial and related to service quality (Sserwanja et al., 2022). This is because their nomadic lifestyle makes it hard for them to

access health care. This disparity is consistent with multi-country analyses that show rural women, especially those living in remote areas with low levels of education, consistently exhibiting the lowest coverage of quality ANC (Ayele et al., 2025).

Conclusion and recommendations

The continuity of antenatal care is the central principle supporting maternal, newborn and child health. Each element of the continuum of care for maternal health provides essential and potentially lifesaving services. Access to skilled health providers for antenatal, delivery and postnatal care enable early detection of pregnancy complications and allows prompt treatment for a mother and a newborn. Based on the findings, despite of high ANC visits, moving along comprehensive ANC service utilization for delivery care and deliveries assisted by a skilled attendant was patently lower. Similarly, very few (19.2%) had timely (first trimester) ANC visits and only 30% had four visits coverage. This indicates that, use of skilled attendants during ANC visits does not in itself promise that women will deliver at the health facility and be assisted by skilled personnel during delivery care. Therefore, this calls for the development of policy and interventions that will facilitate a "continuum of care "program for maternal health services from ANC, delivery care and postnatal care. Similarly, the study demonstrated that women with a high level of education are more likely to receive antenatal care from a skilled health attendant. Thus, there is a need to spearhead policies and programs aiming at increasing the uptake of ANC services for women with less education. This will increase the awareness on the importance of antenatal, delivery care and postnatal care. Strengthening education for girls and women of childbearing age in Sub-Saharan Africa (SDG goal 4) would improve maternal health outcomes (SDG goal 3). This reflects the association between high-quality education and better health. Additionally, research finding shows that women residing in urban areas are more likely to receive antenatal care compared to their rural counterparts. It was found that more than two-thirds (61.1%) of women were living in rural areas. This is because, majority of pastoralist communities tend to live in isolated zones (Bomas) to search land for grazing. Therefore, to increase ANC uptake among pastoralist women in the Kiteto District, some specific interventions by the Ministry of Health are required including mobile clinics for remote access, maternal education outreach program and incentives such as cash transfers to overcome missed opportunities like to deliver timely and to obtain comprehensive ANC services. In addition, community level intervention by strengthening community health workers, traditional birth attendants and males involvement to tackle socio-cultural barriers (Kachimanga et al., 2025; Mwilike et al., 2024). In conclusion, a longitudinal mixed-methods study should be conducted to deeply understand the decision-making process throughout a pastoralist woman's pregnancy journey, tracking how perceptions and barriers change over time.

Study Limitations

The study employed a cross-sectional research design which is appropriate for assessing the prevalence of behaviors or diseases in a given population (Ali et al., 2020). Thus, the use of cross-sectional data for the present study was suitable in terms of identifying women who had received antenatal care from a skilled health attendant. Despite of the importance of the study, there were some limitations encountered including access to data, as the sample frame was extracted from the 2012 Tanzania census report because the 2022 census report was not yet officially published as of the time this research was carried out. Similarly, women experienced a recall bias which is defined as a systematic error due to differences in accuracy or completeness of recall to memory experienced in the past events during their last pregnancy within five (50 years preceding the study (Vasconcelos et al., 2022). This interval of 5 years may therefore, have impacted on respondent's accuracy of recall when completing the questionnaire. This is because women were sampled within four villages, estimates mat be correlated within cluster; designed-based analysis would yield more accurate standard error (Tiwari et al., 2024). Another limitation was based on the conceptual framework. Although acknowledging the strengths and contributions of Andersen's model in health research, it is worth noting that the model has some potential weaknesses and criticisms. The framework ignored the broader social context, such as the social network in which individuals decide to seek healthcare. Also, the model has failed to include psychosocial components which deal with the knowledge regarding illness.

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Conflict of Interest

All authors declared that no conflict of interest regarding this research.

Ethical approval

A written informed consent was obtained from all participants before enrollment.

References

Achen, S., Rwabukwali, C. B., & Atekyereza, P. (2022). Contraceptive use among young women of pastoral communities of Karamoja sub-region in Uganda. *Culture, Health & Sexuality*, *24*(2), 167–179. https://doi.org/10.1080/13691058.2020.1823482

Adewuyi, E. O., Auta, A., Adewuyi, M. I., Philip, A. A., Olutuase, V., Zhao, Y., & Khanal, V. (2024). Antenatal care utilisation and receipt of its components in Nigeria: Assessing disparities between rural and urban areas—A nationwide population-based study. *Plos One*, *19*(7), e0307316.

Ahinkorah, B. O., Seidu, A.-A., Budu, E., Mohammed, A., Adu, C., Agbaglo, E., Ameyaw, E. K., & Yaya, S. (2022). Factors associated with the number and timing of antenatal care visits among married women in Cameroon: Evidence from the 2018 Cameroon Demographic and Health Survey. *Journal of Biosocial Science*, *54*(2), 322–332.

Aikpitanyi, J., Yacin, F., & Tubeuf, S. (2024). Effectiveness of behavioural change interventions to influence maternal and child healthcare-seeking behaviour in low and lower-middle-income countries. *African Journal of Reproductive Health/La Revue Africaine de La Santé Reproductive*, *28*(4), 127–148.

Alatinga, K. A., Affah, J., & Abiiro, G. A. (2021). Why do women attend antenatal care but give birth at home? A qualitative study in a rural Ghanaian District. *Plos One*, *16*(12), e0261316.

Ali, N., Elbarazi, I., Alabboud, S., Al-Maskari, F., Loney, T., & Ahmed, L. A. (2020). Antenatal care initiation among pregnant women in the United Arab Emirates: The Mutaba'ah study. *Frontiers in Public Health*, *8*, 211.

Andersen, R. M. (1995). Revisiting the behavioral model and access to medical care: Does it matter? *Journal of Health and Social Behavior*, 1–10.

Atuoye, K. N., Amoyaw, J. A., Kuuire, V. Z., Kangmennaang, J., Boamah, S. A., Vercillo, S., Antabe, R., McMorris, M., & Luginaah, I. (2017). Utilisation of skilled birth attendants over time in Nigeria and Malawi. *Global Public Health*, *12*(6), 728–743.

Ayele, B. A., Holliday, E., & Chojenta, C. (2025). Determinants of antenatal care service utilisation in sub-Saharan Africa: An analysis of demographic and health surveys data (2015–2022). *Archives of Public Health*, *83*(1), 189. https://doi.org/10.1186/s13690-025-01608-1

Bain, L. E., Aboagye, R. G., Dowou, R. K., Kongnyuy, E. J., Memiah, P., & Amu, H. (2022). Prevalence and determinants of maternal healthcare utilisation among young women in sub-Saharan Africa: Cross-sectional analyses of demographic and health survey data. *BMC Public Health*, *22*(1), 647.

Bintabara, D., Nakamura, K., Ntwenya, J., Seino, K., & Mpondo, B. C. (2019). Adherence to standards of first-visit antenatal care among providers: A stratified analysis of Tanzanian facility-based survey for improving quality of antenatal care. *PloS One*, *14*(5), e0216520.

Birabwa, C., Banke-Thomas, A., Waiswa, P., Semaan, A., Kananura, R. M., van Olmen, J., & Beňová, L. (2024). Maternal health in cities: Analysis of

institutional maternal mortality and health system bottlenecks in Kampala City Uganda, 2016-2021. *Journal of Global Health Reports*, *8*, 1–14.

Boah, M., Mahama, A. B., & Ayamga, E. A. (2018). They receive antenatal care in health facilities, yet do not deliver there: Predictors of health facility delivery by women in rural Ghana. *BMC Pregnancy and Childbirth*, *18*, 1–10.

Dickson, K. S., Kwabena Ameyaw, E., Akpeke, M., Mottey, B. E., Adde, K. S., & Esia-Donkoh, K. (2023). Socio-economic disadvantage and quality Antenatal Care (ANC) in Sierra Leone: Evidence from Demographic and Health Survey. *Plos One*, *18*(1), e0280061.

El-Khatib, Z., Kolawole Odusina, E., Ghose, B., & Yaya, S. (2020). Patterns and predictors of insufficient antenatal care utilization in Nigeria over a decade: A pooled data analysis using demographic and health surveys. *International Journal of Environmental Research and Public Health*, *17*(21), 8261.

Fisher, K. A., Griffith, L. E., Gruneir, A., Upshur, R., Perez, R., Favotto, L., Nguyen, F., Markle-Reid, M., & Ploeg, J. (2021). Effect of socio-demographic and health factors on the association between multimorbidity and acute care service use: Population-based survey linked to health administrative data. *BMC Health Services Research*, *21*, 1–17.

Ftwi, M., Gebretsadik, G. G., Berhe, H., Haftu, M., Gebremariam, G., & Tesfau, Y. B. (2020). Coverage of completion of four ANC visits based on recommended time schedule in Northern Ethiopia: A community-based cross-sectional study design. *PloS One*, *15*(8), e0236965.

Galgalo, D. A., Mokaya, P., Chauhan, S., Kiptulon, E. K., Wami, G. A., Várnagy, Á., & Prémusz, V. (2024). Utilization of maternal health care services among pastoralist communities in Marsabit County, Kenya: A cross-sectional survey. *Reproductive Health*, *21*(1), 126. https://doi.org/10.1186/s12978-024-01865-3

Gashaye, A., Kibret, G. D., Bazezew, Y., & Mengist, B. (2021). Factors affecting institutional delivery in Ethiopia: A multi-level analysis. *International Journal of Africa Nursing Sciences*, *15*, 100331.

Groves, R. M., Fowler Jr, F. J., Couper, M. P., Lepkowski, J. M., Singer, E., & Tourangeau, R. (2011). *Survey methodology*. John Wiley & Sons. https://books.google.com/books?

Hailemariam, T., Atnafu, A., Gezie, L. D., & Tilahun, B. (2023). Utilization of optimal antenatal care, institutional delivery, and associated factors in Northwest Ethiopia. *Scientific Reports*, *13*(1), 1071.

Jung, M. (2023). *Spatial aspects of fertility change in Ethiopia between 2000 and 2016: A district-level analysis* [PhD Thesis, London School of Hygiene & Tropical Medicine]. https://researchonline.lshtm.ac.uk/id/eprint/4671209

Kachimanga, C., Ng'ambi, W., Kazinga, D., Ndarama, E., Amulele, M., Munyaneza, F., Abejirinde, I.-O., Van Den Akker, T., & Kulinkina, A. (2025). Impact of Mobile Health (mHealth) Use by Community Health Workers on the Utilization of Maternity Care in Rural Malawi: A Time Series Analysis. *International Journal of Women's Health*, *Volume 17*, 245–257. https://doi.org/10.2147/IJWH.S497100

Kariuki, J. N. (2025). Determinants of Health Seeking Behaviour of Nomadic Pastoralists in Low and Middle-Income Countries: A Scoping Review. *medRxiv*, 2025–07.

Kish, L. (1949). A Procedure for Objective Respondent Selection within the Household. *Journal of the American Statistical Association*, *44*(247), 380–387. https://doi.org/10.1080/01621459.1949.10483314

Konje, E. T., Hatfield, J., Kuhn, S., Sauve, R. S., Magoma, M., & Dewey, D. (2020). Is it home delivery or health facility? Community perceptions on place of childbirth in rural Northwest Tanzania using a qualitative approach. *BMC Pregnancy and Childbirth*, *20*(1), 270. https://doi.org/10.1186/s12884-020-02967-z

Lin, S. L. (2022). Access to health care among racialised immigrants to Canada in later life: A theoretical and empirical synthesis. *Ageing & Society*, *42*(8), 1735–1759.

Macharia, P. M., Joseph, N. K., Nalwadda, G. K., Mwilike, B., Banke-Thomas, A., Benova, L., & Johnson, O. (2022). Spatial variation and inequities in antenatal care coverage in Kenya, Uganda and mainland Tanzania using model-based geostatistics: A socioeconomic and geographical accessibility lens. *BMC Pregnancy and Childbirth*, *22*(1), 908. https://doi.org/10.1186/s12884-022-05238-1

Maximore, L. S., Mohammed, A. G., Issahaku, G. R., Sackey, S., & Kenu, E. (2022). *Prevalence and determinants of home delivery among Reproductive Age Women, Margibi County, Liberia, 2020*. https://assets-eu.researchsquare.com/files/rs-1497207/v1/b0e60c81-3c35-4721-b67f-2081e8615526.pdf

Mohamed, M., Abdeeq, B. A., Mohamed, A. I., Jama, H. A., Tafese, F., & Getachew, M. (2024). Level of institutional delivery service utilization and associated factors among women who gave birth in the past 12 months, Ga'an libah district, Marodijeh region, Somaliland: A community-based cross-sectional study. *BMC Health Services Research*, *24*(1), 1085. https://doi.org/10.1186/s12913-024-11330-3

Mohd Noh, S. N., Jawahir, S., Tan, Y. R., Ab Rahim, I., & Tan, E. H. (2022). The health-Seeking Behavior among Malaysian Adults in Urban and Rural Areas Who Reported Sickness: Findings from the National Health and Morbidity Survey (NHMS) 2019. *International Journal of Environmental Research and Public Health*, *19*(6), 3193.

Muchema, B. N. (2023). *Assessment of the Influence of Formal and Informal Insurance on Pastoral Resource Cooperation for Drought Management in Samburu Central Sub-county* [PhD Thesis, University of Nairobi]. https://erepository.uonbi.ac.ke/handle/11295/165007

Mugambe, R. K., Yakubu, H., Wafula, S. T., Ssekamatte, T., Kasasa, S., Isunju, J. B., Halage, A. A., Osuret, J., Bwire, C., Ssempebwa, J. C., Wang, Y., McGriff, J. A., & Moe, C. L. (2021). Factors associated with health facility deliveries among mothers living in hospital catchment areas in Rukungiri and Kanungu districts, Uganda. *BMC Pregnancy and Childbirth*, *21*(1), 329. https://doi.org/10.1186/s12884-021-03789-3

Mwangi, M. M. (2023). *Determinants of hospital deliveries among Maasai women aged 18-49 years at Saikeri village in Kajiado county, Kenya*. https://ecommons.aku.edu/etd_ke_sonam_ms-apm/4/

Mwilike, B. E., Welsh, J., Nyamuryekung'e, K. K., Nyaruchary, A. J., Pembe, A. B., & Gross, M. M. (2024). Midwife-Led Mobile Antenatal Clinic: An Innovative Approach to Improve Utilization of Services in Pwani, Tanzania. *International Journal of Environmental Research and Public Health*, *21*(11), 1446.

Ndaboine, E., Hassan, L., Kiritta, R., & Matovelo, D. (2025). Predictors of severe maternal outcomes in a tertiary hospital: A study of maternal near-miss cases and mortality, Mwanza, Tanzania. *Tanzania Journal of Health Research*, *26*. https://search.ebscohost.com/login.aspx?

Ntoimo, L. F. C., Okonofua, F. E., Ekwo, C., Solanke, T. O., Igboin, B., Imongan, W., & Yaya, S. (2022). Why women utilize traditional rather than skilled birth attendants for maternity care in rural Nigeria: Implications for policies and programs. *Midwifery*, *104*, 103158.

Organization, W. H. (2002). WHO antenatal care randomized trial: Manual for the implementation of the new model. In *WHO antenatal care randomized trial: Manual for the implementation of the new model*. https://pesquisa.bvsalud.org/portal/resource/pt/who-42513

Oyedele, O. K. (2023). Disparities and barriers of health facility delivery following optimal and suboptimal pregnancy care in Nigeria: Evidence of home births from cross-sectional surveys. *BMC Women's Health*, *23*(1), 194. https://doi.org/10.1186/s12905-023-02364-6

Raina, N., Khanna, R., Gupta, S., Jayathilaka, C. A., Mehta, R., & Behera, S. (2023). Progress in achieving SDG targets for mortality reduction among mothers, newborns, and children in the WHO South-East Asia Region. *The Lancet Regional Health-Southeast Asia*, *18*.https://www.thelancet.com/journals/lansea/article/PIIS2772-3682(23)00167-1/fulltext

Schriger, S. H., Binagwaho, A., Keetile, M., Kerry, V., Mubiligi, J. M., Ramogola-Masire, D., Roland, M., Barg, F. K., & Cancedda, C. (2021). Hierarchy of qualities in global health partnerships: A path towards equity and sustainability. *BMJ Global Health*, *6*(12), e007132.

Simona, S., Lumamba, C., Moyo, F., Ng'andu, E., & Phiri, M. (2022). The influence of contextual factors on maternal healthcare utilization in sub-Saharan Africa: A scoping review of multilevel models. *medRxiv*, 2022–03.

Sserwanja, Q., Nuwabaine, L., Gatasi, G., Wandabwa, J. N., & Musaba, M. W. (2022). Factors associated with utilization of quality antenatal care: A secondary data analysis of Rwandan demographic health survey 2020. *BMC Health Services Research*, *22*(1), 812.

Stern, M. J., Bilgen, I., & Dillman, D. A. (2014). The State of Survey Methodology: Challenges, Dilemmas, and New Frontiers in the Era of the Tailored Design. *Field Methods*, *26*(3), 284–301. https://doi.org/10.1177/1525822X13519561

Tanzania Ministry of Health (2023). Tanzania demographic and health survey and malaria indicator survey 2022 final report. https://dhsprogram.com/pubs/pdf/FR379/FR379.pdf

Thobias, B., Msengwa, A. S., & Mbago, M. C. (2022). Spatial clustering of maternal health services utilization and its associated factors in Tanzania: Evidence from 2015/2016 Tanzania Demographic Health Survey. *Tanzania Journal of Health Research*, *23*(1), 1–10.

Tiruneh, G. T., Demissie, M., Worku, A., & Berhane, Y. (2022). Predictors of maternal and newborn health service utilization across the continuum of care in Ethiopia: A multilevel analysis. *Plos One*, *17*(2), e0264612.

Tiwari, N., Banerjie, J., Chandra, G., & Bhari, S. (2024). Adaptive cluster sampling based on balanced sampling plan excluding contiguous units. *Communications in Statistics - Theory and Methods*, *53*(15), 5364–5377. https://doi.org/10.1080/03610926.2023.2220448

Tufa, G., Tsegaye, R., & Seyoum, D. (2020). Factors associated with timely antenatal care booking among pregnant women in remote area of bule hora district, Southern Ethiopia. *International Journal of Women's Health*, 657–666.

Uwimana, G., Elhoumed, M., Gebremedhin, M. A., Nan, L., & Zeng, L. (2023). Determinants of timing, adequacy and quality of antenatal care in Rwanda: A cross-sectional study using demographic and health surveys data. *BMC Health Services Research*, *23*(1), 1–12.

Vasconcelos, A., Sousa, S., Bandeira, N., Alves, M., Papoila, A. L., Pereira, F., & Machado, M. C. (2022). Antenatal screenings and maternal diagnosis among pregnant women in Sao Tome & Principe—Missed opportunities to improve neonatal health: A hospital-based study. *PLOS Global Public Health*, *2*(12), e0001444.

Walker, T., Woldegiorgis, M., & Bhowmik, J. (2021). Utilization of skilled birth attendant in low-and middle-income countries: Trajectories and key sociodemographic factors. *International Journal of Environmental Research and Public Health*, *18*(20), 10722.

Wong, K. L. M., Brady, O. J., Campbell, O. M. R., Banke-Thomas, A., & Benova, L. (2020). Too poor or too far? Partitioning the variability of hospital-based childbirth by poverty and travel time in Kenya, Malawi, Nigeria and Tanzania. *International Journal for Equity in Health*, *19*(1), 15. https://doi.org/10.1186/s12939-020-1123-y

Wulifan, J. K., Dordah, A. D., & Sumankuuro, J. (2022). Nomadic pastoralists' experience accessing reproductive and maternal healthcare services in low and middle-income countries: A contextual scoping review. *Pastoralism*, *12*(1), 47. https://doi.org/10.1186/s13570-022-00261-5

Yemane, G. D. (2022). The factors associated with antenatal care utilization in Ethiopia. *Annals of Medicine and Surgery*, *79*, 104092.

Zembe, J., Senkubuge, F., Botha, T., & Achoki, T. (2022). Population health trends analysis and burden of disease profile observed in Sierra Leone from 1990 to 2017. *BMC Public Health*, *22*(1), 1801. https://doi.org/10.1186/s12889-022-14104-w