



Maternal individual determinants of adverse maternal and neonatal outcomes among pastoralist women in Marsabit County, Kenya

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ABSTRACT

Adverse maternal and neonatal outcomes remain a major public health challenge globally, with Sub-Saharan Africa carrying a disproportionate burden. Pastoralist populations face additional barriers to care due to nomadic lifestyles, cultural practices, and limited access to health services, yet evidence on maternal-individual determinants in these settings remains limited. To examine maternal-individual determinants of adverse maternal and neonatal pregnancy outcomes among pastoralist women of reproductive age in Marsabit County, Kenya. A cross-sectional study was conducted among 422 women aged 15–49 years with documented pregnancy outcomes from four major hospitals in Marsabit County. Data were collected using a structured questionnaire and key informant interviews. Quantitative data were analyzed using SPSS v27, with chi-square tests and binary logistic regression performed to identify independent determinants. Qualitative data were coded thematically using NVivo. Results: Twenty-one percent of participants reported at least one adverse maternal or neonatal outcome, with low birth weight and preterm delivery accounting for 64.2% of cases. Significant determinants included planning for pregnancy (OR=0.309, p=0.044), birth preparedness (OR=0.445, p=0.008), early ANC initiation in the first trimester (OR=0.238, p=0.018), maternal age (OR=0.575, p<0.0001), and primiparity (OR=3.529, p<0.0001). The findings show that maternal-individual determinants strongly influence adverse pregnancy outcomes in pastoralist communities. Interventions promoting pregnancy planning, birth preparedness, and early ANC attendance, alongside adolescent pregnancy prevention and support for first-time mothers, are urgently needed.

Key words: Adverse Maternal, Kenya, Outcomes, Pastoralist Women, Neonatal, Marsabit

I. INTRODUCTION

Adverse maternal and neonatal outcomes, including low birth weight (LBW), preterm birth, stillbirth, obstetric complications, and maternal or neonatal death, remain pressing public health concerns globally. Despite steady declines in maternal mortality ratios (MMR) and neonatal mortality rates (NMR) worldwide, Sub-Saharan Africa continues to carry the heaviest burden, accounting for nearly 70% of maternal deaths and reporting an NMR nearly double the global average (IGME, 2024; WHO, 2023). Kenya mirrors these global patterns, with an MMR of 362 per 100,000 live births and an NMR of 21 per 1,000 live births (KNBS, 2023). However, these national averages obscure stark subnational disparities, with pastoralist counties such as Marsabit reporting an MMR of 1,127 per 100,000 live births and an NMR of 36 per 1,000 live births, figures that far exceed national and global averages (KNBS, 2015).

Maternal-individual factors, including pregnancy planning, antenatal care (ANC) attendance, birth preparedness, maternal age, and parity, are critical predictors of pregnancy outcomes (Graham et al., 2016; Patel et al., 2021). In resource-limited settings, delayed ANC initiation and low pregnancy planning rates are strongly associated with complications such as preterm birth, LBW, and perinatal mortality. However, evidence on these determinants among pastoralist populations remains scarce. This study aimed to fill this knowledge gap by examining maternal-individual determinants of adverse maternal and neonatal outcomes among pastoralist women of reproductive age in Marsabit County, Kenya.



1.1 Research Objectives

To assess association between maternal-individual factors and adverse maternal and neonatal pregnancy outcomes among women of reproductive age (15–49 years) from pastoralist communities in Marsabit County, Kenya

II. METHODOLOGY

2.1 Study Design and Setting

A cross-sectional study was conducted in Marsabit County, Kenya, one of the most underserved and remote regions in the country, predominantly inhabited by pastoralist communities.

2.2 Study Population

The study targeted women of reproductive age (15–49 years) who had ever been pregnant and had documented pregnancy outcomes at four purposively selected hospitals namely, Marsabit County Referral Hospital, Kalacha Sub-County Hospital, Moyale Sub County Hospital and Laisamis Sub-County Hospital.

2.3 Sample Size

A sample size of 422 participants was calculated using Fisher's formula

2.4 Sampling Procedure

A multistage sampling approach was employed. First, four facilities namely Marsabit County Referral Hospital, Moyale Sub-County Hospital, Laisamis Sub-County Hospital, and Kalacha Sub-County Hospital, were purposively selected because they serve the largest catchment populations in Marsabit County and provide comprehensive maternal, neonatal, and emergency obstetric care. Second, the total sample size of 422 participants was proportionately allocated across the four facilities based on their reported deliveries between May and October 2023, using data from the Kenya Health Information System (KHIS). Finally, eligible participants were selected using systematic random sampling from maternity unit registers (MOH 733) at each facility. A sampling interval of four was applied to ensure representativeness and minimize selection bias. For each selected participant, maternity files were retrieved, and individuals were contacted either by phone or household visit to arrange participation. After explaining the study objectives, informed consent was obtained, and face-to-face interviews were conducted at a time and place convenient for the participant. Data collection took place between 1st and 30th November 2023.

2.4.1 Inclusion and Exclusion Criteria

Women were included if they were of reproductive age (15–49 years), belonged to pastoralist communities in Marsabit County, had resided in the county for at least six months preceding the study, had experienced at least one pregnancy with outcomes documented in the four participating hospitals, provided written informed consent, and were accessible throughout the study period. Women were excluded if their pregnancy outcomes were undocumented, if they were unavailable at the time of data collection, or if they were severely ill or lacked the capacity to provide informed consent, to ensure both ethical participation and data validity.

2.5 Data Collection

Data were collected using a researcher-administered questionnaire for women of reproductive age and a key informant interview (KII) guide for health providers and community leaders. The questionnaire, structured around the study objectives, comprised five sections capturing information on pregnancy outcomes, socio-demographic and economic characteristics, maternal individual-related factors, socio-cultural practices, and health system determinants. Pregnancy outcomes were extracted from maternity records, while other variables were obtained through participant interviews. The KII guide was used to elicit qualitative insights on maternal, socio-cultural, and health system factors influencing adverse maternal and neonatal outcomes, thereby supplementing quantitative data. To ensure validity, the instruments were reviewed by experts and pre-tested for clarity and appropriateness, while reliability was assessed using a test–retest method with a subsample of participants, yielding a Cronbach's alpha coefficient of 0.82, indicating high internal consistency

2.6 Outcome and Independent Variables

The dependent variable was the presence/absence of adverse outcomes. Independent variables included pregnancy planning, birth preparedness, ANC timing, maternal age, and parity.



2.7 Data Management and Analysis

Quantitative data were checked for completeness, coded, and entered into IBM SPSS Statistics version 27 for analysis. Descriptive statistics, including means, standard deviations, and proportions, were computed to summarize participant characteristics and pregnancy outcomes. Associations between adverse pregnancy outcomes (dependent variable) and maternal individual factors (independent variables) were assessed using Pearson's chi-square tests at a significance level of $\alpha = 0.05$. Variables with statistically significant associations were subjected to binary logistic regression to compute odds ratios (ORs) and 95% confidence intervals (CIs). Qualitative data from key informant interviews were transcribed, imported into NVivo software, and analyzed thematically. Codes were generated and grouped into emergent themes that provided explanatory context to the quantitative findings and enriched interpretation of the results in relation to the study objectives.

2.8 Ethical Considerations

Ethical approval was obtained from the University of East Africa Baraton Ethics and Research Committee (UEAB/ISERC/19/09/2023) and license to conduct study was granted by NACOSTI (NACOSTI/P/23/29702). Written informed consent was obtained from all participants.

III. FINDINGS

3.1 Findings

3.1.1 Sociodemographic and Economic Characteristics Of Participants

Table 1 shows socio-demographic and economic characteristics of the study participants. A total of 400 women participated in the study. The mean age was 25.87 (± 5.31 SD) years, with the largest proportion (35.3%) aged 25–29 years. Most participants (96.8%) were married, of whom 95.0% lived with their spouse. The majority (86.5%) were in monogamous unions, while 10.0% reported polygamous marriages, with 6.8% identifying as the second wife. Regarding education, 30.0% of participants had completed primary school, 27.0% had secondary education, 13.5% had tertiary education, while 4.5% reported no formal education. More than half (54.3%) were engaged in informal employment, whereas 35.0% were not employed and 10.8% were formally employed. Nearly three-quarters of the participants (74.5%) were Muslim, with the remaining 25.5% identifying as Christian.

Table 1

Sociodemographic and Economic Characteristics of the Study Participants

Characteristic	n	%
Age in years		
15–19	51	12.8
20–24	115	28.7
25–29	141	35.3
30–34	60	15.0
35–39	29	7.2
40–44	4	1.0
Education level completed		
None	18	4.5
Primary	120	30.0
Secondary	108	27.0
Tertiary	54	13.5
Other	100	25.0
Marital status		
Married	387	96.8
Single	1	0.3
Widowed	2	0.5
Separated	9	2.3
Divorced	1	0.3
Live with spouse		
Yes	380	95.0
No	7	1.8
Type of marriage		
Monogamous	346	86.5
Polygamous	40	10.0
Other	1	0.3



Polygamous: wife number		
First	5	1.3
Second	27	6.8
Third	8	2.0
Nature of occupation		
Formally employed	43	10.8
Informally employed	217	54.3
Not employed	140	35.0
Religion		
Christian	102	25.5
Muslim	298	74.5

3.1.2 Prevalence of Adverse Maternal and Neonatal outcomes

Among the 400 participants, 84 (21.2%) reported at least one adverse maternal or neonatal outcome. Low birth weight (32.1%) and premature delivery (32.1%) were the most frequently reported adverse outcomes. Stillbirth (7.1%), abortion (6.0%), and gestational diabetes (6.0%) followed, while ruptured uterus (4.8%), neonatal death (3.6%), pre-eclampsia (3.6%), and congenital abnormalities (2.4%) were reported less frequently as shown in Table 2.

Table 2

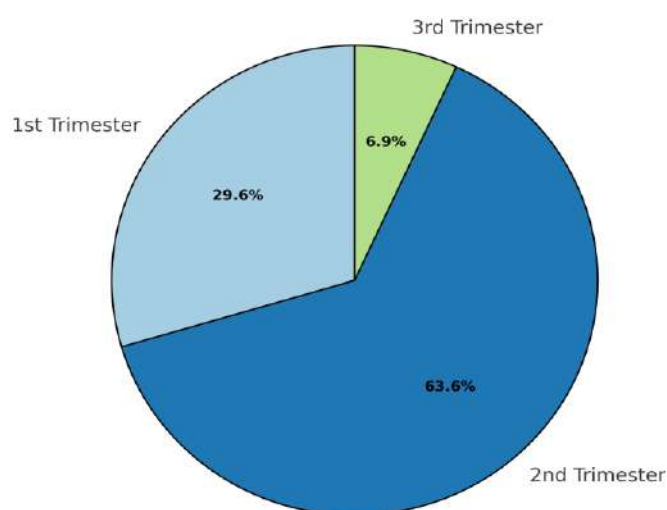
Prevalence of Adverse Maternal and Neonatal Pregnancy Outcome Types

n=84		
Adverse maternal and neonatal pregnancy outcome	n	Percentage (%)
Abortion	5	6.0
Antepartum hemorrhage	2	2.4
Gestational Diabetes	5	6.0
Low Birth Weight	27	32.1*
Premature Delivery	27	32.1*
Still Birth	6	7.1
Neonatal Death	3	3.6
Pre-Eclampsia	3	3.6
Congenital Abnormalities	2	2.4
Raptured uterus	4	4.8

*: majority of the participants, proportions generated using descriptive statistics

3.1.3 Maternal Individual Determinants of Adverse Maternal and Neonatal Outcomes

The study explored maternal-individual factors associated with adverse pregnancy and neonatal outcomes among women of reproductive age from pastoralist communities in Marsabit County. Among participants who reported attending antenatal care (ANC), 29.3% initiated ANC in the first trimester, 63.0% in the second trimester, and 6.8% in the third trimester as shown in Figure 1. Majority of women from pastoralist communities begin ANC in the second trimester, potentially limiting timely identification and management of pregnancy-related complications.

**Figure 1**

Timing of antenatal care (ANC) initiation among women from pastoralist communities in Marsabit County

Chi-square tests were performed to examine associations between maternal-individual factors and adverse maternal or neonatal pregnancy outcomes among women from pastoralist communities in Marsabit County. Several factors showed statistically significant associations with adverse outcomes, including planning for pregnancy ($p=0.005$), having a birth plan ($p=0.001$), attending ANC during the last pregnancy ($p=0.002$), month of ANC initiation ($p<0.0001$), number of ANC visits attended ($p<0.0001$), previous family planning (FP) use ($p=0.026$), nature of pregnancy (primiparous vs. multiparous; $p=0.004$), and maternal age category ($p<0.0001$). Conversely, type of index pregnancy (singleton, twin, triplet) and previous history of adverse pregnancy outcomes did not show significant associations ($p>0.05$). Table 3 presents the detailed associations between maternal-individual determinants and adverse pregnancy outcomes.

Table 3

Associations between Maternal Individual Related Factors and Adverse Pregnancy Outcome Among Women from Pastoralist Communities (n=400)

Variables	Adverse maternal and neonatal pregnancy outcome		χ^2	p-value
Maternal-individual determinants	No n (%)	Yes n (%)		
Plan for pregnancy				
Yes	307 (76.8)	75 (18.8)	4.608	0.005*
No	9 (2.2)	9 (2.2)		
Had a birth plan				
Yes	252 (63.0)	52 (13.0)	7.126	0.001*
No	64 (16.0)	32 (8.0)		
Attend ANC during last pregnancy				
Yes	316 (79.0)	80 (20.0)	0.000	0.002*
No	0 (0.0)	4 (1.0)		
Month started ANC attendance				
0 to 3 rd month	92 (23.0)	25 (6.3)	5.552	<0.0001*
4 th to 6 th month	210 (52.5)	42 (10.5)		
7 th to 9 th month	14 (3.5)	13 (3.3)		
Number of ANC attendance				
One time	1 (0.3)	2 (0.5)	1.818	<0.0001*
Two times	7 (1.8)	3 (0.8)		
Three times	39 (9.8)	18 (4.5)		
Four times	171 (42.8)	35 (8.8)		
More than four times	98 (24.5)	22 (5.5)		
Previous FP use				
Yes	141 (35.3)	27 (6.8)	0.707	0.026*
No	175 (43.8)	57 (14.2)		
Nature of pregnancy				



Primiparous	78 (19.5%)	34 (8.5)	13.089	0.004*
Multiparous	238 (59.5)	50 (12.5)		
Type of index pregnancy				
Singleton	225 (56.3)	50 (12.5)	3.186	0.218
Twin	54 (13.5)	22 (5.5)		
Triplets	26 (6.5)	8 (2.0)		
Other	11 (2.8)	4 (1.0)		
Previous history of adverse pregnancy				
Yes	19 (4.8)	8 (2.0)	0.11	0.183
No	297 (74.3)	76 (19.0)		
Maternal age categories				
15-19	25 (6.3)	26 (6.5)	19.468	<0.0001*
20-24	89 (22.3)	26 (6.5)		
25-29	121 (30.3)	20 (5.0)		
30-34	54 (13.5)	6 (1.5)		
35-39	23 (5.8)	6 (1.5)		
40-44	4 (1.0)	0 (0.0)		

Pearson Chi-Square (χ^2) test for associations/proportionality, *Statistically significant χ^2 associations at $\alpha \leq 0.05$

To identify independent maternal-individual determinants of adverse maternal and neonatal outcomes, binary logistic regression analysis was performed on factors that demonstrated significant associations with chi-square test. Planning for pregnancy significantly reduced the odds of adverse outcomes by 69% compared with not planning (OR=0.309, 95% CI: 0.099-0.967; $p=0.044$). Similarly, having a birth plan was protective, reducing the odds of adverse outcomes by 55% (OR=0.445, 95% CI: 0.245-0.806; $p=0.008$).

Initiating ANC in the first trimester was associated with a 76% lower likelihood of adverse outcomes compared with initiating ANC in the third trimester (OR=0.238, 95% CI: 0.072-0.786; $p=0.018$). Maternal age was also protective, with each increasing age category reducing the odds of adverse outcomes by 48% (OR=0.575, 95% CI: 0.449-0.735; $p<0.0001$). In contrast, primiparous women had a 3.5-fold higher risk of experiencing adverse outcomes compared with multiparous women (OR=3.529, 95% CI: 1.782-6.986; $p<0.0001$). Attending ANC during the last pregnancy, number of ANC visits attended, and previous family planning use were not statistically significant determinants ($p>0.05$) as shown in Table 4.

Table 4

Binary Logistic Regression Analysis of Maternal-Individual Determinants of Adverse Pregnancy and Neonatal Outcomes (n = 400)

Variable	95% C.I.	OR	p-value
Plan for pregnancy	0.099-0.967	0.309	0.044*
Had a birth plan	0.245-0.806	0.445	0.008*
Attend ANC during last pregnancy	0.000	0.000-	0.999
Month started ANC attendance	0.072-0.786	0.238	0.018*
Number of ANC attendance	0.799-3.377	1.642	0.178
Previous FP use	0.426-1.407	0.774	0.400
Nature of pregnancy	1.782-6.986	3.529	<0.0001*
Maternal age categories	0.449-0.735	0.575	<0.0001*

*Statistically significant association at $\alpha \leq 0.05$. OR= Odds Ratio; 95% CI: 95% Confidence Interval. OR generated through binary logistic regression using stepwise procedure.

Qualitative findings from key informant interviews provided context to the quantitative results and highlighted the socio-cultural realities influencing maternal behaviors. Several respondents emphasized that family planning was rarely practiced, as children are culturally regarded as a source of wealth. One key informant noted,

“In this community, children are considered as wealth and as such women are always planning to have an additional child immediately after birth. Family planning is not embraced and even the few who want sometimes do not have access to family planning services due to lack of commodities” (KI4).

Late ANC initiation was also widely reported, with cultural beliefs contributing to delayed disclosure of pregnancy. As KI2 explained,

“Most women here do not want people to know they are pregnant as this is believed to lead to the death of their newborn. Despite consistent health education at the community level, they attend their first ANC visit late, making it challenging to achieve the eight ANC visits requirement.”



The interviews further underscored the vulnerabilities of adolescent and primiparous mothers, who face both social stigma and increased medical risk.

“Marsabit County continues to experience a high rate of adolescent and young mothers’ pregnancies, partially contributed by early marriages. However, most unmarried pregnant girls do not visit the facilities since they are considered outcasts in the community. Additionally, young mothers also shy away from visiting the facilities. As a result, they are likely to get complications” (K17).

Another respondent reinforced this, stating,

“Women who are giving birth for the first time are at risk of developing adverse pregnancy outcomes” (K15).

These narratives corroborate the regression findings, reinforcing that low uptake of birth planning, delayed ANC initiation, and primiparity significantly elevate the risk of adverse pregnancy and neonatal outcomes among women in pastoralist communities.

IV. DISCUSSION

The present study found that pregnancy planning significantly reduced the likelihood of adverse pregnancy and neonatal outcomes. This observation is consistent with previous studies emphasizing the critical role of preconception care in optimizing pregnancy outcomes (Caulfield et al., 2016; Galgalo et al., 2024). Among pastoralist populations, planned pregnancies has been found to facilitate timely health-seeking behavior and nutritional preparedness, both of which enhance neonatal survival. Comparable findings from Marsabit County revealed that women who intentionally planned their pregnancies were more likely to access antenatal services early and adhere to recommended care practices (Galgalo et al., 2024). Similarly, (Caulfield et al., 2016) observed that pregnancy planning improved maternal nutritional status and reduced preterm birth risks. These convergent findings highlight the transformative potential of reproductive planning in resource-constrained, nomadic communities.

Similarly, birth preparedness emerged as a strong protective factor, lowering the likelihood of adverse events by more than half. This finding aligns with studies in pastoralist settings that emphasize the role of birth plans in facilitating timely utilization of maternal health services and enabling emergency preparedness (Caulfield et al., 2016; Galgalo et al., 2024). Having a birth plan allows families to organize transport, secure financial resources, and identify skilled attendants, thereby reducing delays in accessing care and preventing maternal and neonatal deaths (Mwangi et al., 2019).

Consistent with previous research, timely antenatal care attendance emerged as a strong protective factor, reducing the risk of adverse outcomes by 76%. Studies in Ethiopia and Nigeria have similarly reported that insufficient ANC visits or late initiation significantly increase the risk of low birth weight and preterm delivery (Degno et al., 2021; Ollo, 2019; Sadiq et al., 2016). ANC attendance allows for the early detection of complications and provision of nutritional and health education interventions that mitigate conditions such as anemia and preeclampsia. Nonetheless, persistent barriers, including geographic inaccessibility, nomadic lifestyle and cultural constraints, continue to suppress ANC uptake among pastoralist women (Caulfield et al., 2016; Galgalo et al., 2024). These findings collectively reinforce the need to strengthen early ANC engagement and service delivery quality, as advocated by (Muluneh et al., 2022).

Maternal age also showed a significant association with pregnancy outcomes, with older women experiencing fewer adverse outcomes. This aligns with existing evidence linking adolescent pregnancies to higher risks of preterm birth, low birth weight, and neonatal death (Degno et al., 2021; Ollo, 2019; Patel et al., 2021). Similar relationships have been documented in India and Bangladesh, where younger maternal age correlated with miscarriage, stillbirth, and obstetric complications (Patel et al., 2021; Sikder et al., 2014). However, this finding contrasts with studies associating advanced maternal age (≥ 35 years) with gestational hypertension and diabetes (Kebede et al., 2018; Sadiq et al., 2016). The divergence may reflect contextual dynamics in pastoralist settings, where older women benefit from accumulated maternal experience and improved care-seeking behaviors, potentially offsetting the biological risks associated with advanced age.

The study further revealed that primiparous women were 3.5 times more likely to experience adverse outcomes than multiparous counterparts. This observation aligns with (Ollo, 2019), who reported that first-time mothers in pastoralist settings face higher risks due to limited experience and suboptimal healthcare utilization. In contrast, other studies have linked high parity to adverse outcomes through maternal depletion syndrome (Degno et al., 2021), underscoring the complex, context-dependent nature of parity-related risk. In pastoralist populations, the greater vulnerability of primiparous women highlights the need for targeted interventions focusing on early counseling and skilled attendance during delivery. Although previous family planning (FP) use did not remain significant in binary regression analysis, the bivariate association suggests its role in enabling pregnancy planning and spacing, which has been shown to reduce maternal morbidity and mortality (Baqui et al., 2018; Sara et al., 2019). The limited uptake of FP in pastoralist communities reflects persistent cultural and logistical barriers, underscoring the need for context-specific



strategies to increase awareness, acceptability, and access. Recently Galgalo and colleagues found that family planning uptake among pastoralist women in Marsabit county remains low due to restrictive cultural norms, gender roles, and mobility patterns (Galgalo et al., 2024). Expanding culturally sensitive reproductive health outreach could therefore address these persistent barriers.

V. CONCLUSION & RECOMMENDATIONS

5.1 Conclusion

Maternal-individual determinants significantly shape pregnancy outcomes among pastoralist women in Marsabit County. Promoting early ANC attendance, pregnancy planning, and support for adolescents and primiparous mothers could substantially reduce preventable maternal and neonatal morbidity and mortality.

5.2 Recommendations

The Ministry of Health to strengthen interventions that promote preconception counseling, birth preparedness, and timely ANC initiation, particularly among first-time and younger mothers. Additional offer tailored health promotion and community engagement initiatives aimed at addressing sociocultural barriers, enhancing service coverage, to reduce preventable adverse maternal and neonatal outcomes in pastoralist settings.

Declaration of Interest

The authors declare that they do not have any known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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