

BMJ Open Effect of antenatal care attendance on maternal and birth outcomes in Somaliland: a cohort study

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ABSTRACT

Objective Antenatal care (ANC) plays a critical role in improving maternal and neonatal health outcomes. However, incomplete ANC attendance in Somaliland is associated with adverse maternal and birth outcomes. Barriers to ANC attendance may increase the risk of pregnancy-related complications, including maternal morbidity, mortality and poor neonatal health outcomes. Understanding the effect of ANC attendance on maternal and birth outcomes is crucial for informing policies and interventions aimed at reducing these risks. Hence, this study aimed to assess the effect of ANC attendance on maternal and birth outcomes in Somaliland.

Design A prospective cohort study was conducted among 1205 pregnant women enrolled by systematic sampling method.

Setting and participants The study was conducted in the Republic of Somaliland, which is situated in the Horn of Africa. Baseline data were collected at recruitment, and participants were followed up to delivery for the collection of outcome variables. The number of ANC visits was considered to be a dichotomous independent variable; incomplete attendance (≤ 3 visits) and complete attendance (≥ 4 visits). The risk of pregnancy outcome among those with incomplete ANC was assessed using multi-variable logistic regression.

Variables The outcome variables of the study were the maternal and birth outcomes. The independent variables included socio-demographic characteristics, such as age, residence, educational status, occupation, family size, wealth index and marital status, and reproductive factors, such as parity, gestational age at first ANC visit, current pregnancy desirability and previous pregnancy history.

Results Out of the total participants, 43.3% of women had complete attendance. The incidence of postpartum haemorrhage was 10.0% (95% CI 8.6 to 12.3); antepartum haemorrhage, 3.6% (95% CI 2.6 to 4.7); caesarean section, 14.8% (95% CI 12.9 to 16.8); preterm delivery, 13.7% (95% CI 11.7 to 15.4); low birth weight, 25.8% (95% CI 23.4 to 28.1); and stillbirth, 3.2% (95% CI 2.3 to 4.2). Complete attendance to ANC significantly reduced the risk of antepartum haemorrhage, caesarean section, preterm delivery and admission to the neonatal intensive care unit and stillbirth.

Conclusion Nearly more than half of women in Somaliland had less than four ANC visits. The incidence of maternal and birth complications is higher among pregnant women who attended <4 ANC visits than among

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ A prospective cohort design with follow-up from pregnancy to delivery enabled temporal assessment of antenatal care attendance and pregnancy outcomes while minimising recall bias.
- ⇒ Systematic sampling and a large sample size ($n=1205$) enhanced the representativeness of the study population and statistical power.
- ⇒ The use of multivariable logistic regression allowed adjustment for measured confounders in assessing associations between antenatal care attendance and outcomes.
- ⇒ Antenatal care exposure was measured solely by the number of visits, without capturing the timing, content or quality of care.
- ⇒ The use of a four-visit antenatal care classification may limit comparability with studies adopting the WHO eight-contact model, and residual confounding from unmeasured factors may remain.

those who attended ≥ 4 ANC visits. Promoting access and quality ANC services would help in reducing maternal and neonatal complications in the country.

INTRODUCTION

Maternal mortality remains a critical global health challenge, with 94% of maternal deaths in 2017 occurring in low-resource settings, particularly in Sub-Saharan Africa (SSA), where maternal mortality ratios often exceed 400 per 100 000 live births.¹ In many low-resource countries, including Somaliland, pregnancy-related preventable morbidity and mortality are unacceptably high. Somaliland is one of the SSA countries where the maternal mortality ratio varied from 732/100 000 to $<400/100\ 000$ in 2015. The respective ratio for infant mortality was 85/1000, with a neonatal mortality of 40/1000 and under five mortality of 137/1000.² Limited access to antenatal care (ANC) and skilled attendants during delivery significantly contributed to these high rates.³ In regions with the highest maternal mortality, such as SSA and South



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Asia, less than half of pregnant women receive ≥ 4 ANC visits.⁴

Adequate ANC services, including risk assessment, pregnancy-related disease prevention and treatment, health promotion and risk identification, help in lowering the risk of adverse pregnancy outcomes.⁵ It is a good opportunity for a pregnant woman to contact health professionals and seek necessary services, thus offering an entry point for integrated care, promoting healthy home practices and enabling easy linkage of women with pregnancy complications to a referral system. Women are more likely to give birth by a skilled attendant if they have had an ANC visit.⁶

The improvement in content of care and number of visits was considered to have positive pregnancy experience.⁷ An increased number of ANC visits (≥ 8) could reduce preventable maternal mortality.⁸ The WHO also released a guideline in 2016 that showed the ANC visit of 4–8 times could reduce the burden of adverse maternal and neonatal outcomes.⁹

In Somalia, only 25% of pregnant women attend ANC, and those who do often receive poor-quality services.¹⁰ Besides, only 20% of women attend ≥ 4 visits, and around 52% of mothers did not receive ANC services.¹¹ In light of these challenges, this study aimed to address a critical gap in understanding the adherence level to antenatal visit and its effects on maternal and birth outcomes in Somaliland. Unlike previous cross-sectional studies, this research employed a cohort study design to comprehensively assess the adherence to ANC visits and evaluate its effect on maternal and neonatal outcomes.

While the benefits of the eight-contact model are well-documented globally, there is a profound evidence gap regarding its implementation and impact within the specific socio-political and health system context of Somaliland. Most existing local data are derived from cross-sectional studies, which provide a ‘snapshot’ of attendance but fail to establish a longitudinal link between the continuity of care and specific maternal or neonatal outcomes. As Somaliland strives to align its national health policies with the 2016 WHO guidelines, it is urgent to determine whether increased adherence to these visits actually translates to improved survival rates in a resource-constrained environment.

This study aimed to address this gap by employing a prospective cohort design. By following women throughout their pregnancy, this study sought to evaluate the current level of adherence to ANC and quantify its direct effect on maternal and neonatal birth outcomes in Somaliland.

METHODS

Study setting, study period and study design

The Republic of Somaliland is situated in the Horn of Africa. The territory of the Republic of Somaliland covers the same area as that of the former Somaliland Protectorate.¹² Nearly 1.85 million people are living in urban

areas (52.9%), compared with about 0.4 million in rural areas and 1.2 million nomadic/pastoralist (combined 44.8%) and 84 000 internally displaced persons (only 2.4%). Over the past years, the proportion of the population living in urban areas has increased over those living in rural areas.¹³ According to the Republic of Somaliland socio-economic environment report, approximately 55% of Somaliland’s population are nomadic pastoralists, and livestock husbandry, including keeping camels, goats and sheep, is a traditional and dominant source of livelihood for the majority of the population.¹⁴ The Health Facility Assessment in 2016 found that 336 health facilities were functional in Somaliland. There are 443 private health facilities and hospitals in Somaliland, mostly urban-based.¹⁵ This prospective cohort study was conducted from 25 February 2023 to 10 February 2024.

Patient and public involvement

Patients and the public were not involved in the design, conduct, reporting or dissemination plans of this research.

Study population and eligibility

The source population for the study comprised all women who registered for ANC services in public health institutions in Somaliland. The participants were recruited at the time of their initial ANC visit and were followed through the course of their pregnancy until delivery and postpartum period.

Eligibility criteria

Inclusion criteria

- Pregnant women who registered for ANC services in selected public health facilities during the study period.
- Women planning to complete ANC visits and deliver in the same health facility.
- Residents of Somaliland for at least the past 6 months.

Exclusion criteria

- Women with severe pregnancy-related complications requiring immediate referral at the time of recruitment.
- Women who planned to migrate or deliver outside the study area.

Recruitment process and timeline

When were they recruited?

- Participants were enrolled at their first ANC visit within the study period. The recruitment occurred prospectively over 12 months.

How were they recruited?

- Eligible women were identified at ANC clinics in selected public health facilities.
- Informed consent was obtained before enrolment.
- Baseline data on socio-demographic characteristics, obstetric history and initial ANC status were collected at recruitment.

Follow-up and outcome assessment

- ▶ Participants were monitored throughout their pregnancy.
- ▶ Data on ANC attendance (number and timing of visits) was recorded.
- ▶ Maternal and birth outcomes (eg, preeclampsia, caesarean section, antepartum haemorrhage (APH), postpartum haemorrhage (PPH), premature rupture of membrane (PROM), low birth weight, stillbirth, admission to neonatal intensive care unit (NICU) and preterm birth) were assessed at delivery and postpartum period.
- ▶ Follow-up was completed at the time of birth.

Sample size determination

The double population proportion formula was used to calculate the sample size using the EpiInfo sample size calculator.¹⁶ The following assumptions were considered; a two-sided CI of 95%, 80% power, ratio of unexposed to exposed of 2 to 1, a non-response rate of 10% and design effect of 2. The proportion of maternal and birth outcomes among mothers with complete and incomplete ANC adherence was taken from previously conducted studies.^{17 18}

$$n_1 = \left[\frac{Z_{\alpha/2} \sqrt{\left(1 + \frac{1}{r}\right) P(1-P)} - Z_{\beta} \sqrt{\frac{P_1(1-P_1) + \frac{P_2(1-P_2)}{r}}{(P_1 - P_2)^2}} \right]^2$$

where n_1 is the number of exposed, and n_2 is the number of unexposed.

$Z_{\alpha/2}$ = standard normal deviation for a two-tailed test based on alpha level (relates to the CI level)

Z_{β} = standard normal deviation for a one-tailed test based on the beta level (relates to the power level)

r = ratio of the unexposed to the exposed; p_1 = proportion of the exposed with disease; and $q_1 = 1 - p_1$ p_2 = proportion of the unexposed with disease and $q_2 = 1 - p_2$.

By substituting the values into the double population proportion formula and using the prevalence of postpartum hemorrhage reported in a prospective cohort study conducted in Tigray public health institutions, Ethiopia (18), the final calculated sample size was 1205 mothers.¹⁸

Sampling procedure

Systematic random sampling was used in participant selection. Women who had complete ANC attendance were categorised as the exposed group, whereas those with incomplete ANC attendance were classified as the non-exposed group. Both groups were enrolled in the cohort and followed until the postpartum period.

Out of the 22 districts in the country, 12 (54%) were randomly selected. Within these districts, there were approximately 70 health facilities, and 40 were chosen using a simple lottery method. The sample size was then allocated to these facilities proportionally based on the previous year's client flow rates at public health institutions in research areas. Women were enrolled in the study

in the order they attended ANC services at the selected health facilities.

Variables of the study

- ▶ Dependent variables: maternal and birth outcomes.
- ▶ Independent variables: socio-demographic characteristics (age, residence, educational status, occupation, family size, wealth index, marital status, etc.)
- ▶ Reproductive factors (parity, gestational age at the first ANC visit, current pregnancy desirability, previous pregnancy history, etc).
- ▶ The main independent variable was the ANC adherence level.

Operational definitions

- ▶ **Complete ANC attendance:** defined as women who attended ≥ 4 ANC visits as reported by the mother. This threshold was selected in alignment with the Somaliland Ministry of Health guidelines and the 2020 Somaliland Demographic and Health Survey indicators, which utilise the 4+visit model as a key metric for maternal health coverage in the region, ensuring comparability with national data.
- ▶ **Incomplete ANC attendance:** women who had attended ANC visits ≤ 3 times as reported by the mother.
- ▶ **Adverse birth outcomes:** imply the presence of at least ≥ 1 of the following conditions in the current pregnancies: low birth weight, stillbirth, admission to NICU and preterm birth based on clinical records and follow-up data collected prospectively throughout the study period.
- ▶ **Adverse maternal outcomes:** include pre-eclampsia, caesarean section, APH, PPH and PROM based on clinical records.

Data collection

A structured, interviewer-administered questionnaire was used for data collection. The tool was developed after reviewing relevant research papers, survey reports and WHO recommendations on maternal health. Data collection was carried out in three phases: baseline, follow-up and end-line data collection.

Baseline data collection (at enrolment)

Women attending ANC services at public health institutions who met the criteria for the cohort study were enrolled and followed till the end of the postpartum period. After reviewing women's records based on their ANC visits, they were recruited to the exposed and non-exposed groups; those with complete attendance of ANC visits were considered as the exposed group, whereas those with incomplete ANC attendance were considered in the non-exposed group.

- ▶ **Exposed group:** women who attended ≥ 4 ANC visits (complete ANC attendance).
- ▶ **Non-exposed group:** women who attended ≤ 3 ANC visits (incomplete ANC attendance).

Baseline data collected included

- ▶ **Socio-demographic characteristics** (age, education, marital status, residence and occupation).
- ▶ **Obstetric history** (gravidity, parity, previous adverse birth outcomes and history of ANC use).
- ▶ **Maternal health status** at the time of ANC registration (eg, haemoglobin levels, blood pressure and body mass index).
- ▶ **Other risk factors** (eg, history of hypertension, diabetes and infections).

Follow-up data collection (during antenatal care visits and pregnancy)

Participants were followed throughout their pregnancy to track:

- ▶ **Number and timing of ANC visits.**
- ▶ **Essential ANC services received**, including the following:
 - Iron and folic acid supplementation.
 - Tetanus toxoid vaccination.
 - Blood pressure monitoring.
 - Screening for infections and gestational diabetes.
 - Counselling on nutrition and danger signs.
- ▶ **Maternal complications during pregnancy** (eg, pre-eclampsia, APH and PPH).

End-line data collection (at delivery and postpartum period)

The study continued until the postpartum period, during which maternal and birth outcomes were documented.

- ▶ **Maternal outcomes assessed**
 - **Adverse maternal outcomes**
 - Pre-eclampsia.
 - Caesarean section.
 - APH.
 - PPH.
 - PROM.
 - **Mode of delivery** (vaginal, C-section and assisted)
- ▶ **Neonatal outcomes assessed**
 - **Adverse birth outcomes**
 - Low birth weight.
 - Stillbirth.
 - Admission to the NICU.
 - Preterm birth.

Data analysis

Data were entered into EpiData version 3.1 and exported to SPSS V.20 for analysis. Data cleaning involved checking for missing values and outliers. Continuous variables were assessed for normality using the Shapiro–Wilk test. Descriptive statistics, including frequencies, percentages and means ($\pm$ SD), summarised the population characteristics.

Bivariable analysis was performed to calculate relative risks (RRs) with 95% CIs. To control for confounding, variables with a $p < 0.2$ in the bivariable analysis were entered into a multivariable binary logistic regression model. The Hosmer–Lemeshow test was used to assess model fit, and

the variance inflation factor (VIF) was used to check for multi-collinearity. Statistical significance was set at $p < 0.05$.

Validity of the study

Internal validity

To ensure the internal validity of the study and minimise the potential for systematic error (bias), several rigorous measures were implemented. First, the study employed a prospective cohort design, which significantly reduces recall bias regarding ANC visits and pregnancy symptoms compared with retrospective studies, as data were recorded as events occurred.

Data were collected using standardised, structured and pre-tested interviewer-administered questionnaires adapted from validated WHO maternal health tools. To minimise inter-observer bias, all data collectors and supervisors underwent intensive training on the study protocol, ethical conduct and uniform data recording techniques. Furthermore, clinical outcomes such as caesarean sections and birth weights were verified against hospital clinical records to ensure objective measurement and reduce information bias.

External validity

The findings of this study possess high external validity (generalisability) within the context of the Republic of Somaliland's public health system. This was achieved through a multi-stage systematic random sampling procedure that spanned 12 out of 22 districts, covering 54% of the country's administrative divisions.

By including 40 diverse public health facilities and using proportional allocation based on client flow, the study captured a representative cross-section of the maternal population utilising public health services. Consequently, the results regarding the prevalence and factors associated with caesarean section deliveries can be generalised to women attending public health institutions across Somaliland, providing a robust evidence base for national health policy and maternal care interventions.

RESULTS

Socio-demographic characteristics of the participants

Out of total participants, 1199 (99.5%) women completed the follow-up and were incorporated into the final analysis. The mean ($\pm$ SD) age of women was 27.57 ($\pm$ 6.56) years. 412 (34.4%) were 25–29 years old. 1070 (89.2%) were predominantly from urban areas. 521 (43.5%) attended primary level education. 603 (50.3%) of the participants were having a family size of 4–6 members (table 1).

Reproductive history of the participants

429 (35.8%) women married at age ≤ 19 , and 337 (28.1%) women had a history of teenage pregnancy.

Table 1 Socio-demographic characteristics of pregnant women attending antenatal care service in Somaliland, 2024

Variables	Category	Frequency	Percent (%)
Age (in years)	15–19	200	16.7
	20–24	141	11.8
	25–29	412	34.4
	30–34	271	22.5
	35–39	101	8.4
	≥ 40	74	6.2
Residence	Urban	1070	89.2
	Rural	129	10.8
Educational status	Can't read and write	43	3.5
	Can read and write	84	7.0
	Primary level	521	43.5
	Secondary level	174	14.4
	College and above	377	31.6
Occupation	Housewife	1018	84.9
	Government employed	65	5.4
	Self-employed	116	9.7
Husband education	Can't read and write	186	15.5
	Can read and write	436	36.4
	Primary level	142	11.8
	Secondary level	180	15.0
	College and above	255	21.3
Family size	1–3 members	139	11.6
	4–6 members	603	50.3
	≥ 7 members	457	38.1
Household monthly income in Somaliland shilling	First quartile (100–850K)	347	28.9
	Second quartile (851–1800K)	255	21.3
	Third quartile (1801–2655K)	305	25.4
	Fourth quartile (2656–450 000K)	292	24.4

At time of data collection, US\$ 1 is equivalent to 10,000 Somaliland shilling.
K, thousand.

520 (43.4%) participants were multiparous, whereas 440 (36.7%) were grand multiparous. 320 (26.7%) participants reported a history of using modern contraceptive methods. Concerning the desirability

Table 2 Reproductive history of pregnant women attending ANC services in Somaliland, 2024

Variables	Category	Frequency	Percentage (%)
Age at marriage	≤19	429	35.8
	20–29	705	58.8
	≥30	65	5.4
Age at first pregnancy	≤19	337	28.1
	20–29	805	67.1
	≥30	57	4.8
Parity	Nulliparous	35	2.9
	Primiparous	204	17.0
	Multiparous	520	43.4
	Grand multiparous	440	36.7
History of abortion	Yes	155	12.9
	No	1044	87.1
History of home delivery	Yes	289	24.1
	No	910	75.9
History of contraceptive uptake	Yes	320	26.7
	No	879	73.3
Current pregnancy desirability	Intended pregnancy	648	54.0
	Unintended pregnancy	551	46.0
Intimate partner violence in last 1 year	Yes	207	17.3
	No	992	82.7
Malaria in current pregnancy	Yes	69	5.8
	No	1130	94.2
Nausea and Vomiting	Yes	404	33.7
	No	795	66.3
Vaginal bleeding in current pregnancy	Yes	164	13.7
	No	1035	86.3
Smoking in pregnancy	Yes	10	0.8
	No	1189	99.2
Onset of labour	Spontaneous	1117	93.2
	Induced	82	6.8

ANC, antenatal care.

of the current pregnancy, 551 (46.0%) women were having an unintended pregnancy (table 2).

(ANC attendance of the participants)

All participants enrolled to the study had visited ANC clinics. Hence, all of them are attendants of the ANC clinic. 797 (66.5%) pregnant women initiated ANC services late. Regarding the number of ANC visits, the majority of women visited <4 times (figure 1). 680 (56.7%) women

Antenatal care (ANC) Attendance of the participants

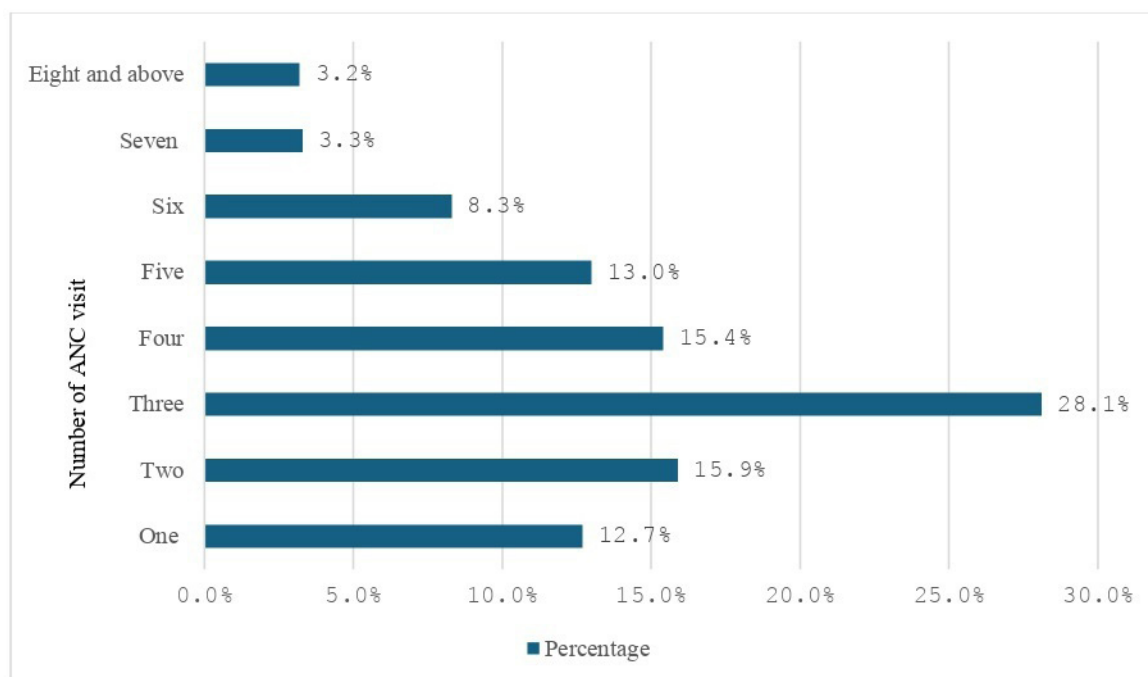


Figure 1 Percentage of pregnant women and number ANC visits in Somaliland 2024.

had incomplete ANC attendance, and the remaining 519 (43.3%) women had complete ANC attendance (table 3).

Incidence of adverse maternal and birth outcomes

Table 4 summarises incidence of adverse birth outcomes. Of the total participants, 177 (14.8%) women delivered by caesarean section, and 120 (10.0%) had PPH. Regarding neonatal outcomes, 164 (13.7%) women had preterm delivery, 95 (9.2%) neonates were admitted to the NICU and 38 (3.2%) were stillbirth (table 4).

Effect of antenatal care on pregnancy outcomes

Bivariable and multivariable binary logistic regression analyses were conducted. Variables with $p < 0.2$ were

included in multivariable regression. Independent variables included in the multivariable regression analysis were as follows: residence, age, women's educational level, income quartile, family size, parity, gestational age at the first ANC visit, current pregnancy desirability and ANC attendance. After controlling for confounding variables, table 5 describes the statistical association between ANC attendance and different pregnancy outcomes.

Women with complete attendance had 0.67 times less risk of undergoing a caesarean section than those with incomplete attendance (adjusted relative risk (ARR)=0.67, 95% CI 0.46 to 0.97, $p=0.032$). For APH, women with complete attendance were found to have

Table 3 ANC attendance of pregnant women in Somaliland, 2024

Variables	Category	Frequency	Percentage (%)
GA at the first ANC visit	Early (<16 weeks)	402	33.5
	Late (≥ 16 weeks)	797	66.5
ANC attendance	Incomplete	680	56.7
	Complete	519	43.3
Taken TT vaccine	Yes	855	71.3
	No	319	26.6
Taken iron folic acid supplementation	Yes	1009	84.2
	No	190	15.8
Attended postnatal care	Yes	764	63.7
	No	435	36.5

.ANC, antenatal care; GA, gestational age; TT, tetanus toxoid.

Table 4 Incidence of adverse pregnancy outcomes among women who attended ANC clinics at public health facilities in Somaliland, 2024

Variables	Frequency	Percentage, % (CI)
Caesarean section	177	14.8 (12.9 to 16.8)
PROM	168	14.0 (12.6 to 16.6)
Preeclampsia	115	9.6 (8.3 to 11.7)
APH	42	3.6 (2.6 to 4.7)
PPH	120	10.0 (8.6 to 12.3)
Low birth weight	309	25.8 (23.4 to 28.1)
Preterm delivery	164	13.7 (11.7 to 15.4)
Stillbirth	38	3.2 (2.3 to 4.2)
Admitted to NICU	95	9.2 (7.4 to 11.0)

ANC, antenatal care; APH, antepartum haemorrhage; NICU, neonatal intensive care unit; PPH, postpartum haemorrhage; PROM, premature rupture of membranes.

a 67% lower risk of experiencing APH than their counterparts (ARR=0.33, 95% CI 0.17 to 0.47, $p=0.031$). The incidence of pre-eclampsia, PPH and PROM was slightly higher among women with incomplete attendance, but the risk is not statistically significant (table 5).

Regarding neonatal outcomes, preterm delivery was notably reduced among women with complete attendance, with a risk that was 0.65 times that of the risk of

women with incomplete attendance (ARR=0.65, 95% CI 0.43 to 0.96, $p=0.042$). Neonates born from women with complete ANC attendance had 0.59 times reduced risk of being admitted to NICU than those born from women with incomplete attendance (RR=0.59, 95% CI 0.29 to 0.78, $p=0.006$). Similarly, women with complete attendance experienced 68% reduced risk of stillbirth compared with their counterparts (ARR=0.32, 95% CI 0.15 to 0.82, $p=0.015$) (table 5).

DISCUSSION

While this study defined 'complete ANC' as ≥ 4 visits to maintain consistency with the local policy framework and the Demographic and Health Survey,¹¹ it is important to acknowledge the evolving global standards. In 2016, the WHO transitioned from the four-visit focused ANC model to a new recommendation of a minimum of eight contacts.¹⁷ The eight-contact model is considered the 'ideal' standard, as it is associated with increased opportunities for maternal assessment, improved detection of complications and a better overall experience of care for the woman.

The incidence of some maternal outcomes, including caesarean section and PPH, and fetal outcomes, including preterm delivery, admission to NICU and stillbirth, was assessed. The study also assessed the effect of ANC attendance on the pregnancy outcomes.

Table 5 Effect of ANC attendance on adverse maternal and birth outcomes in Somaliland, 2024

Adverse maternal & birth outcomes	Category	Incomplete adherence	Complete adherence	Crude RR, 95% CI	Adjusted RR, 95% CI	P value
Caesarean section	Yes	110 (16.2)	67 (12.9)	0.77 (0.55 to 1.06)	0.67 (0.46 to 0.97)	0.032
	No	569 (83.8)	452 (87.1)	1	1	
PROM	Yes	102 (15.9)	66 (13.1)	0.79 (0.51 to 1.11)	0.98 (0.66 to 1.46)	0.944
	No	541 (84.1)	439 (86.9)	1	1	
Preeclampsia	Yes	67 (10.4)	48 (9.4)	0.89 (0.61 to 1.32)	0.71 (0.46 to 1.08)	0.113
	No	576 (89.6)	461 (90.6)	1	1	
APH	Yes	27 (4.2)	15 (2.9)	0.34 (0.23 to 0.45)	0.33 (0.17 to 0.47)	0.031
	No	615 (95.8)	494 (97.1)	1	1	
PPH	Yes	69 (10.7)	51 (10.0)	0.93 (0.64 to 1.34)	0.93 (0.59 to 1.46)	0.761
	No	577 (89.3)	457 (90.0)	1	1	
Low birth weight	Yes	169 (24.9)	140 (27.0)	1.08 (0.86 to 1.45)	0.98 (0.73 to 1.32)	0.926
	No	511 (75.1)	379 (73.0)	1	1	
Preterm delivery	Yes	109 (16.0)	55 (10.6)	0.62 (0.44 to 0.88)	0.65 (0.43 to 0.96)	0.042
	No	571 (84.0)	464 (89.4)	1	1	
Stillbirth	Yes	30 (4.4)	8 (1.5)	0.34 (0.15 to 0.74)	0.32 (0.15 to 0.82)	0.015
	No	650 (95.6)	511 (98.5)	1	1	
Admission to NICU	Yes	57 (10.1)	38 (8.1)	0.4 (0.22 to 0.89)	0.59 (0.29 to 0.78)	0.006
	No	501 (89.9)	433 (91.9)	1	1	

ANC, antenatal care; APH, antepartum haemorrhage; NICU, neonatal intensive care unit; PPH, postpartum haemorrhage; PROM, premature rupture of membranes; RR, relative risk.

A current study revealed that more than half of pregnant women have incomplete ANC attendance (56.7%, 95% CI 54.0% to 59.7%). This report is in line with another study conducted in northeastern Ethiopia (57.1% (95% CI 53.3% to 60.7%).¹⁸ However, it is higher than reports from studies conducted in the Tigray region of Ethiopia,¹⁸ Malaysia¹⁹ and Zambia.²⁰ Moreover, the incomplete ANC attendance level in the present study is higher than the Demographic and Health Survey report of SSA countries²¹ and East African countries.²² This could be due to the fact that Somaliland has poor health system setup and infrastructure and inadequate health professionals. Additionally, differences in socio-demographic characteristics of the study participants and the study design difference could have contributed to the observed discrepancy among the studies.

The study finding showed that the overall incidence of caesarean section was 14.8%. This is in line with the upper incidence limit and critical threshold for caesarean section in any country as reported by WHO (15%).²³ The report is also supported by other studies conducted in Bangladesh (13%)²⁴ and Rwanda (15.6%).²⁵ However, it is lower than findings from other studies conducted in Ethiopia (29.55%),²⁶ Tanzania (26.75%)²⁷ and Uganda (17.3%).²⁸ The reported incidence rate was inconsistent because the current study included only public health facilities. A study conducted across SSA countries showed that private institutions were found to have a higher rate of caesarean section than public health institutions.²⁹ The other possible explanation could be variations in the health service setup and socio-demographic and anthropometric differences between study participants.

The study revealed that the incidence of caesarean section among women with incomplete ANC attendance (16.2%) was significantly higher than that among women with complete ANC attendance (12.9%). This is in contrast with other studies conducted in Ethiopia³⁰ and Pakistan³¹ showing that ANC attendance increased the rate of caesarean section. Despite the lack of crystal-clear explanation for this association, the possible reason could be that adequate ANC uptake reduces pregnancy risk, which in turn determines mode of delivery. As the WHO recommended, every woman should have a minimum of eight ANC visits for positive pregnancy outcome¹⁷ because ANC visits could be an opportunistic moment to take precautionary measures to prevent complications that may lead to caesarean section.³²

The study revealed the incidence of other adverse maternal outcomes including PROM (14.0%, 95% CI 12.6% to 16.6%), pre-eclampsia (9.6%, 95% CI 8.3 to 11.7), APH (3.6%, 95% CI 2.6% to 4.7%) and PPH (10.0%, 95% CI 8.6% to 12.3%). All of these outcome variables, except APH, had no statistically significant difference in women with complete ANC attendance compared with those with incomplete ANC attendance. The reported overall incidence of APH (3.6%) in the current study is in line with that in another study conducted in Cameroon

(3.47%).³³ However, it is higher than those in other studies conducted in Burkina Faso (1.6%),³⁴ India (2%)³⁵ and Bangladesh (2.7%).³⁶ This could be due to differences in the socio-demographic characteristics of the study participants. A study found out that ANC attendance significantly reduced the risk of APH. The research conducted in Nigeria also showed a significant association between ANC attendance and APH.³⁷ The possible explanation for the association can be the importance of ANC on timely diagnosis and treatment of predisposing cause of APH.

Regarding neonatal outcomes, the study showed the incidence of preterm delivery (13.7%), stillbirth (3.2%) and NICU admission (9.2%). There was also a significant association of complete ANC attendance with a lower risk of preterm delivery (ARR=0.65, $p=0.042$), stillbirth (ARR=0.32, $p=0.015$) and NICU admission (ARR=0.59, $p=0.006$).

The overall incidence of preterm delivery in the current study (13.7%), which is in line with the study from Amhara region, Ethiopia (11.41%),³⁸ Tanzania (14.2%)³⁹ and Tigray region, Ethiopia (13.3%).⁴⁰ However, it is higher than recent evidence of demographic and health surveys of SSA countries.⁴¹ This could be due to the difference in the socio-demographic background of the participants and quality of health services. The risk of preterm delivery is lower among women with complete ANC attendance than in those with incomplete attendance. This is in line with a study conducted in Bangladesh,⁴² showing that the number of ANC visits was associated with the reduced risk of preterm delivery in other studies conducted in Tanzania,³⁹ Ethiopia⁴³ and Ghana.⁴⁴ This is because attendance to ANC services provides information and allows for the early detection of obstetric complications and case management,⁴⁴ which hence can prevent preterm delivery.

In this study, the overall NICU admission rate (9.2%) was higher than that in another study conducted in Guinea-Bissau (4.8%).⁴⁵ It also revealed that complete attendance to ANC decreased the risk of NICU admission (ARR=0.59 95% CI 0.29 to 0.78). Similar to our findings, previous studies have reported decreased odds of admission to NICU among women with adequate ANC.⁴⁶ This suggests that the number of ANC visits is critical for well-performed screening to identify high-risk pregnancy. Hence, special attention could be provided so that both maternal and neonatal health outcomes are better maintained.

The incidence of stillbirth in the current study is 3.2%, which is nearly similar to the report from other studies conducted in Uganda (3.0%).⁴⁷ However, a systematic review reported the incidence of stillbirth in East Africa ranges from 0.39% in Kenya to 2.28% in Burundi,⁴⁸ which is lower than the current report. The observed discrepancy could be due to differences in the socio-demographic factors of the participants and differences in the study period. The higher stillbirth incidence in Somaliland than in other East African countries could indicate a lack of adequate

access to obstetric care to manage pregnancy complications leading to stillbirth.

The study also indicated that stillbirth is significantly linked to incomplete ANC attendance. Women with complete attendance to ANC services had 68% less risk of stillbirth than those with incomplete attendance. This is in line with the report from other studies conducted in low-income and middle-income countries,⁴⁹ Ethiopia,^{50–52} Nepal,⁵³ Namibia⁵⁴ and Uganda.⁴⁷ This is because ANC is the best place for early detection and treatment of complications. Scaling up quality antenatal and intrapartum interventions to end preventable stillbirth is also recommended by the Lancet Ending Preventable Stillbirths Series Advisory Group.⁵⁵ It points the country to focus and properly allocate budget on the healthcare system, particularly maternal healthcare. The cost of averting stillbirth would be reverted 25-fold by these live children. Despite this, stillbirth is a hidden societal burden and is overlooked by most low-income and middle-income countries, including Somalia.⁵⁵ This finding aligns with studies conducted in Iran, which showed that long travel distances (200–400 km) to reach secondary or tertiary healthcare facilities significantly influence mothers' decisions to seek obstetric consultation.⁵⁶ These geographical challenges are best understood through the lens of the 'second delay' (delay in reaching a health facility) and the 'first delay' (delay in the decision to seek care). When facilities are prohibitively far, mothers often adopt a 'wait-and-see' approach, delaying health-seeking behaviour until the onset of labour or the appearance of a life-threatening emergency.

Strengths and limitations of the study

The strength of this study relied on the prospective study in which pregnant women were followed until delivery to assess attendance of ANC. This gives ideal information to determine the effect of ANC on pregnancy outcome compared with most previous studies considering one-time ANC visit and its associated outcome variables. The study also included a large sample, which increases the reliability of the results. Nevertheless, some limitations should be taken into consideration. Owing to security issues during data collection and lack of transportation, nomadic communities and remote border rural villages were not included in the study. Besides, the study is facility-based; hence, ANC drops and home deliveries were not taken into consideration. These factors could bias the generalisability of the results.

CONCLUSION AND RECOMMENDATION

More than half of pregnant women in Somaliland fail to adhere to the recommended level of ANC visits. This negatively affects various pregnancy outcomes,

including APH, increased rate of caesarean section, preterm delivery, higher incidence of admission to NICU and stillbirth. It is recommended to increase ANC attendance among pregnant women to reduce adverse pregnancy outcomes. Although the 4+visit model remains the primary benchmark for the Somaliland health system at this time, our findings suggest that moving toward the WHO 2016 recommendations could further reduce the burden of adverse maternal and birth outcomes observed in this cohort. Government and non-governmental organisations working on maternal health should focus on enhancing ANC utilisation. Nationwide community-based studies shall be conducted to obtain generalisable results.

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Ethics approval This study involves human participants and was approved by the institutional review board of the Ministry of Health and Development, Somaliland (Ref: MOHD/DG: 2/335/2023) and the Joint Ethics Review Committee of the University of Ibadan and the University College Hospital, Ibadan, Nigeria (UI/EC/22/0459). Written informed consent was obtained from each participant after a brief explanation of all research activities, aim, benefit and risk of participating in the study. Voluntary participation and confidentiality of data were kept in every stage of data handling and no identifier was included. Participants gave informed consent to participate in the study before taking part.

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