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Individual-level and community-level determinants of use of maternal health services in Northwest Ethiopia: a prospective follow-up study

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ABSTRACT

Objective The use of maternal health services is an important indicator of maternal health and socioeconomic development. Evidence on individual-level and community-level determinants of use of maternal health services in Benishangul Gumuz Region was not well known so far. Hence, this study fills this gap.

Design A prospective follow-up study

Setting This study was conducted from March 2020 to January 2021 in Northwest Ethiopia.

Participants A total of 2198 pregnant women participated in the study.

Main outcome measures A multistage random sampling technique was used to select study subjects. Data were collected via face-to-face interviews using pretested semistructured questionnaires. Collected data were coded, cleaned and analysed using Stata software. Multilevel regression models were applied to determine individual-level and community-level factors of use of maternal health services.

Results This study found that the proportions of women who visited recommended antenatal care (ANC), received skilled delivery care and postnatal care (PNC) were 66.1%, 58.3% and 58.6%, respectively. Being rural (adjusted OR (AOR)=3.82, 95% CI 1.35 to 10.78), having information on maternal health services (AOR=2.13, 95% CI 1.21 to 3.75), with a history of pregnancy-related problems (AOR=1.83, 95% CI 1.15 to 2.92) and women with decision-making power (AOR=1.74, 95% CI 1.14 to 2.68) were more likely to attend fourth ANC visits. Similarly, women who attended tertiary school (AOR=4.12, 95% CI 1.49 to 11.33) and who initiated the first ANC visit within 4–6 months of pregnancy (AOR=0.66, 95% CI 0.45 to 0.96) were determinants of skilled delivery care. Finally, women whose partners attended tertiary education (AOR=3.67, 95% CI 1.40 to 9.58), women with decision-making power (AOR=1.8, 95% CI 1.09 to 2.97), women who attended the fourth ANC visit (AOR=10.8, 95% CI 6.79 to 17.2), women received iron–folic acid during pregnancy (AOR=1.96, 95% CI 1.11 to 3.49) and women who received skilled delivery care (AOR=1.63, 95% CI 1.1 to 2.42) were more likely to get PNC services.

Conclusion The proportion of women who attended ANC, received skilled delivery services and PNCs was low. Different individual-level and community-level factors that influenced the use of these services were discovered. Therefore, community-based interventions should target those identified factors to improve maternal health services.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ The strengths of this study are using a prospective follow-up study design that helped to measure the true cause-and-effect relationship; a large sample size was used for this study that resulted in high power and precision for the multilevel analyses; and using advanced statistical models to handle clustering effects and identifying factors at different levels for intervention purposes.
⇒ The limitation of this study is health facility data were collected by health workers who were liable to social desirability bias which might compromise the findings.
⇒ Around 8.5% of the study participants were lost to follow-up, which might have some deviation from the result.
⇒ In the region, 15 medium clinics were providing maternal health services, but the rest of the private health facilities did not provide maternal health services for the community. However, this study did not include private health facilities, which might compromise the findings.

INTRODUCTION

Regardless of the significant reduction in maternal and neonatal mortality globally and also in high-income countries, still maternal and neonatal mortality in low-income countries including Ethiopia is the highest and have no significant reduction.[1 2] However, proper provision of maternal health services is essential for women's and babies' health.[1] Thus, antenatal care (ANC), delivery services and postnatal care (PNC) are the major pillars of maternal health services that have an effort to reduce maternal and neonatal mortality.[3 4] Even though use of maternal health services is an indirect indicator of maternal and perinatal death, fewer women are using ANC, facility delivery, and PNC,

which is an alarming challenge to rapidly reduce maternal and neonatal mortality rates.[3 5]

According to WHO recommendation, every pregnant woman attends at least fourth ANC visits to save the life of women and babies, which warrants more programmatic attention.[6 7] However, use of ANC services is low and varies across the nations and within the country.[1 7–26] This underuse of ANC services is due to different factors: sociodemographic characteristics,[1 3 4 21 24–27] availability of health facilities,[27] Household Wealth Index,[1 4 21 24 25] women empowerment,[21] present and past obstetric history,[3 4 21 26] information and perception on maternal health services[4 25 26] and health insurance.[21]

The use of skilled delivery is extremely low, and there is a big variability between the uptake of skilled delivery and ANC within the nation and countries abroad.[1 5 9–13 18 19 22 24 28] Empirical evidence identifies different factors that affect the uptake of institutional delivery services such as sociodemographic and economic factors,[1 3 4 21 26 27 29] obstetric history,[3 4 21 26 27 30] transportation services and perception on quality of services.[26 29]

Health interventions after delivery are a crucial period and key strategy to reduce maternal and neonatal mortality.[10 29] However, use of postnatal services was extremely low even comparing with the use of ANC and delivery services.[1 9–11 14 18 19 21 22 24 25 31] This underuse of the services is due to different factors: sociodemographic factors,[4 21 32] Household Wealth Index,[4 21] obstetric factors,[3 4 21] women's empowerment[21] and health insurance.[21]

However, prior studies determine the magnitude of use of maternal health services and explore individual-level factors using the traditional logistic regression model, which excludes community-level factors and advance statistical modelling. These may lead to underestimating or overestimating magnitudes and their predictors of maternal health services, which are crucial for the establishment of community-based interventions for maternal and child health (MCH) programmes. Multilevel regression modelling is an appropriate method for controlling the nesting effect of clusters at different levels, which is not addressed in previous studies. Therefore, by overcoming the drawbacks of the previous studies, this study aimed to determine individual-level (*level 1*) and community-level (*level 2*) determinant factors of maternal health services (at least fourth ANC visit, skilled delivery and PNC services).

METHODS

Study settings

This study was conducted in Benishangul Gumuz Regional State. It is 1 of the 11 regions constituting the Federal Democratic Republic of Ethiopia (FDRE), located in Northwest Ethiopia. The capital city of the region is Assosa town, located at 670 km away from Addis Ababa, the capital city of Ethiopia. Administratively, the region has three zones (namely, Assosa zone, Metekel zone and Kamashi zone), three town administrations (namely, Assosa, Gilgel Beles and Kamashi town administrations), one special woreda (namely, Mao-Komo special woreda), and 475 kebeles (439 rural and 36 urban). The region hosts nearly 60 000 refugees.

Based on the 2007 national population and household census, the 2018 population projection revealed that the total population of the region was 1 127 001, which covers 1.1% of the national population, the total number of pregnant women in the region, and the selected study districts were 36 754 and 15 368 pregnant women, respectively.[33] Health facilities serving these populations were 446 public health facilities (401 health posts, 41 health centres, 4 primary hospitals and two general hospitals); 119 private and non-governmental organisation health institutes (15 medium clinics and 104 primary clinics) and 91 private pharmaceutics (three pharmacies, 50 drug stores and 38 rural drug vendors).

Study design and period

A community and health facility-linked prospective follow-up study design was carried out from March 2020 to January 2021.

Source population and study participants

All pregnant women within the study area during the time of the baseline survey were the source population. Randomly selected pregnant women using the sampling technique were study participants. The inclusion criteria were women who were permanent residents (living more than 6 months) in the selected districts and categorised as pregnant women, women whose gestational age is >8 weeks and also fulfil pregnancy screening criteria, whereas the exclusion criteria were pregnant women who have hearing or other disabilities hindering communication; severely ill and mentally disturbed, pregnant women who reported their pregnancy is less than 8 weeks, and pregnant women who completed the fourth ANC visit during the time of baseline survey.

Sample size and sampling procedure

The sample size was computed using both single and double population proportion formulas. For the single population proportion, the following assumptions were considered while computing the sample size: the proportion of women who used the whole maternal healthcare service is 60% (p=0.6).[34] The margin of error is 5% (d=0.05) with a 95% level of CI (1.96), taking a design effect of 2 and a non-response rate of 10%. Then, the sample size calculated is 812 pregnant women.

Similarly, the double population proportion formula was used to compute the sample size for each determinant of use of maternal health services. Among all the factors considered for sample size calculation, women's age is found to have the maximum sample size. Thus, considering the following assumption for double population formula: the proportion of women

who completed the whole maternal health services (ANC, skilled delivery and PNC services), among women whose age is greater than 35 is 48% (p_1=0.48) and among women whose age between 20 and 35 years old is 62% (p_2=0.62)[34]; pooled population proportion (p=0.55); r=1:1 ratio of exposure to non-exposure; 5% significant level; 80% power, design effect of 2 and 10 non-response rate. Then, 874 sample sizes were generated through Stata/MP V.13.0 software. As a result, a total of 874 pregnant women were calculated for this study. This study, however, was part of larger research work,[35] and the sample size determined for another objective was 2402 pregnant women, which was used as the final sample size for this study.

A multistage clustered sampling technique was employed to reach the study participants. In this study, the study area was first stratified into three zones and three town administrations with one special woreda. In the first stage, of these stratified areas, two zones and one town administration were selected using a simple random sampling technique. Then after, seven districts/woredas and two town districts/woredas were randomly selected from two zones and one town administration, respectively, as the second stage. Subsequently, at the third stage, 51 Kebeles/clusters were randomly selected from the selected districts/woredas.

A 1-month baseline census was conducted to identify pregnant women using a pregnancy screening criterion to prepare a sampling frame. Then, all pregnant women who resided in the selected kebeles/clusters were included in the study and then followed up for an average of 11 months.

Mean time of the house-to-house survey and public health facilities that provide at least basic maternal health services for the community were identified. Then, all eligible public health facilities were recruited and made a candidate for a facility-based survey. Based on these, 46 health facilities (3 hospitals, 12 health centres and 31 health posts) were included in the health facility-based survey.

Data collection and quality control

The research questionnaire was prepared in English, which was adapted from Ethiopia Demographic and Health Survey (EDHS) 2011,[2] National Technical Guidance for MPDSR 2017,[36] MCH Program Indicator Survey 2013,[37] survey tools conducted in Jimma Zone, Southwest Ethiopia,[38] survey tools conducted in Rural South Ethiopia[5] and other relevant different works of literature. After finalising the research instrument preparation, training, pretest, supervision and use of local languages were made to ensure the quality of data. Then, the trained data collectors gather information through face-to-face interviews at comfortable and convenient places. After all, completed questionnaires were reviewed by supervisors on a monthly base for accuracy and consistency.

Variables and measurement

Outcome variables

In this study, maternal health service encompasses care during pregnancy, childbirth and after birth within 42 days. Therefore, we have three primary outcomes: attending recommended ANC visits (fourth visits or more), receiving skilled delivery care and attending PNC fourth visits within 42 days.

Independent variables

Independent variables were categorised into two levels. *Individual-level variables* (level 1) included individual-related factors: women's age, educational level (women and partner), occupational status (women and partner), information on maternal health services, age at first marriage and pregnant, past and present bad obstetric history, women and partner decision-making power in health-seeking behaviours, iron and folic acid (IFA) supplementation during pregnancy and provision of tetanus toxoid (TT) vaccination during pregnancy. *Higher-level variables* (cluster 2) included community and health facility-related factors such as place of residence, Household Wealth Index, accessibility of health facilities, availability of health facilities within the community and quality of maternal health services.

Data management and statistical modeling

The collected data were coded and entered into Epi. Info V.7.2.2.6. After data entry was completed, it was exported to Stata software V.14.1. Then, data were cleaned, edited and analysed using Stata software. Descriptive statistics and crude OR at 95% CI were computed for all variables to select candidate variables for multivariable analysis (p<0.25). The composite indicator of the Household Wealth Index was computed and categorised into three categories using principal component analysis. Before running the full model, the coefficient of the interaction term at p>0.1 and the multicollinearity effect between independent variables were determined by using variance inflation factors (>10%). Finally, all included variables had no multicollinearity and interaction effect.

Even though a multistage clustered sampling method was used in the study, a multilevel regression model was applied by using Stata V.14.1 to identify community and individual-level factors having significant association with use of maternal healthcare (ANC fourth visits or more, skilled delivery care and PNC fourth visits). Kebele/ketena was considered as cluster, and cluster-level variables including a place of residence, access to health posts and Household Wealth Index were taken as higher levels (level 2), whereas individual factors such as sociodemographic, obstetric history, age at first marriage and pregnancy, information on maternal health services, women decision-making power, key services offered during pregnancy and pregnancy-related problems were taken as lower levels (level 1). The goodness of fit of the multilevel model was tested by the log-likelihood ratio test

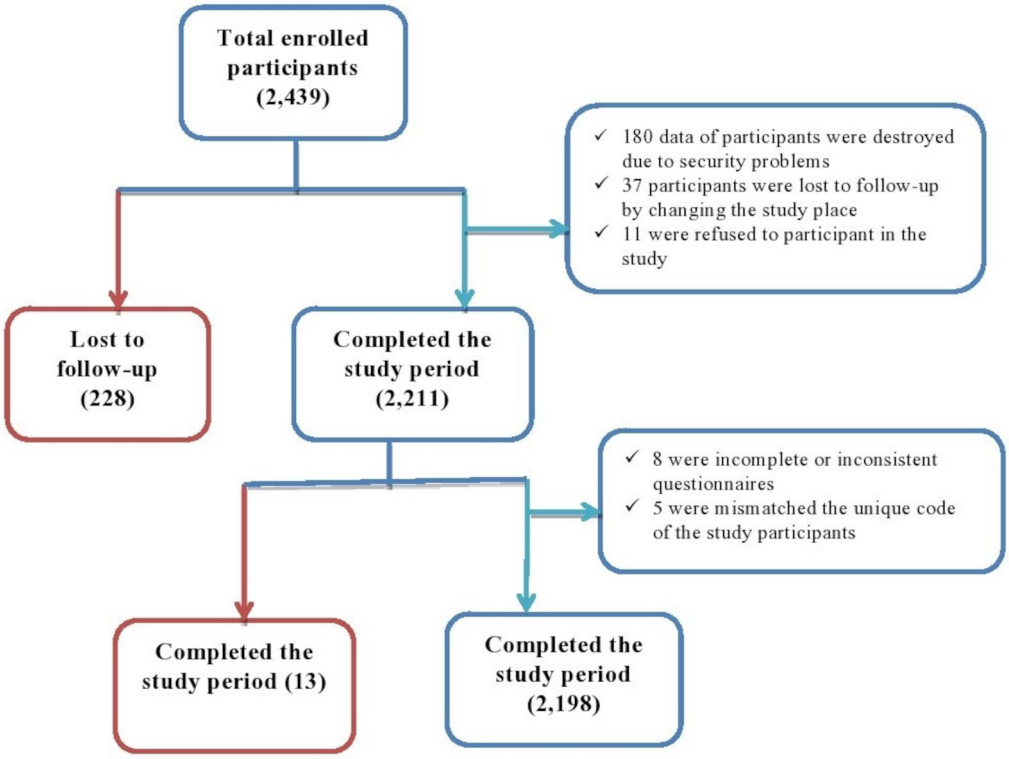

Figure 1 Flow diagram of the overall study process in Benishangul Gumuz Region, Northwestern Ethiopia, March 2020–January 2021.

and found to be statistically significant such as data fit the model.

Patient and public involvement

In this study, patients or the public were not involved in the design, conduct, report or dissemination plans of our research.

RESULT

Sociodemographic characteristics

A total of 2439 pregnant women were enrolled and included in the study. Of them, 2198 participants completed a follow-up period and were included in the final analysis (figure 1). Of these participants, 1403 (63.8%) resided in rural areas and belonged to the age group of 25–29 years with a mean (±SD) of 26.34+5.25. Majority of the women were married 2102 (95.6%) and were illiterate 1084 (49.3%). In line with occupational status, 1733 (78.8) of the women were housewives (table 1).

Coverage of use of maternal health services

Use of ANC services and related issue

Among the study participants, 1453 (66.1%, 95% CI 64.1% to 68.1%) of pregnant women attended the recommended ANC visits. The key interventions received during ANC visits were informed on the danger signs of pregnancy 1740 (79.2%) followed by blood pressure measured 1701 (77.4%). Two-thirds, 1330 (65.5%), were initiated on their first ANC visit within the second trimester (4–6 months of gestational age). However, 466 (24.3%) women were dropout from ANC follow-up service due to different reasons such as lack of knowledge on the benefit of ANC services (324 (69.5%)) and fear of privacy (139 (29.8%)) (table 2).

Institutional delivery services and related issues

The prevalence of skilled delivery service was 58.3% (95% CI 56.2% to 60.4%). Among the study participants, 1404 (63.9%) of women gave birth at the facility. The main reasons for health facility delivery were informed her to deliver in the health facility (1277 (91.0%)) and previous bad experiences from home delivery (263 (18.7%)), whereas, more than one-third (36.1%) of women gave birth at home. The main reasons for home delivery: labour was going well 424 (53.4%) and feeling more comfortable at home delivery 392 (49.4%). Moreover, 295 (14.3%) women suffered from pregnant-related complications during childbirth. Common pregnant-related complications were obstructed/prolonged labour 187 (63.4%) and excessive bleeding 102 (34.6%) (table 3).

Use of postnatal (PNC) service and related issues

This study revealed that more than half (58.6%) of women received the recommended PNC services with a 95% CI (56.4%–60.7%). Of them, 504 (28.9%) of women initiated the first postnatal services within 48 hours. The key services received during the postnatal visits were immunisation of baby 1692 (81.9%) and physical examination of the mother 1248 (60.4%). The main reasons for use

Table 1 Sociodemographic characteristics of study subjects in Benishangul Gumuz Region, Northwestern Ethiopia, March 2020–January 2021

Variables	Frequency	Percent (%)
Place of residence		
Rural	1403	63.8
Urban	795	36.2
Age (years)		
15–19	186	8.5
20–24	608	27.7
25–29	795	36.2
30–34	400	18.2
35–39	177	8.1
40–45	32	1.5
Marital status		
Married	2102	95.6
Single	84	3.8
Divorced	12	0.6
Woman's education level		
Illiterate	1084	49.3
Read and write	251	11.4
First cycle (grades 1–4)	106	4.8
Secondary cycle (grades 5–8)	316	14.4
High school (grades 9–12)	248	11.3
Tertiary education (grade 12+)	193	8.8
Woman's occupational status		
Housewife	1733	78.8
Governmental employee	185	8.4
Student	139	6.3
Merchant	94	4.3
Farmer	47	2.1

Table 2 Use of ANC services and related issues of study subjects in Benishangul Gumuz Region, Northwestern Ethiopia, March 2020–January 2021

Variables	Frequency	Per cent (%)
Ever receive ANC services during last pregnancy		
No	279	12.7
Yes	1919	87.3
Visit of ANC received during last pregnancy		
First ANC visit	1919	87.3
Second ANC visit	1815	82.6
Third ANC visit	1674	76.2
Fourth ANC contact	1453	66.1
Key interventions received during ANC contact (n=1919, multiple responses)		
Informed on danger signs of pregnancy	1740	79.2
Blood pressure measured	1701	77.4
Iron folic acid supplementation	1677	76.3
Nutritional counselling	1623	73.8
Urine sample taken	1607	73.1
Blood sample taken	1578	71.8
Protection of birth from tetanus	1562	71.1
Other	22	1.0
Reason for dropout from ANC follow-up (n=466 multiple responses)		
Didn't know about the importance of ANC	324	69.5
No problems encountered	298	63.9
Fear of lack of privacy	139	29.8
Influence of other peoples	137	29.4
Couldn't pay for transportation	114	24.5
Health institution was too far	111	23.8
No transportation services	56	12.0
Male health professionals	45	9.7
No money to pay for services	38	8.2
Time of first ANC services initiation (n=2032)		
1–3 months of pregnancy	570	28.1
4–6 months of pregnancy	1330	65.5
After 6 months of pregnancy	132	6.5
Information offered to deliver at health facility		
Yes	1901	86.5
No	297	13.5

ANC, Antenatal care; ANC, antenatal care.

of PNC were baby needed immunisation 1598 (89.6%) and the midwifery had told her to use the services 1305 (73.2%). In other direction, the reasons for not using postnatal services were ignorance of women's privacy 137 (48.6%) and long waiting time at health facilities 95 (33.7%). Around, 249 (12.1%) of women had postpartum complications (table 4).

Individual-level and community-level determinants of maternal health services

Individual and community-level factors affecting the use of maternal healthcare were detected by using a multilevel regression model. Before running the multilevel regression model, ICC (ρ) was calculated in the empty model for each outcome (ANC fourth, skilled delivery care and PNC fourth). Meantime, ICC/*rho* (ρ) was calculated as a full model for the outcomes to detect the variability attributed to clusters after controlling the individual level.

Table 3 Delivery services and related issues for current delivery services in Benishangul Gumuz Region, Northwestern Ethiopia, March 2020–January 2021

Variables	Frequency	Per cent (%)
Delivery services for last delivery		
Skilled care	1281	58.3
Unskilled care	917	41.7
Place of last delivery		
Home	794	36.1
Health post	353	16.1
Health centre	775	35.3
Hospital	276	12.6
Attendant of last delivery		
Families/friends/relatives	611	27.8
Traditional birth attendants	166	7.6
Health extension workers	141	16.4
Midwife/nurses/health officers	1184	53.9
Medical doctors	96	4.4
Mode of last delivery		
Spontaneous vaginal delivery	1943	88.4
Assisted vaginal delivery	156	7.1
Caesarean section	74	3.4
Assisted delivered stillbirth	25	1.1
Reason for health facility delivery (n=1404)		
She was informed to deliver in HFs.	1277	91.0
Previous bad experiences with home delivery	263	18.7
She faced problems: forced to deliver in HF	227	16.2
Others	53	3.8
Reason for Home delivery (n=*794*)		
The labour was going well	424	53.4
She feels more comfortable at home	392	49.4
Close attention from relatives/family	332	41.8
It is usual practice	331	41.8
No transportation services	248	31.2
Cannot pay for transportation services	202	25.4
Previous bad experiences with ID	65	8.2
Cannot afford to pay for health services	22	2.8
Culture doesn't allow to give birth at HF	15	1.9
Others	5	0.6
Pregnant related complications at labour (n=*2065*)		
No	1769	85.7
Yes	295	14.3
Pregnant related complications at labour/childbirth (n=295, multiple responses)		
Obstructed/Prolonged labour	187	63.4
Excessive bleeding during labour	102	34.6
Elevated blood pressure	76	25.8
Premature rupture of membranes	69	23.4
Intrauterine fetal death	47	15.9
Preterm labour	12	4.1
Others	5	1.7

Rho (ρ)/ICC was calculated for the ANC fourth visits in the empty model and it was found to be 0.37, indicating that 37% of the variation was contributed by cluster variations. The test of preference of log likelihood versus logistic regression was statistically significant (p<0.0001). Then, the full model was run by including both the community-level and individual-level variables, and the ICC (ρ) increased to 0.46. This again indicated that 46% of the variation was attributed to cluster-level variables. The preference for log-likelihood versus logistic regression was statistically significant (p<0.0001). Hence, this suggests that the preferred model for this outcome variable was the multilevel logistic regression model. Similarly, r (ρ)/ICC and test preference of log likelihood were determined in the empty and full model for both skilled delivery care and PNC fourth visits and indicated that statistically significant association. Hence, a multilevel logistic regression model is the preferred model for these outcomes (table 5).

Community-level factors

Regarding community-level factors, different programmatic important indicators (place of residence, Household Wealth Index, quality of maternal health services, accessibility and availability of health facilities within the community) were assessed. Of them, place of residence, Household Wealth Index and accessibility of health posts were selected as candidate variables for multivariable multilevel logistic regression analysis.

After controlling for any confounders in the final multilevel model, among the community-level variables, a place of residence had a statistically significant association with use of the recommended ANC visits (fourth visits or more), but it was not a statistically significant association with skilled delivery care and recommended PNC visits (PNC fourth). The odds of attending the recommended

Table 4 Postnatal services and related issues of study participants in Benishangul Gumuz Region, Northwestern Ethiopia, March 2020–January 2021

Variables	Frequency	Per cent (%)
Component of PNC contact she received (n=2065)		
First contact of PNC services	1783	86.3
Second contact of PNC services	1545	74.8
Third contact of PNC services	1373	66.5
Fourth contact of PNC services	1210	58.6
The key interventions offered during the postnatal period (n=2065, multiple responses)		
Immunisation of baby	1692	81.9
Counselling on proper nutrition	1516	73.4
Breastfeeding education	1436	69.5
Physical examination	1248	60.4
Family planning services	1074	52.0
Others	30	1.5
Time interval for first PNC visit (n=1741)		
Within 2 days after delivery	504	28.9
Between 3 days and 7 days after delivery	754	43.3
Between 8 days and 42 days after delivery	483	27.7
Reason for seeking PNC services (n=1783)		
The baby needs immunisation	1598	89.6
The midwife had told me to seek the services.	1305	73.2
She wanted to start family planning.	975	54.7
She wanted to make sure she is back to normal.	834	46.8
Because of her illness	272	15.3
Reason for not seeking PNC services (n=282)		
They did not teach properly	181	64.2
Fear of privacy	137	48.6
Waiting more time at health facility	95	33.7
They examined roughly.	77	27.3
Religious, forbidden	64	22.7
A health professional shouted at me.	37	13.1
Others	14	5.0
Postpartum complications (n=2065)		
No	1816	87.9
Yes	249	12.1
Type of postpartum complications (n=249)		
Headache and visual disturbances	170	68.3
Convulsions/rigidity	118	47.4
Fever with or without chills	85	34.1
Heavy bleeding	66	26.5
Loss of consciousness	66	26.5
Foul-smelling discharge	52	20.9
Severe abdominal pain	5	2.0
Others*	3	1.2

*Leg oedema, nausea, vomiting and severe malaria during pregnancy.
PNC, postnatal care.

ANC visits (fourth visits or more) among women who resided in rural areas (adjusted OR (AOR)=3.82, 95% CI 1.35 to 10.78) were four times higher than among women who resided in urban areas. Similarly, among community-level factors, Household Wealth Index had a statistically significant association with skilled delivery services but no statistically significant association with the fourth ANC visits and recommended PNC visits. The odds of receiving skilled delivery services among women who belonged to the third quintile wealth index of household (AOR=2.23, 95% CI 1.27 to 3.89) were two times higher than among women who belonged to the first quintile wealth index of the household.

Individual-level factors

In the individual-level (level 1) variables, multiple factors were detected that had programmatically important implications and depicted the statistically significant association with use of maternal healthcare.

Concerning individual-level factors of use of ANC services, we found that the odds of attending the recommended ANC visits (ANC fourth or more) among women who had any information on maternal health services (AOR=2.13, 95% CI 1.12 to 3.75) were two times higher than among women who did not have any information on maternal health services. Moreover, women with a history of pregnancy-related problems (AOR=1.83, 95% CI 1.15 to 2.2), women with a history of stillbirth (AOR=1.67, 95% CI 1.02 to 2.73) and women with decision-making power (AOR=1.74, 95% CI 1.14 to 2.68) were two times higher in odds of attending recommended ANC visits than women who belonged with their counterpart.

This study found that the odds of using skilled delivery care among women who completed recommended ANC visit or more (AOR=2.29, 95% CI 1.59 to 3.32) and who attended primary school (AOR=1.71, 95% CI 1.04 to 2.81) and tertiary school (AOR=4.12, 95% CI 1.49 to 11.33) were higher in the odds of attending skilled delivery care than women residing with their counterpart. However, women with a history of pregnancy-related problems (AOR=0.57, 95% CI 0.37 to 0.86) and a history of stillbirth (AOR=0.43, 95% CI 0.28 to 0.66) were 60% lower in the odds of receiving skilled delivery care than among women who were free from any problems. The odds of skilled delivery care use among women who delay first ANC visit initiation between 4 months and 6 months

Table 5 Parameter of OR and test of goodness of fit for multilevel models, Benishangul Gumuz Region, Northwest Ethiopia, 2021

Models	Fixed intercept (–cons (95% CI))	Random effect as level 2 variance var (–cons (95% CI))	Intraclass correlation coefficient (ρ)	Log-likelihood (LR) deviance	Significance of LR test versus logistic regression (P value)
ANC fourth and more*					
Empty model	2.54 (1.7 to 3.78)	1.92 (1.23 to 3.04)	0.37=37%	–1161.48	<0.0001
Full model	0.26 (0.04 to 1.67)	2.76 (1.54 to 4.96)	0.46=46%	–633.06	<0.00001
Skilled delivery*					
Empty model	1.48 (1.17 to 1.87)	0.59 (0.36 to 0.96)	0.15=15%	–1402.31	<0.0001
Full model	1.18 (0.3 to 4.66)	1.1 (0.63 to 1.92)	0.25=25%	–706.65	<0.00001
PNC fourth*					
Empty model	1.59 (0.99 to 2.54)	2.72 (1.72 to 4.33)	0.45=45%	–1099.36	<0.0001
Full model	0.08 (0.01 to 0.71)	2.25 (1.27 to 3.98)	0.40=40%	–523.25	<0.00001

A p value less than 0.05 is statistically significant and the data fit for the multilevel model.
*Multilevel regression model applied to measure the effect of factors on outcome.
ANC, antenatal care; CI, Confidence Interval; LR, log-likelihood ratio; OR, Odds ratio; PNC, postnatal care.

of gestational age (AOR=0.66, 95% CI 0.45 to 0.96) were 34% lower than among women who initiate first ANC visit early (within 3 months of gestational age).

Similarly, this study indicated that the odds of using the recommended PNC services among women who attended ANC fourth visits or more (AOR=10.8, 95% CI 6.79 to 17.2), a partner who attended tertiary education (AOR=3.67, 95% CI 1.40 to 9.58), women with decision-making power (AOR=1.8, 95% CI 1.09 to 2.97), IFA supplementation during pregnancy (AOR=1.96, 95% CI 1.11 to 3.49) and women who attended skilled delivery care (AOR=1.63, 95% CI 1.11 to 2.42) were higher than among women who belonged within their counterpart. However, the odds of use of PNC service among women with history of stillbirth (AOR=0.51, 95% CI 0.29 to 0.87), women who delay initiating the first ANC visit within 4–6 months of gestational age (AOR=0.39, 95% CI 0.24 to 0.61) and after 6 months of gestational age (AOR=0.1, 95% CI 0.03 to 0.24) were 49%, 61% and 90% lower, respectively, than among women within their counterpart (table 6).

DISCUSSION

Status of use of maternal health services

Among 2198 pregnant women, 66.1% of the women attended the recommended ANC visits. Of them, 28.1% of the pregnant women initiated first ANC visit within the first trimester. Similarly, more than half (58.3%) of the births were attended by skilled providers, and 58.6% of the women attended the recommended PNC visits.

The recommended ANC visits (fourth or more ANC visits) play a pivotal role in maternal health services and warrant more programmatic attention.[6 7] Besides, two-thirds (66.1%) of the pregnant women attended the recommended ANC visits, which is consistent with studies done in North Ethiopia,[7 16] Cambodia[12] and Bihar India.[13] However, this finding is lower than studies in South Asia and sub-Saharan Africa,[7] Debre Berhan town[17] and Northern Bangladesh.[8] However, it is higher than evidence in Pakistan,[9] Ratanakiri Cambodia,[10] Rural Khammouane Lao PDR,[11] sub-Saharan Africa (51%),[14] EDHS 2014 (33%),[15] Arba Minch districts (25.2%),[19] West Gojjam zone (39.9%,[18] and Tigray (49.9%).[20] This disparity could be explained by variability of health delivery system and infrastructure among the study areas to deliver maternal health services to the community. Moreover, in the study areas, there are misperceptions and cultural barriers that hinder the use of maternal health services. Similarly, this study found that 28.1% of pregnant women initiated their first ANC contact within the recommended schedule. This finding is lower than evidence from Rural Khammouane,[11] South Asia,[7] Ghana,[39] EDHS 2014,[15] Arba Minch[19] and Debre Berhan town.[17] But it was higher than studies done in Sub-Sahara Africa[7] and the West Gojjam zone.[18] This discrepancy may be in the study area, there is low awareness and lack of knowledge on early initiation of maternal health services, and also the region is a remote area and hard to reach area in Ethiopia, which lacks availability and accessibility of health facilities and lacks skilled health providers. Not only delay of ANC initiation but also one-fourth of pregnant women were dropouts from ANC follow-up due to lack of knowledge on the benefit of services, perceived as the absence of problems, fear of privacy and influence of other people.

The current study found that 58.3% of births were attended by a skilled provider, which is consistent with a study in Pakistan.[9] However, this finding is lower than that in the study in Cambodia,[12] Tanzania[28] and Bihar, India,[13] whereas it is higher than evidence in Ratanakiri, Cambodia,[10] Rural Khammouane,[11] West Gojjam[18] and Arba Minch South Ethiopia.[19] This discrepancy

Table 6 Individual-level and community-level determinants of use of maternal healthcare in Benishangul Gumuz Region, Northwestern Ethiopia, March 2020–January 2021

Variables	ANC fourth+ visits AOR (95% CI)	Skilled delivery care AOR (95% CI)	PNC fourth visits AOR (95% CI)
Level 2 (community-level) variables			
Place of residence			
Urban	**1**	1	1
Rural	**3.82 (1.35 to 10.78)**	1.22 (0.55 to 2.73)	1.14 (0.44 to 2.91)
Distance to health post			
<2 hours	1	1	1
≥2 hours	0.25 (0.02 to 2.73)	0.49 (0.08 to 2.89)	0.88 (0.1 to 10.26)
Household Wealth Index			
First quintile (poor)	1	1	1
Second quintile (middle)	1.06 (0.69 to 1.61)	1.13 (0.78 to 1.63)	0.74 (0.46 to 1.21)
Third quintile (rich)	1.46 (0.81 to 2.62)	**2.23 (1.27 to 3.89)**	0.43 (0.22 to 1.06)
Level 1 (individual-level) variables			
Age (years)			
< 20	1	–	1
20–29	0.95 (0.27 to 3.31)	–	1.53 (0.42 to 5.62)
≥30	0.86 (0.24 to 3.02)	–	1.33 (0.36 to 4.96)
Women's educational level			
No formal education	1	1	1
Primary school	0.92 (0.54 to 1.57)	**1.71 (1.04 to 2.81)**	0.69 (0.38 to 1.27)
High school	1.14 (0.57 to 2.28)	1.49 (0.77 to 2.89)	0.68 (0.3 to 1.52)
Tertiary education	1.43 (0.60 to 3.37)	**4.12 (1.49 to 11.33)**	0.52 (0.2 to 1.37)
Partner educational level			
No formal education	1	1	1
Primary school	1.22 (0.69 to 2.15)	0.66 (0.39 to 1.1)	1.07 (0.57 to 1.98)
High school	0.87 (0.48 to 1.59)	0.76 (0.44 to 1.32)	1.49 (0.75 to 2.95)
Tertiary education	1.98 (0.88 to 4.45)	0.56 (0.25 to 1.25)	**3.67 (1.40 to 9.58)**
Partner occupational status			
Governmental employee	1	1	1
Others	1.23 (0.64 to 2.36)	0.61 (0.31 to 1.21)	1.48 (0.69 to 3.18)
Information on MHS			
No	**1**	1	1
Yes	**2.13 (1.21 to 3.75)**	1.23 (0.7 to 2.17)	1.04 (0.49 to 2.18)
Age at first marriage (year)			
<18	1	1	1
≥19	0.92 (0.54 to 1.56)	1.13 (0.7 to 1.82)	0.98 (0.54 to 1.73)
Age at first pregnancy (year)			
<19	1	1	1
≥19	1.13 (0.67 to 1.91)	1.24 (0.77 to 2.01)	0.98 (0.55 to 1.74)
History of pregnancy-related problems during labour for a previous birth			
No	**1**	**1**	1
Yes	**1.83 (1.15 to 2.92)**	**0.57 (0.37 to 0.86)**	1.63 (0.98 to 2.7)
History of stillbirth			
No	**1**	**1**	**1**

Continued

Table 6 Continued

Variables	ANC fourth+ visits AOR (95% CI)	Skilled delivery care AOR (95% CI)	PNC fourth visits AOR (95% CI)
No	**1.67 (1.02 to 2.73)**	**0.43 (0.28 to 0.66)**	**0.51 (0.29 o 0.87)**
Women' decision-making power			
Didn't make a decision	1	1	**1**
Make decision	**1.74 (1.14 to 2.68)**	1.22 (0.81 to 1.85)	**1.8 (1.09 to 2.97)**
ANC fourth visit completed			
No	–	1	**1**
Yes	–	**2.29 (1.59 to 3.32)**	**10.8 (6.79 to 17.2)**
Offered information on danger signs during ANC visit			
No	–	1	1
Yes	–	0.7 (0.44 to 1.12)	0.71 (0.38 to 1.33)
Time of first ANC visit start			
Within 3 months of GA	–	**1**	**1**
4–6 months of GA	–	**0.66 (0.45 to 0.96)**	**0.39 (0.24 to 0.61)**
After 6 months of GA	–	**0.33 (0.16 to 0.68)**	**0.1 (0.03 to 0.24)**
Provision of information on health facility delivery			
No	–	1	1
Yes	–	0.9 (0.49 to 1.68)	1.05 (0.51 to 2.17)
IFA supplementation during pregnancy			
No	–	–	**1**
Yes	–	–	**1.96 (1.11 to 3.49)**
Provision of TT during pregnancy			
No	–	–	1
Yes	–	–	1.58 (0.93 to 2.69)
Skilled delivery care			
No	–	–	1
Yes	–	–	**1.63 (1.11 to 2.42)**
Pregnancy-related problems immediately after labour			
No	–	–	1
Yes	–	–	1.1 (0.55 to 2.21)

Bold value indicate statistically significant assocaition
AOR, adjusted OR; GA, Gestational age; IFA, iron and folic acid.

might be due to variations in sociodemographic and economic status, culture, belief, time of the study and design. The main reasons for health facility delivery were being informed on the benefits of delivering at the health facility and previous bad experiences from home delivery. This evidence is supported by a study done in west Gojjam.[18] In contrast to the reasons mentioned for facility delivery, the main reasons for home delivery were labour was going well, feeling more comfortable at home delivery, getting close attention/support from relatives/families and being as a usual practice, which is also consistent with a study done in West Gojjam.[18]

PNC is the key strategy in reducing maternal and neonatal mortality and morbidity.[10] Hence, more than half (58.6%) of the women attended the recommended PNC visits, which is lower than the study done in Pakistan,[9] sub-Saharan Africa[14] and Ghana.[31] However, it is higher than the study done in West Gojjam Zone,[18] Ratanakiri, Cambodia,[10] Arba Minch,[19] and Rural Khammouane.[11] In line with these, the effectiveness of PNC services was not only determined by coverage of the use of the services but also by the key services and quality of postnatal services. As a result, key PNC services provided for women and newborns were immunising the babies (81.9%), counselling on proper nutrition (73.4%), breastfeeding education (69.5%), physical examination for women (60.4%) and family planning services (52.0%). This finding is similar to those of the studies

conducted in Arba Minch,[19] West Gojjam Zone[18] and Ghana.[31]

Community-level and individual-level determinants of maternal health services

Community-level factors on maternal health services

In this study, we found that resident of women was statistically significant association with the recommended ANC visit (fourth ANC visit) but not statistically significant association with the skilled delivery services and PNC visits. Similarly, Household Wealth Index had a statistically significant association with the skilled delivery services, but there was no statistical significant association with the recommended ANC visits and PNC visit. However, quality of maternal health services, accessibility and availability of health facility were not statistically significantly associated with use of maternal health services.

The odds of completing recommended ANC visits (fourth visits or more) among women residing in rural areas were four times higher than among women residing in urban areas. In contrast, evidence in South Asia and sub-Saharan Africa found that rural women had lower odds of receiving all the elements of maternal health services compared with urban women.[7] This discrepancy is due to the study region, where private health institutes were concentrated in urban areas which provide maternal health services. As a result, once women confirmed their pregnancy and initiated ANC follow-up at public health facilities, then after, they switch to the private health institute. This argument is supported by the finding that women who obtained ANC in the private sector had nearly two times greater odds of receiving maternal health services compared with those who received care in the public sector.[40] Moreover, this study did not include private health sectors to measure the coverage of use of maternal health services. Other reasons include the following: in the rural areas, there are strong defaulter tracing mechanisms by health extension worker; they have a list of all pregnant women with their names in their catchment areas, and then follow the pregnant women up to the postnatal period during home visits.

Socioeconomic status, especially the Household Wealth Index, is strongly linked to the place of delivery. As the Household Wealth Index increases, the uptake of institutional delivery service also increases. This evidence is supported by different studies in sub-Saharan Africa,[29] Nigeria,[21] Ethiopia[4] and EDHS 2016.[24] This is because the wealthier families can afford the direct and indirect costs associated with birth in the health facilities.

Individual-level factors on maternal health services

We found that information on maternal health services, history of pregnancy-related problems, history of stillbirth and women decision-making power were statistically significantly associated with the recommended ANC visit (fourth visit). Similarly, completing the recommended ANC visits, women's educational status, time of first ANC visit initiate, history of pregnancy-related problems and history of stillbirths were statistically significantly associated with skilled delivery services. Moreover, partner educational status, women's decision-making power, completing ANC fourth visits, time of first ANC visit initiated, IFA supplementation during pregnancy, skilled delivery services and history of stillbirth were statistically significantly associated with the recommended PNC visits.

Health-seeking behaviour may be influenced by health information offered to pregnant women on the issues of maternal health services. Besides, the odds of women attending the recommended ANC visits among women who did have information on maternal health services were two times higher than the odds of women who did not have information on maternal health services. This finding is similar to the study conducted in Ethiopia[4] and the rural areas of Ethiopia.[25]

The odds of completion of the whole ANC visits among women with a history of pregnancy-related problems during labour and a history of stillbirth were two times higher than those of women who belonged within their counterparts. This evidence is supported by a study done in Kombolcha.[26] This is because prior bad experiences gave a big lesson for women on maternal health services which encouraged and motivated the women to consult health professionals during their subsequent pregnancies, and also women will start ANC services early and attend the recommended ANC visits.

Women and partner decision-making powers have a significant role in the use of maternal health services. In line with these, the odds of using the recommended ANC visits among women who had decision-making power within the households were almost two times higher than those of women who had no decision-making power. This finding is consistent with the study done in Nigeria.[21] This might be because if the household resources are controlled by others and women have no power to decide on their resources, women will not have the freedom to access maternal health services whenever they need care. Autonomy may also be related to other variables such as women's education level, information on maternal health services and urban residence; all of these parameters increase the likelihood of using maternal health services, particularly ANC services, which is an entry point of maternal health services.

Similarly, the educational status of women has a significant effect on the use of institutional delivery services. This finding has been consistently supported by many other studies conducted in different parts of the world including Ethiopia.[4 21 24 26 41] This positive correlation can be explained by the fact that educated women are more aware of the importance of medical services to themselves and their newborns and also they have a more modern cultural perspective on the use of maternal health services.

Provision of the recommended ANC visits during pregnancy and early initiation of ANC within the WHO recommended time significantly affected the use of institutional delivery services. These findings are supported by studies conducted in Ethiopia[41] and Nigeria.[21] This may

be because the women will be aware of the importance of institutional and skilled delivery services as they may be educated and counselled during the ANC session. Even though women have adequate information on maternal health services, the probability of using maternal health services will be increased.[32 41 42] Other evidence supported that use of ANC is one of the strongest determinants for the use of skilled delivery and institutional delivery services.[21]

Uptake of PNC service is directly related to partner education, which showed a positive influence on use of PNC services. This finding is consistent with other studies conducted in Ethiopia and nations abroad.[4 21 32] This is because educated husbands may have a better understanding of the benefit of PNC services and good communication with their wives and willingness to discuss the use of maternal health services. Moreover, women attending the recommended ANC visits, timely initiation of ANC services and skilled delivery services are more likely to attend the recommended PNC visits. This evidence is strongly supported by systematic review and meta-analysis pooled results[43] and also other studies done in Nigeria[21] and Ethiopia.[3 4] However, the odds of use of PNC services among women with a history of stillbirth are 49% times lower than those among women free of stillbirth history. This finding is consistent with the evidence in Lubumbashi City in the Democratic Republic of Congo.[3] This is due to the finding that when women encountered stillbirth, their chance of going to the health facility for check-up purpose is poor and null. Another reason may be that women have no confidence and motivation to treat and undergo check-ups themselves after the event of stillbirth.

Generalisability (external validity)

Since this study used a representative large number of sample size (2198 study participants) of randomly selected 51 kebeles, it can be generalised to Benishangul Gumuz Region having similar characteristics in population, socioculture, access to and availability of healthcare, and health service-seeking behaviours.

Strength and limitations of the study

The strengths of this study were using a prospective follow-up study that helped to measure the cause and effect relationship, a large sample size that resulted in high power and precision for the multilevel analyses, and using advanced statistical models (multilevel logistic regression model) to handle clustering effects and identify factors at different levels for intervention purposes.

However, the limitation of this study was health facility data were collected by health workers who were liable to social desirability bias which might compromise the findings. In the region, 15 medium clinics were providing maternal health services, but the rest of the private health facilities did not provide maternal health services for the community. However, this study did not include private health facilities, which might compromise the findings. Finally, some of the study participants (8.5%) were lost to follow-up, which might have some deviation in the result.

CONCLUSION AND RECOMMENDATION

The proportion of women, who attended ANC, received skilled delivery care, and PNC were low as compared with the national target. In this study, we found different individual-level factors that influenced the use of these services. Those factors were women and partner education, information on maternal health services, history of pregnancy-related problems for previous birth, history of stillbirth, ANC fourth visit, early initiation of first ANC visit, iron–folic acid supplementation during pregnancy, skilled delivery care and women decision-making power. Among community-level factors, only place of residence and Household Wealth Index had significantly influenced the use of maternal health services.

Therefore, this study strongly recommended reinforcing women's autonomy, particularly household decision–making power; efforts are also needed to reinforce and improve the information given to pregnant women, as well as strengthen the communication system between healthcare providers and the community, and participating within the community dialogues. This will contribute to raising awareness of women on safe motherhood initiatives, particularly ANC, institutional delivery and PNC services in the study area.

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Contributors MA conceived and designed the study, then later collected, analysed and interpreted the data, and wrote the whole document. AW and GTD critically commented on the whole document and genuinely guided the whole work. All authors read and approved the final manuscript.

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Ethics approval This study involves human participants and was approved by the research review and ethics committee of the School of Public Health, Addis Ababa University (protocol number SPH/3089/011) and the institutional review board of College of Health Sciences of Addis Ababa University (protocol number 048/19/SPH). Necessary permission letters were obtained from the Regional Health Bureau and the respective all local districts. Confidentiality was maintained by avoiding mentions of any identities from the questionnaire. Before starting the actual data collection, written and verbal consent was obtained from each study subject.

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