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 sharing; however, the authors who were involved in the study and the area health office collaborated to get the result.

⇒ 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.\textsuperscript{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.\textsuperscript{6,7} However, use of ANC services is low and varies across the nations and within the country.\textsuperscript{1,7-26} This underuse of ANC services is due to different factors: sociodemographic characteristics,\textsuperscript{1,3,4,21-27} availability of health facilities,\textsuperscript{27} Household Wealth Index,\textsuperscript{1,4,21-25} women empowerment,\textsuperscript{21} present and past obstetric history,\textsuperscript{3,4,21-26} information and perception on maternal health services\textsuperscript{1,4,25,26} and health insurance.\textsuperscript{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.\textsuperscript{15-19,21-24,28} Empirical evidence identifies different factors that affect the uptake of institutional delivery services such as sociodemographic and economic factors,\textsuperscript{1,3,4,21-26}29 obstetric history,\textsuperscript{1,3,4,21-26,29} transportation services and perception on quality of services.\textsuperscript{26,29}

Health interventions after delivery are a crucial period and key strategy to reduce maternal and neonatal mortality.\textsuperscript{10,29} However, use of postnatal services was extremely low even comparing with the use of ANC and delivery services.\textsuperscript{1,9-11,14,18,19,21,22,24,25,31} This underuse of the services is due to different factors: sociodemographic factors,\textsuperscript{4,21,32} Household Wealth Index,\textsuperscript{4,21} obstetric factors,\textsuperscript{3,4,21} women’s empowerment\textsuperscript{21} and health insurance.\textsuperscript{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).
who completed the whole maternal health services (ANC, skilled delivery and PNC services), among women whose age is greater than 35 is 48% (p=0.48) and among women whose age between 20 and 35 years old is 62% (p=0.62); 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, 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, National Technical Guidance for MPDSR 2017, MCH Program Indicator Survey 2013, survey tools conducted in Jimma Zone, Southwest Ethiopia, survey tools conducted in Rural South Ethiopia 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 modelling

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 socio-demographic, 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.
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

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

### 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 | Percent (%) |
|------------------------------------------------------------------|-----------|-------------|
| 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.

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 (\(\rho\)) was calculated in the empty model for each outcome (ANC fourth, skilled delivery care and PNC fourth). Meantime, ICC/\(\rho\) (\(\rho\)) was calculated as a full model for the outcomes to detect the variability attributed to clusters after controlling the individual level.
Rho ($\rho$)/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 ($\rho$) 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, $r$ ($\rho$)/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 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          |

**Table 3 Continued**

| Variables                                      | Frequency | Per cent (%) |
|-----------------------------------------------|-----------|--------------|
| 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          |

Zelka MA, et al. BMJ Open 2022;12:e061293. doi:10.1136/bmjopen-2022-061293
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         |
| 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         |
| Reasons 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         |

Continued

| Variables                                      | Frequency | Per cent (%) |
|------------------------------------------------|-----------|--------------|
| 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=1.42, 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...
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 who delay initiating the first ANC visit within 4–6 months of gestational age (AOR=0.61) and after 6 months of gestational age (AOR=0.1) were 1.63 and 10.8, respectively, than among women within their counterpart.

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 then the 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. 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 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 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 | <0.0001 |
| 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 | <0.0001 |
| 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 | <0.0001 |

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; OR, Odds ratio; PNC, postnatal care.

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 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
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 Africa14 and Ghana.31 However, it is higher than the study done in West Gojjam Zone,18 Ratanakiri, Cambodia,10 Arba Minch,19 and Rural Khambouane.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

| Table 6 Continued |
|-------------------|-------------------|-------------------|
| Variables         | ANC fourth+ visits AOR (95% CI) | Skilled delivery care AOR (95% CI) | PNC fourth visits AOR (95% CI) |
| 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 association
AOR, adjusted OR; GA, Gestational age; IFA, iron and folic acid.
conducted in Arba Minch,19 West Gojjam Zone18 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 Ethiopia4 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 Ethiopia4 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 Nigeria21 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 Ethiopia41 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. Other evidence supported that use of ANC is one of the strongest determinants for the use of skilled delivery and institutional delivery services.

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. 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 and also other studies done in Nigeria and Ethiopia. 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. 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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Competing interests None declared.

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

Patient consent for publication Consent obtained directly from patient(s).

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/165/007) 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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Data availability statement All data relevant to the study are included in the article.

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