Individual and Community-level determinants of maternal health services utilization in Northwest Ethiopia: Multilevel Analysis

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Research note

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Abstract

Objective

Utilization of maternal health services is a direct and indirect indicator of perinatal death, and socio-economic development. Evidence on individual and community level determinants of maternal health services in Ethiopia, particularly in the study region was not found. Hence, this study fills this gap.

Results

Among 2,198 study subjects, proportion of pregnant women who visited antenatal care (ANC4^{+}), received skilled delivery care, and postnatal care (PNC) were 66.1%, 58.3%, and 58.6% respectively. Besides these, community and different individual-level factors for the three indicators were detected. For ANC 4th visits: place of resident (AOR=3.82), information on MHS (AOR=2.13), history of pregnancy-related problems (AOR=1.83) and women's decision-making (AOR=1.74). For skilled delivery were belonged in 3rd quintile household wealth (AOR=2.23), women's education (AOR=1.71), attended ANC visit 4th (AOR=2.29), delay initiation of ANC visit between 4–6 months (AOR=0.66). Finally, for PNC services: partner education (AOR=3.67), attending recommended ANC visits (AOR=10.8), iron folic acid supplementation (AOR=1.96) and skilled delivery (AOR=1.63). Hence, community based interventions are strongly recommended to improve utilization of maternal health services.

Introduction

Regardless of significant reduction of maternal and neonatal mortality globally and developed countries, still in Ethiopia, it was the highest and no significant reduction(1, 2). Maternal health services are essential for women and baby health(1). Even though, utilization of maternal health services are an indirect indicator of maternal and perinatal death, fewer women were using ANC, facility delivery and PNC that is an alarming challenge to reduce maternal mortality(3, 4). This underutilization of maternal health services were due to different factors: socio-demographic and economic(1, 4–12), obstetric(4–6, 9, 10, 13), availability of HFs(10), transportation services and quality of services(9, 11), household index(1, 5–8), women empowerment(6), health insurance(6), information on maternal health services(5, 8, 9).

However, prior studies were determining magnitude and individual level factors using traditional logistic regression which excluded community level factors and advance statistical modeling. This might lead to underestimate or overestimate the magnitude and their predictors which are crucial for the establishment of community based interventions for maternal health services. Multilevel mode 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 limitation of previous study, the aim of this study was to determine individual (*level-1*) and community level (*level-2*) determinants of maternal health services.

Methods

Study settings

This study was conducted in Benishangul Gumuz Regional State. It is one of the eleven regions constituting in Ethiopia, located in the Northwest Ethiopia.

Study design and period

A community and health facility linked prospective follow up study design has been conducted from March 2020 to January 2021.

Source population and study participants

All pregnant women within the study area during the time of baseline survey were source population. A randomly selected pregnant women using sampling technique were study participants.

Sample size determination and sampling procedure

Sample size was computed using both single and double population proportion formulas. Then, the calculated maximum sample size using two methods were 812 and 874 respectively. However, this study was part of larger research work, and the sample size determined for another objective was 2,402, which was used as the final sample size for this study. Multistage sampling technique was employed to reach the study participants. Finally, 51 kebeles were randomly selected from the selected districts. Similarly, all eligible public HFs which served the selected kebeles were recruited and make candidate for survey. Thus, 46 health facilities were included for health facility based survey.

Data collection and quality control

Questionnaire was prepared in English, adopted from different relevant sources (2, 3, 14–16). Then, training, pretest, supervision and use of local languages were made to ensure the quality of data. The trained data collectors gather information through face to face interviews. After all, completed questionnaires were reviewed by supervisors on monthly base for accuracy and consistency.

Variables: This study have three outcomes: receiving recommended ANC visits, skilled delivery and PNC 4th visits. Independent variables were categorized in to two levels. *Individual level variables (level-1)* included individual and household related factors: socio-demographic and economic, obstetric and decision making power. *Higher level variables (cluster-2)* included community and health facility related factors: place of resident and access to HF.

Data analysis

Data were coded and entered into Epi. Info software, then it was exported, cleaned, edited, and analyzed using STATA software. Descriptive statistics and crude odds ratio at 95%CI were computed for all

variables to select candidate variables ($p<0.25$). Composite indicator of household wealth index was computed and categorized into three categories using Principal Component Analysis. Before running the full model, coefficient of the interaction term at $p \geq 0.1$ and variance inflation factors >10% were determined. Thus, all included variables had no multi-collinearity and interaction effect. Goodness of fit for multilevel model was tested by the log likelihood ratio (LR) test found to be statistical significant, data fit the model. Therefore, multilevel regression model was applied.

Result

Utilization of ANC services

Pattern of ANC visit were 1st ANC 1919(87.3%), 2nd ANC 1815(82.6%), 3rd ANC 1674(76.2%), and 4th ANC 1453(66.1%). Key interventions received during ANC contact were informed on danger signs of pregnancy 1740(79.2%) and blood pressure measured 1701(77.4%). Two thirds (65.5%) were initiated their first ANC contact within 4 – 6 months of pregnancy.

Institutional delivery services

The prevalence of skilled delivery service was 58.3%. The reasons for home delivery: labour was going well 424(53.4%) and feeling more comfortable 392(49.4%). Beside, 295(14.3%) of women were suffered from pregnant-related complications. Among them, obstructed/prolonged labour 187(63.4%) and excessive bleeding 102(34.6%) were common problems.

Postnatal (PNC) service utilization

Pattern of PNC visits: 1783(86.3%), 1545(74.8%), 1373(66.5%) and 1210(58.6%) of women were attended 1st PNC, 2nd PNC, 3rd PNC and 4th PNC services respectively. Key services received during PNC visits: immunization services 1692(81.9%) and physical examination 1248(60.4%). The main reasons explored for not utilize PNC were they didn’t teach them well 181(64.2%) and ignorance of her privacy 137(48.6%). Around, 249(12.1%) of women had postpartum complications, of them, the common problems were headache with visual disturbances 170(68.3%) and convulsions/rigidity 118(47.4%)(Table 1).

Table 1
Utilization of maternal health services and related issues of study subjects in Benishangul Gumuz Region, Northwestern Ethiopia, March 2020 – January 2021

Variables	Frequency	Percent
Visit of ANC received during last pregnancy	1919	87.3
1st ANC contact	1815	82.6
2nd ANC contact	1674	76.2
3rd ANC contact	1453	66.1
4th ANC contact		
Key interventions received during ANC contact (*n = 1919, multiple response*)	1740	79.2
Informed on danger sign of pregnant	1701	77.4
Blood pressure measured	1677	76.3
Iron foliate supplementation	1623	73.8
Nutritional counseling	1607	73.1
Urine sample taken	1578	71.8
Blood sample taken	1562	71.1
Protection of birth from tetanus	22	1.0
Other		
Reason for dropout from ANC follow up (*n = 466*)	324	69.5
Didn't know about importance of ANC	298	63.9
No problems encountered	139	29.8
Fear of lack of privacy	137	29.4
Influence of other peoples	114	24.5
Couldn't pay for transportation	111	23.8
Health institution was too far	56	12.0
No transportation services	45	9.7
Male health professionals	38	8.2
No money to pay for services		

* *Leg edema, nausea, vomiting and sever malaria during pregnancy*

Variables	Frequency	Percent
Time of first ANC services initiation (*n = 2032*)	570	28.1
1-3 months of pregnancy	1330	65.5
4-6 months of pregnancy	132	6.5
After 6 months of pregnancy		
Delivery services for last delivery	1281	58.3
Skilled care	917	41.7
Unskilled care		
Reason for health facility delivery (*n = 1404*)	1277	91.0
She was informed to deliver in HFs	263	18.7
Previous bad experience from home delivery	227	16.2
She faced problems: forced to deliver in HF	53	3.8
Others		
Reason for Home delivery (*n = 794*)	424	53.4
The labour was going well	392	49.4
She feel more comfortable at home	332	41.8
Close attention from relatives/family	331	41.8
It is usual practice	248	31.2
No transportation services	202	25.4
Cannot pay for transportation services	65	8.2
Previous bad experience from ID	22	2.8
Cannot afford to pay for health services	15	1.9
Culture doesn't allow to give birth at HF	5	0.6
Others		
Pregnant related complications at labour (*n = 2065*)	1769	85.7
No	295	14.3
Yes		

* *Leg edema, nausea, vomiting and sever malaria during pregnancy*

Variables	Frequency	Percent
Pregnant related complications at childbirth (*n = 295*)	187	63.4
Obstructed/prolonged labour	102	34.6
Excessive bleeding during labour	76	25.8
Elevated blood pressure	69	23.4
Premature rupture of membranes	47	15.9
Intrauterine fetal death	12	4.1
Preterm labour	5	1.7
Others		
Component of PNC contact, she received (*n = 2065*)	1783	86.3
1st contact of PNC services	1545	74.8
2nd contact of PNC services	1373	66.5
3rd contact of PNC services	1210	58.6
4th contact of PNC services		
The key interventions offered during PNC (*n = 206*)	1692	81.9
Immunization of baby	1516	73.4
Counseling on proper nutrition	1436	69.5
Breast feeding education	1248	60.4
Physical examination	1074	52.0
Family planning services	30	1.5
Other		
Reason for seeking PNC services (*n = 1783*)	1598	89.6
The baby needed it's immunization	1305	73.2
The midwife had told me to seek the services	975	54.7
She wanted to start family planning	834	46.8
She wanted to make sure she is back to normal Because of illness	272	15.3

* *Leg edema, nausea, vomiting and sever malaria during pregnancy*

Variables	Frequency	Percent
Reason for not seeking PNC services (*n = 282*)	181	64.2
They did not teach properly	137	48.6
Fear of privacy	95	33.7
Waiting more time at HF	77	27.3
They examined roughly	64	22.7
Religious forbidden	37	13.1
Health professional shouted at me	14	5.0
Other		
Postpartum complications (*n = 2065*)	1816	87.9
No	249	12.1
Yes		
Type of postpartum complications (*n = 249*)	170	68.3
Headache, visual disturbances	118	47.4
Convulsions/rigidity	85	34.1
Fever with or without chills	66	26.5
Heavy bleeding	66	26.5
Loss of consciousness	52	20.9
Foul smelling discharge	5	2.0
Severe abdominal pain	3	1.2
Other*		
* *Leg edema, nausea, vomiting and sever malaria during pregnancy*		

Determinants of maternal health services

Before running multilevel model, ICC (ρ) was calculated in the empty model for ANC 4th, skill delivery and PNC 4th. Meantime, ICC/*rho* (ρ) was calculated as a full model for each outcome. Rho (ρ)/ICC and test preference of log-likelihood was determine in the empty and full model for ANC 4th visit, skilled delivery care and PNC 4th visits and indicating that statistical significant association. Hence, multilevel model is the preference model for each outcome (Table 2).

Table 2
Parameter of odd ratio and Test of Goodness-of-fit for Mixed-effect Multilevel Models, Benishangul Gumuz Region, Northwest Ethiopia, 2021

Models	Fixed intercept -cons(95%CI)	Random effect as Level-2 variance var(-cons (95%CI))	Intra-class Correlation Coefficient: ICC(ρ)	Log likelihood (LR)-deviance	Significance of LR test Vs Logistic regression (P-value)
ANC 4th and more	2.54(1.7, 3.78)	1.92(1.23, 3.04)	0.37 = 37%	-1161.48	P < 0.0001
Empty model	0.26(0.04,1.67)	2.76 (1.54, 4.96)	0.46 = 46%	-633.06	P < 0.00001
Full model					
Skilled delivery	1.48(1.17, 1.87)	0.59(0.36, 0.96)	0.15 = 15%	-1402.31	P < 0.0001
Empty model	1.18(0.3,4.66)	1.1(0.63, 1.92)	0.25 = 25%	-706.65	P < 0.00001
Full model					
PNC 4th	1.59(0.99, 2.54)	2.72(1.72, 4.33)	0.45 = 45%	-1099.36	P < 0.0001
Empty model	0.08(0.01,0.71)	2.25 (1.27, 3.98)	0.40 = 40%	-523.25	P < 0.00001
Full model					

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*

After controlling confounders, among community level variables: place of resident was statistically significant association with recommended ANC visits but it was not statistical significant association with the rest outcomes. The odds of receiving the recommended ANC visits among women who reside in urban (AOR=3.82; 95%CI: 1.35-10.78) were four times higher than among women who reside in rural area.

Regarding individual level factors, the odds of receiving the recommended ANC visits among women who had any information on MHS (AOR=2.13; 95%CI: 1.12-3.75), history of pregnant related problems (AOR=1.83; 95%CI: 1.15-2.2), stillbirth (AOR=1.67; 95%CI: 1.02-2.73) and decision making power (AOR=1.74; 95%CI: 1.14-2.68) were two times higher than among women belonged with their counterpart.

Similarly, the odds of utilizing skilled delivery among women who completed recommended ANC visits (AOR=2.29; 95%CI: 1.59-3.32), belonged in 3rd quintile wealth index (AOR=2.23; 95%CI: 1.27-3.89), attended primary school (AOR=1.71; 95%CI: 1.04-2.81) were higher than among women residing within their counterpart. However, women delayed 1st ANC visit initiation between 4 – 6 months of GA (AOR=0.66; 95%CI: 0.45-0.96) were lower in the odds of receiving skilled delivery.

The odds of utilizing PNC services among women who received ANC 4th visits (AOR=10.8; 95%CI: 6.79-17.2), partner attended tertiary education (AOR=3.67; 95%CI: 1.40-9.58), decision making power (AOR=1.8; 95%CI: 1.09-2.97), iron folic acid supplementation during pregnancy (AOR=1.96; 95%CI: 1.11-3.49) and skilled delivery (AOR=1.63; 95%CI: 1.11-2.42) were higher than among women who belonged within their counterpart(Table 3).

Table 3
Individual and community level determinants of maternal health care utilization in Benishangul Gumuz Region, Northwestern Ethiopia, March 2020 – January 2021

Variables	*ANC 4th + visits*	*Skilled delivery care*	*PNC 4th*
	AOR (95%CI)	AOR (95%CI)	AOR (95%CI)
Level – 2 (Community level) variables			
Place of resident	**1**	1	1
Rural	**3.82(1.35, 10.78)**	1.22(0.55, 2.73)	1.14(0.44, 2.91)
Urban			
Distance to Health Post	1	1	1
< 2 Hours	0.25(0.02,2.73)	0.49(0.08, 2.89)	0.88(0.1, 10.26)
>= 2 Hours			
Leve-1 (individual level) variables			
Household Wealth Index	1	1	1
1st Quintile (Poor)	1.06(0.69, 1.61)	1.13(0.78, 1.63)	0.74(0.46, 1.21)
2nd Quintile (Middle)	1.46(0.81, 2.62)	**2.23(1.27, 3.89)**	0.43(0.22, 1.06)
3rd Quintile (Rich)			
Age (Years)	1	- - -	1
< 20	0.95(0.27, 3.31)		1.53(0.42,5.62)
20 – 29	0.86 (0.24, 3.02)		1.33(0.36,4.96)
>= 30			
Women educational level	1	1	1
No formal education	0.92(0.54, 1.57)	**1.71(1.04, 2.81)**	0.69(0.38, 1.27)
Primary school	1.14(0.57, 2.28)	1.49(0.77, 2.89)	0.68(0.3, 1.52)
High school	1.43(0.60, 3.37)	**4.12(1.49, 11.33)**	0.52(0.2, 1.37)
Tertiary education			

Variables	*ANC 4th + visits*	*Skilled delivery care*	*PNC 4th*
	AOR (95%CI)	**AOR (95%CI)**	**AOR (95%CI)**
Partner educational level	1	1	1
No formal education	1.22(0.69, 2.15)	0.66(0.39, 1.1)	1.07(0.57, 1.98)
Primary school	0.87(0.48, 1.59)	0.76(0.44, 1.32)	1.49(0.75, 2.95)
High school			
Tertiary education	1.98(0.88, 4.45)	0.56(0.25, 1.25)	**3.67(1.40, 9.58)**
Partner occupational status	1	1	1
Governmental employee	1.23(0.64, 2.36)	0.61(0.31, 1.21)	1.48(0.69, 3.18)
Others			
Information on MHS	**1**	1	1
No	**2.13 (1.21, 3.75)**	1.23(0.7, 2.17)	1.04(0.49, 2.18)
Yes			
Age at first marriage (year)	1	1	1
< 18	0.92(0.54, 1.56)	1.13(0.7, 1.82)	0.98(0.54, 1.73)
>=19			
Age at first pregnancy (year)	1	1	1
< 19	1.13(0.67, 1.91)	1.24(0.77, 2.01)	0.98(0.55, 1.74)
>= 19			
History of pregnant related problem during labour for previous birth	**1**	**1**	1
No	**1.83 (1.15, 2.92)**	**0.57 (0.37, 0.86)**	1.63(0.98, 2.7)
Yes			
History of stillbirth	**1**	**1**	**1**
No	**1.67(1.02, 2.73)**	**0.43 (0.28, 0.66)**	**0.51(0.29, 0.87)**
No			
Women decision making power	1	1	**1**
Didn't make decision	**1.74(1.14, 2.68)**	1.22 (0.81, 1.85)	**1.8(1.09, 2.97)**
Make decision			

Variables	*ANC 4th + visits*	*Skilled delivery care*	*PNC 4th*
	AOR (95%CI)	AOR (95%CI)	AOR (95%CI)
ANC 4th visit completed	-	1	**1**
No		**2.29(1.59, 3.32)**	**10.8(6.79, 17.2)**
Yes			
Offered information of danger sign during ANC visit	-	1	1
No		0.7 (0.44, 1.12)	0.71(0.38, 1.33)
Yes			
Time of 1st ANC visit start	- - -	**1**	**1**
Within 3 months of GA		**0.66(0.45, 0.96)**	**0.39(0.24, 0.61)**
4 – 6 months of GA		**0.33(0.16, 0.68)**	**0.1(0.03, 0.24**)
After 6 months of GA			
Provision of information on health facility delivery	-	1	1
No		0.9(0.49, 1.68)	1.05(0.51, 2.17)
Yes			
IFA supplementation during pregn.	-	-	**1**
No			**1.96(1.11, 3.49)**
Yes			
Provision of TT during pregnant	-	-	1
No			1.58(0.93, 2.69)
Yes			
Skilled delivery care	-	-	1
No			**1.63(1.11, 2.42)**
Yes			
Pregnant related problems immediately after labour	-	-	1
No			1.1(0.55, 2.21)
Yes			

Discussion

Magnitude of maternal health services

In this study, 66.1% pregnant women were attended the recommended ANC visits which was consistent with different studies(17–20). However, it was lower than studies in South Asia and Sub-Saharan Africa (18), Debre Berhan(21) and Northern Bangladesh(22). But, it was higher than evidence in Pakistan(23), Ratanakiri(24), Khammouane(25), Sub–Saharan Africa(26), EDHS-2014(27), Arbaminch(28), West Gojjam(29) and Tigrary(30). This is due to variability of socio-demographic, wealth status of the nations, availability and accessibility HFs and medical equipment's in the health system.

This study revealed that 58.3% of birth attended by skilled providers which was consistent with other study(23). This finding was lower than study in Cambodia(19); Tanzania(31); Bihar(20). Whereas, it was higher than evidence in Ratanakiri(24), Khammouane(25), West Gojjam(29) and South Ethiopia(28). This discrepancy might be due to variation of culture, belief, time of study and design. However, reason mention for facility delivery, the main reasons for home delivery: labour was going well and being feel more comfortable at home delivery which were consistent with study done in West Gojjam(29).

This study found that 58.6% of women received the recommended PNC visits, which was lower than study in Pakistan(23), Sub – Saharan Africa(26) and Ghana(32). Whereas, it was higher than study in West Gojjam(29), Ratanakiri(24), Arbaminch(28) and Khammouane(25).

Determinant of maternal health services

In this study, women who had information on MHS were two times higher to receive recommended ANC visits which was supported by studies conducted in different setting (5, 8). Women who had history of pregnant related problems and stillbirth were two times higher to completed whole visits of ANC which was supported by other study(9). This is because prior bad experiences give good lesson for women that encourage them to consult health professional during pregnancy.

Similarly, women who had decision making power were almost two times higher to receive the recommended ANC visits. This finding is consistent with study done in Nigeria(6). This might be because if the household resources are controlled by others and no power to decide on their resources, women do not have the freedom to access health services whenever they need care. Education of women was positively significant effect on the utilization of institutional delivery services which was supported by other studies(1, 5, 6, 9, 10). This positive correlation can be explained by the fact that educated women are more aware on the importance of medical services to their mothers. Household wealth index is strongly linked to place of delivery: as household wealth index increases, the uptake of institutional delivery service is also increase. This evidence is supported by different studies(1, 5–7, 11).

Uptake of PNC service is directly related with partner education which showed a positive association which was consistent with other studies(5, 6, 12). This is because educated husbands may have a better understanding on the benefit of maternal health services. Similarly, receiving the recommended, timely

initiation of ANC visits and skilled delivery are strongly significant association with utilization of PNC. This evidence is strongly supported by SRMA pooled result(33) and other studies(4–6).

Generally, the coverage of ANC 4th visits, skilled delivery and PNC services were low as compared with national target. This study explored different individual and community level factors that influenced utilization of the services which had important programmatic implication. Hence, we strongly recommended that reinforcing women's autonomy and community based interventions to enhance utilization of maternal health services.

Limitation

- Even though health facility based data were collected by health workers, social desirability bias was expected which compromised the finding.
- Around 8.5% of the study participates were lost to follow up that might have some deviation on the result.

Abbreviations

ANC
Antenatal Care
AOR
Adjusted Odds Ratio
BF
Breast Feeding
BGRS
Benishangul Gumuz Region
CI
Confidence Interval
EDHS
Ethiopia Demographic and Health Survey
GA
Gestational Age
HF
Health Facility
ICC
Intra class Correlation
IFA
Iron Folic Acid
IGA
Income Generating Activities
IRB

Institutional Review Board

LR

Log Likelihood

MCH

Maternal and Child Health

MHS

Maternal Health Service

MPDSR

Maternal and Perinatal Death Surveillance Response

NGO

Non-Governmental Organization

PCA

Principal Component Analysis

PNC

Postnatal Care

SMI

Safe Motherhood Initiative

SPH

School of Public Health

SRMA

Systematic Review and Meta-analysis

TT

Tetanus Toxoid

VIF

Variance Inflation Factors

Declarations

Ethics approval and consent to participate

Ethical approval was endorsed from Research Review and Ethics Committee (REC) of School of Public Health, Addis Ababa University's with protocol number SPH/3089/011 and Institutional Review Board (IRB) of College of Health Sciences of Addis Ababa University with protocol number 048/19/SPH. Necessary permission letters were obtained from Regional Health Bureau and respective all local districts. Confidentiality was maintained by avoiding any identities from the questionnaire. Before starting actual data collection, written and verbal consent was obtained from each study subjects.

Consent to publish

Not Applicable

Availability of data and materials

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

MA conceived and designed the study. Then after, data was collected, analyzed, interpreted and wrote the whole document. *AW and GT* were critically commenting the whole document and genuinely guide the whole work. All authors read and approved the final manuscripts.

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