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Research article

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Rural-Urban Disparity in Maternal Health Care Service Utilization in Four Regions of Ethiopia: Ecological and Decomposition Analysis

Tigist Shumet[1,2*] and Nigatu Regassa Geda[1,3]

[1]*Center for Population Studies, College of Development Studies, Addis Ababa University, Ethiopia*

[2]*Health System and Reproductive Health Research Directorate, Ethiopian Public Health Institute, Ethiopia*

[3]*College Pharmacy and Nutrition, University of Saskatchewan, Canada*

[*]Corresponding Author
Tigist Shumet, Center for Population Studies, College of Development Studies, Addis Ababa University and Health System and Reproductive Health Research Directorate, Ethiopian Public Health Institute, Ethiopia.

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Abstract

Background: *Maternal healthcare services utilization is very low in Ethiopia with a disparity among regions. Therefore, this study aimed to assess rural-urban disparity in maternal healthcare service utilization in four regions of Ethiopia.*

Method: *This study used 2016 Ethiopian Demographic and Health Survey data. 2563 and 1555 women who delivered in 5-years and in 2-years prior to the survey from 220 clusters respectively included as respondents of the study. Partial ecological approach used a mixture of individual level and ecological variables (group level). Multivariable logistic regression, Blinder Oaxaca decomposition and Moran's index were used during data analysis.*

Result: *This study found; Media exposure in rural-urban, and wealth-index in rural areas as predictors of antenatal-care utilization. Wealth-index in rural, husband education level in urban, women autonomy for own healthcare and antenatal-care utilizations in rural and urban areas as predictors of place of delivery. Wealth-index in rural, antenatal-care utilization in urban; and place of delivery in both urban and rural areas predict postnatal-care utilization. Moreover; geographic clustering observed in the utilization of ANC (Moran's I = 0.185031, p = 0.011056), health-facility delivery (Moran's I = 0.271865, p = 0.000209), and PNC (Moran's I = 0.315410, p = 0.000015). The study also revealed huge rural-urban disparities in utilization of maternal healthcare services in those four regions.*

Conclusion: *Significant rural-urban inequalities in utilization of maternal healthcare services found in four regions of Ethiopia. Therefore, policymakers and concerned stakeholders needs to develop relevant strategies that will enhance maternal healthcare utilization in those marginalized regions.*

Keywords: ANC, Decomposition, Ethiopia, Inequality, Place of Delivery, PNC

Abbreviations

AIC: Akaike information criterion
ANC: Antenatal Care
AOR: Adjusted Odd Ratio
BIC: Bayesian information criterion
CI: Confidence Interval
COR: Crude Odd Ratio
CSA: Central Statistics Agency
EA: Enumeration Area
EDHS: Ethiopian Demographic and Health Survey
MCH: Maternal and Child Health Service
PCA: Principal Component Analysis
PNC: Post-Natal Care
SD: Standard deviation
VIF: Variance inflation Factor
WHO: World Health Organization

1. Background

Maternal health refers to the health of women during pregnancy, childbirth, and the postpartum period. Maternal health is an important indicator of wellbeing of women, and has significant implications for the survival of the neonates and children [1]. The most

commonly known maternal health interventions includes antenatal care service (ANC), delivery at health facilities, and postnatal care services (PNC) [1]. Antenatal care (ANC) is a service given to pregnant women by a skilled health care provider. This service is given during pregnancy to ensure better health outcomes to both the mother and the newborn [2].

Currently, the World Health Organization (WHO) recommends, under normal circumstances, a pregnant woman is expected to get ANC services at least eight times during her pregnancy. The first visit is recommended during the 12 weeks of pregnancy [3]. In this regard, insufficient ANC visits or delays in visits or reduced number of ANC visits may lead to poor pregnancy outcomes [4].

Another key maternal and child health intervention is health facility delivery. Giving birth in a healthcare facility with the assistance of skilled birth attendants can significantly reduce the rates of maternal morbidity and mortality [5]. Using health facility during birth is also playing a crucial role in prevention of stillbirths and enhance the survival of a new-born child [6]. Postnatal care (PNC) must be provided in the first two months after delivery and usually considered as a golden opportunity for health service providers to train mothers on healthy breastfeeding practices, to screen mothers for a postpartum depression, monitor the infant growth and overall health status, to observe and treat childbirth-related complications, advice those women about the existing family planning options and refer/ link the mother and baby for specific care if needed, among other services [7,8]. According to a WHO recommended guideline, women and the newborn should get at least three postnatal contacts with the health service provider after childbirth. The first visit should be made between 48 and 72 hours, the second visit between day 7 and 14th and the third at six weeks postpartum [7].

Globally, an estimated 800 women die every day from complications related to pregnancy, childbirth and postpartum period in 2020 [9]. In the same year, nearly 70% maternal deaths occurred in sub- Saharan Africa [9]. In Ethiopia, Maternal Mortality Ratio (MMR) was estimated as 420 per 100,000 live births in 2016 [10]. Globally 87% of pregnant women get the antenatal care services given by skilled health personnel at least once during their pregnancy period [11].

The lowest levels of antenatal care service provision rates are observed in Sub-Saharan Africa and South Asia. Dickson et al in 2022 done a pooled analysis of the ANC utilization from a data collected from year 2000 to 2018 from 32 countries from Sub-Saharan Africa using DHS surveys. The result revealed that 76% of pregnant women had at least one ANC check-up. Among countries in this region, Gambia (99%) and Burundi (8%) had relatively higher and lower prevalence of ANC respectively [12]. Evidence from the 2019 EMDHS indicated that, 43% of pregnant women in Ethiopia had at least four ANC visits in 2019, 59% and 37% for urban and rural areas, respectively [13].

In 2020, birth assisted by a skilled attendant in the world reached 83% [14,15]. Similarly, in Ethiopia, birth assisted by a skilled attendant reached 50%, increasing from 26% in 2016 to 48% in 2019, with prevalence of 70% for urban and 40% for rural areas [13]. Only 34% of women in Ethiopia received a postnatal check within two days of delivery, and with prevalence of 48% for urban and 29% for rural areas 2019 [13]. Previous studies conducted in Ethiopia focused on the determinants of maternal health care service utilization (i.e., which includes ANC, health facility delivery, and PNC).

For instance, some of the most commonly cited predictors of ANC included: availability, educational level, history of antenatal care use, wealth index, husband's attitude, the home visits by health extension workers, level of understanding the health complications related to pregnancy, health related training given to household and place of residence [16-21]. Most frequently reported predictors of delivery at facility were wealth/income, women and their husbands' education level, place of residence, and the utilization of ANC [14-16,18,20]. Moreover, the predictors of PNC service utilization included; wealth, place of residence, model family, prenatal stay at maternity waiting homes, antenatal care in the first trimester, complete antenatal care service, family conversation during pregnancy, cesarean delivery (C-section), the notification of birth to health extension workers, maternal health education, information on postnatal care service utilization, and women autonomy [16,18,20,22].

This being the case, very little attention has been given to the study of MCH in the four study regions concerned, even though service utilization in these dominantly pastoral regions is unacceptably low [10]. Previous studies on the subject have also typically employed individual based cross-sectional data or a single indicator (such as ANC or PNC or delivery care) to estimate prevalence and determinants [16-19,22-26]. In addition, none of them quantified the contributions of observed and unobserved heterogeneity at the individual, household and community level through decomposition techniques. To the best of our knowledge, very few studies were conducted in Ethiopia that examined the cluster level inequality in the three key maternal health care service utilizations. Therefore, the aim of this study is to assess the urban-rural inequality of maternal health care utilization in four regions of Ethiopia.

2. Methods

2.1. Study Setting

The study is done in four more or less geographically marginalized regions of Ethiopia, namely, Afar, Benishangul Gumuz, Gambela and Somali regions. They all have similar physical characteristic i.e.; all the four regions have a border line with the neighboring countries with Ethiopia. In terms of economic status, these regions are deemed disadvantageous for access to basic health services which includes maternal and child health (MCH) i.e., prevalence of most MCH service utilization is much lower compare to the remaining regions of Ethiopia [10]. According to the 2020 projected population size by Central Statistical Agency (CSA) of Ethiopia,

the total women population size in Afar region was 885 thousand (46% of the total population of the region), Somali region had 2,893 thousand (48% of the total population of the region), Benishangul-Gumuz had 570 thousand (49% of the total population), and Gambella had 229 thousand (48% of the total regional population) [27].

2.2. Data Source

This study used the 2016 Ethiopian Demographic and Health Survey (EDHS) data sets which are freely available online. The 2016 EDHS sample was designed to provide estimates for each indicator for the entire country. In addition, sample size for urban and rural areas was calculated separately. The survey was carried out by the Ethiopian Central Statistics Agency (CSA) and ICF. The data collection was done in the period from March 2016 to July 2016. Therefore, we extracted the required data for this particular study for the four regions of Ethiopia (i.e., Afar, Benishangul Gumzu, Gambela and Somali regions) from the existing data set [10].

2.3. Study Design

In this study, combinations of cross-sectional and partial ecological designs were used. It is cross-sectional because the 2016 EDHS collected the date at a specific point in time in the lives of respondents. This makes it difficult to assess the cause-effect relationship between the outcomes and explanatory variables of interest. On the other hand, the analysis followed a partial ecological design. A partial ecological study design involves a mixture of individual level and ecological variables (group level). In ecological analysis, the unit of observation is a group, not separate individuals for one or more study variables. To make ecologic inferences about effects on group rates the study subjects were grouped by place (cluster) [28].

2.4. Sampling

The EDHS 2016 survey used a two-stage stratified sample. In the first stage a total of 645 Enumeration Areas (EAs) were selected with a probability proportional to the size of the Enumeration Area (EA) and in the second stage sampling a fixed 28 households per EA were selected. Then, the data collection for maternal health care service utilization indicators were done by interviewing all women in the reproductive age group (i.e., women in the age range 15 to 49) in those fixed 28 selected households. The present analysis considered 2563 women who gave birth in five years and 1555 women who gave birth in the two years preceding the survey from 220 clusters located in those four regions.

2.5. Study Variables

2.5.1. Outcome Variables

Maternal health care utilization: the three key maternal health services (ANC, delivery, and postnatal care) were used as outcome variables and all of them were recoded as dummy variables (0 =ANC utilization <4, 1=ANC utilization >=4; 0 =home delivery (with no assistance health professional), 1 = delivery takes place at health facility; 0 =postnatal care not utilized, 1 = postnatal care utilized in the first 2 day after birth).

2.5.2. Exposure Variables

Cluster level variables: Year of woman education, woman age, total children ever born, wealth index, Media access (generated from TV, Radio, internet and magazines by using PCA), women working status, husband education, and women autonomy for own health care utilization were found by polling individual data in cluster level. To create the cluster level variable values, the study used a mean value/ proportion of the individual level data by using an aggregation technique in STATA.

2.5.3. Individual Level: Marital Status, Type Place of Residence and Region

For numerical variables this study measured by their mean and standard deviations. The categorical variables of the study classified as follows; Wealth index classified in to 5 categories i.e. poorest, poorer, middle, richer, and richest. Women autonomy for own health care utilization answered as (women decision making autonomy for own health care coded as "yes" and women consultation with husband or others, and decision making by her husband or others coded as "no". Marital status was classified in to "others" and "married", Place of residence as "urban" and "rural", Region was as Afar, Benishangul-Gumuz, Gambella and Somali.

2.6. Statistical Analysis

Data cleaning and analysis were done using STATA -v17. The analysis began with aggregating the individual level variables by Enumeration Areas (EAs). The variables aggregated were woman education, woman age, total children ever born, wealth index, and media access, husband education, and women autonomy for own health care utilization and women work status. The remaining variables such as a marital status, type place of residence, and region were not aggregated and were considered as individual level variables. We used ArcGIS 10.6.1 to display the utilization of maternal health care services by each EA. The Moran's Index was calculated to assess this distribution.

Spatial autocorrelation (Global Moran's I) statistic measures to see whether the optimal maternal health care services utilization patterns were dispersed, clustered, or randomly distributed in the four regions of Ethiopia. Moran's I is a spatial statistic which is valid to estimate the spatial autocorrelation by considering the entire data set but it produces a single output value which usually ranged from − 1 to + 1. The output of Moran's I values is interpreted as; when Moran's I close to − 1 indicates the maternal health care service utilization is dispersed, whereas I close to + 1 indicate the maternal health care service utilization clustered; the maternal health care service utilization is said to be distributed randomly if Moran's I value is zero. A statistically significant Moran's I ($p < 0.05$) is leading to the rejection of the null hypothesis (example facility delivery is randomly distributed) and indicates the presence of spatial autocorrelation [29].

For the regression analysis, bivariate logistic regression was used to select the potential variables using a cut off $p< 0.2$. Those variables with $p<0.2$ were further assessed in the multivariable logis-

tic regression analysis to see their net effect on the three outcome variables. Multicollinearity among the independent variables was checked using VIF and values >2.5 were removed. The preliminary analysis indicated that region, total children ever born, and women education had significant multicollinearity with Variable Inflation Factor (VIF) >2.5. Therefore, the study excluded those three predictors from the logistic regression analysis. The Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) were used to select the model. In addition, Blinder Oaxaca decomposition technique was used to assess rural urban disparity of MCH service utilization.

Blinder Oaxaca Decomposition Technique is particularly useful for identifying and quantify the individual contribution of group differences in measurable characteristics such as education, work experience, marital status, and geographic location, gender and ethnic differences in outcomes. Although not used as often, this technique is also useful to identify reasons for geographic differences (e.g., urban/rural), time-period difference, or other categorical differences [30]. In recent years, we have found studies showing how the Blinder-Oaxaca decomposition technique was used to explain inequalities in health outcomes between two groups. The technique identifies the factors that made the difference, and it is necessary to allocate the mean difference between the two groups (group 1 and group 2) for some ongoing health outcomes [29].

For this study, the outcome variable of interest is key maternal health care service utilization (ANC, place of delivery, and PNC). To explain the rural-urban disparities in maternal health care service utilization among mothers residing in those four regions, we used the Blinder-Oaxaca decomposition. This technique decomposes the gap in maternal health care utilization between urban and rural areas into two parts; a part that is due to difference in the distribution of the determinants of maternal health care utilization (covariates effect) between those two areas, and another part that is due to the difference in the effect of these determinants (coefficients effect) between urban and rural areas.

For example, if yi, our outcome variable, is affected by a single variable, x, and we have two groups, urban and rural, then maternal health care utilization for the rural, and urban mothers are given by Eqs. (1) and (2) respectively. The superscripts in the below equations are r is stands to describe rural and u stands to describe urban

$$yi\ r = \beta r\ xi + \varepsilon ir \quad \text{(Eq.-1)}$$

$$yi\ u = \beta u\ xi + \varepsilon i\ u \quad \text{(Eq.-2)}$$

therefore, the urban-rural gap in the mean maternal health care utilization in the four regions of Ethiopia (yiu− yir), is given as in Eq. (3).

$$yu - yr = \beta u\ xu - \beta r\ xr \quad \text{(Eq.-3)}$$

Where xu and xr are the independent variable at their means for the urban and rural. The overall urban- rural gap could be decomposed into a gap attributable to the difference in the level of the covariates, X's, and a gap that is attributable to difference in coefficients, β's as in Eqs. (4) and (5):

$$yu - yr = \Delta x\ \beta r - \Delta\beta xu \quad \text{(Eq.-4)}$$
$$yu - yr = \Delta x\ \beta u - \Delta\beta xr \quad \text{(Eq.-5)}$$

Where $\Delta x = xu - xr$ and $\Delta\beta = \beta u - \beta r$. Here the study decomposition equation can be re-written as in Eq. (6):

$$yu - yr = \Delta x\ \beta r + \Delta\beta xr + \Delta\beta\Delta x$$
$$= E + C + CE \quad \text{(Eq.-6)}$$

Therefore, in this study the overall urban-rural gap in maternal health care utilization in four regions of Ethiopia consists of the gap in endowment (E), and the gap between coefficients(C), and the interactions (CE).

3. Result

3.1. Background Characteristics of Study Participant

For the maternal health care services, a total of 2563 women were interviewed in 220 clusters (EAs) which comprises mothers who gave birth within five years before the survey. The cluster /community/ level background characteristics of those women who were included in this study from the four regions of Ethiopia is summarized and presented in Table 1 below.

The result indicates that the mean age of women included in the study was 28.6 (SD =2.38, 95% CI (28.53- 28.71)), the mean children ever born was 4.2 (SD =1.09, 95% CI (4.15- 4.24)), the mean year of school attendance was 1.51 years (SD= 1.9, 95% CI (1.45-1.58)) and on average respondents of the study had at least 1 media exposure (SD= 2.16, 95% CI (0.94-1.11) (Table 1). The individual level background characteristics of the respondents are summarized in table-2. It is seen that 93% of them were married, and 84% of them lived in rural area Table 2.

ANC and Place of Delivery						
	Mean	**SD**	**95%_CI**		**P25**	**P75**
Women Age	28.62	2.38	28.53	28.71	26.8	30.22
Household size	5.93	1.03	5.89	5.97	5.27	6.54
Birth order	4.2	1.09	4.15	4.24	3.5	4.88
Total children ever born	4.2	1.09	4.15	4.24	3.5	4.88
Women education status	1.51	1.69	1.45	1.58	0.2	2.5
Media exposure	1.02	2.16	0.94	1.11	0	0.81
wealth Index						
poorest	20.0		18.50	21.60		
poorer	20.3		18.90	22.00		
Middle	19.6		18.10	21.20		
Richer	20.2		18.70	22.00		
Richest	19.8		18.30	21.40		
Women Employment status						
Not working %	78%		77%	80%		
working %	22%		20%	23%		
PNC N=1501						
	Mean	**SD**	**95%_CI**		**P25**	**P75**
Women Age	28.48	2.33	28.37	28.6	26.71	30.08
Household size	5.96	1.02	5.91	6.01	5.29	6.56
Birth order	4.24	1.07	4.18	4.29	3.62	4.88
Total children ever born	4.24	1.07	4.18	4.29	3.62	4.88
Women education status	1.46	1.66	1.37	1.54	0.19	2.4
Media exposure	1	2.16	0.89	1.11	0	0.77
wealth Index						
poorest	20.4		18.40	22.50		
poorer	20.0		18.10	22.10		
Middle	20.2		18.20	22.20		

Richer	19.8		17.80	21.90		
Richest	19.6		17.60	21.70		
Women Employment status						
Not working %	81		78	82		
working %	19		18	22		

Table 1: Community Level Background Characteristics of Women in Four Regions of Ethiopia

ANC and place of delivery (N= 2563)					PNC (N=1501)			
	Count	**Percent**	**95% CI**		**Count**	**Percent**	**95% CI**	
Marital status								
Others	185	7	6	8	79	5	4	7
Married	2378	93	92	94	1422	95	93	96
Residence								
Urban	411	16	15	18	241	16	14	18
Rural	2152	84	82	85	1260	84	82	86
Region								
Afar	647	25	24	27	383	26	23	28
Somali	806	31	30	33	527	35	33	38
Benishangule Gumuze	576	22	21	24	323	22	20	24
Gambela	534	21	19	22	268	18	16	20
Total	2563	100			1501	100		

Table 2: Individual Level Background Characteristics of Women in Four Regions of Ethiopia

For PNC service utilization, the data were collected from a total of 1501 women residing in 220 clusters who delivered a baby within two years before the survey. The community level background characteristics of those women who utilized the PNC service and included in this study is summarized in Table 1. It is seen that the mean age of the women was 28.48 (SD =2.33, 95% CI (28.37-28.6)), the mean children ever born was 4.24 (SD= 1.07,(4.18-4.29)), the mean year of school attendance by women was 1.46 years (SD= 1.66, 95%CI (1.37-1.54)) and on average respondents of the study had at least 1 media exposure (SD= 2.16, 95%CI (0.89-1.11) . In addition, of those who utilized the PNC, about 81% of them were not working during the survey (Table 1). The individual level background characteristics of the women across the four study regions is summarized in Table 2 also indicates 95% of them married, and 84% of them lived in rural areas (Table 2).

3.2. Spatial Patterns in the Utilization of Maternal Health Care in Four Regions of Ethiopia

Figure 1 shows a geographic distribution of maternal health service utilization among women in the age group 15–49 in 220 clusters situated in the four regions of Ethiopia respectively. The results indicate the utilization of a maternal health services (ANC, delivery at health facility and PNC) ranges from 0% to 100%. Utilization of maternal health services is lowest in Somali and Afar regions as compared to Benishangule-Gumuz, and Gambela regions. In Afar region, there are few clusters which have highest

utilization of some of the maternal health services but the presence of geographical clustering was analyzed for all selected outcome indicators i.e., maternal healthcare services (ANC, place of delivery and PNC) using global spatial auto-correlation (Moran's' Index) at cluster levels as presented in figure 2. Maternal healthcare services considered in this study there were an indication of geographic clustering in the utilization of all maternal healthcare services considered in this study i.e., ANC (Moran's I = 0.185031, p = 0.011056), health facility delivery (Moran's I = 0.271865, p = 0.000209) and PNC (Moran's I = 0.315410, p = 0.000015).

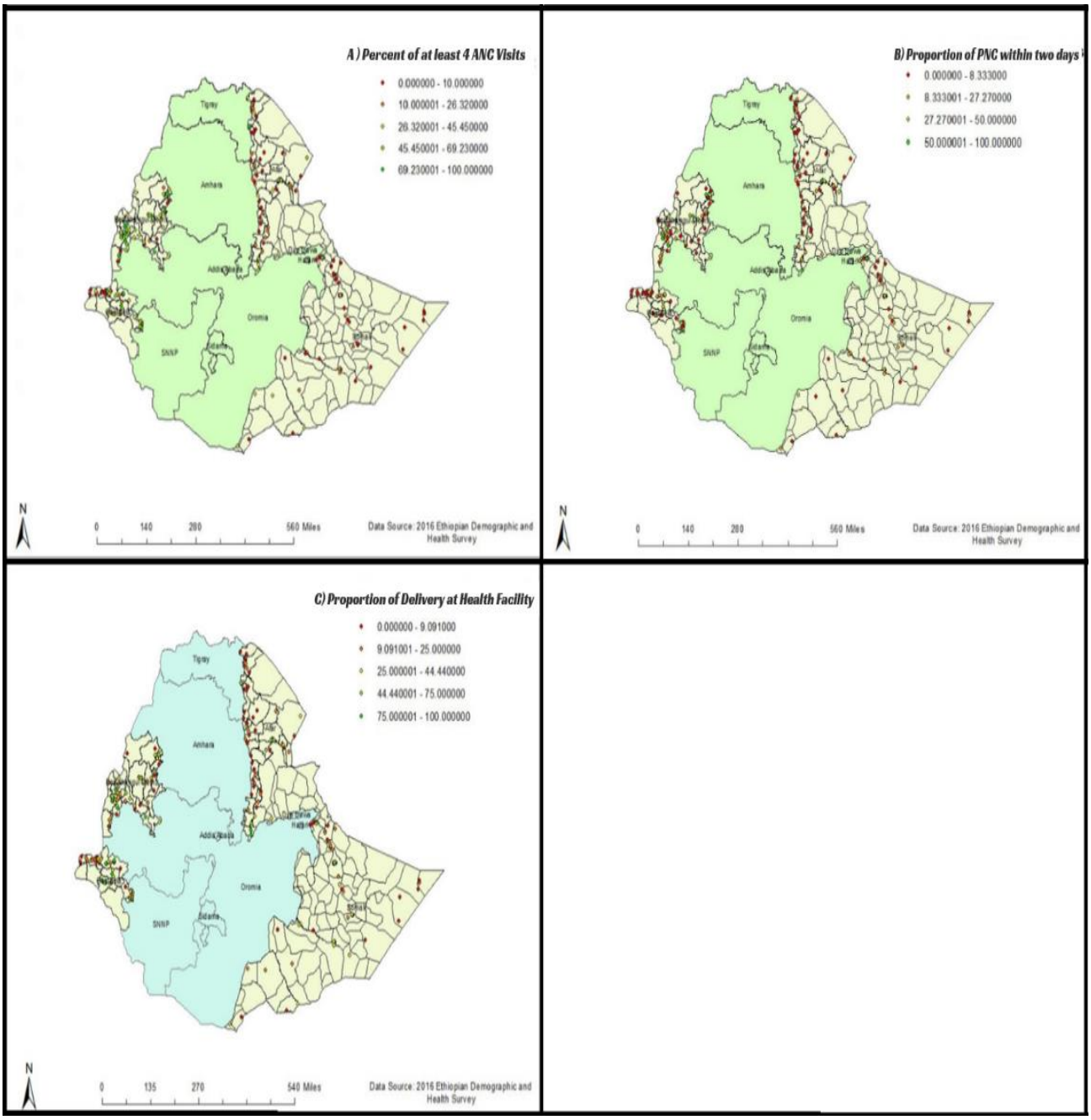

Figure 1: Maps Showing Geographic Distribution of Maternal Health Service Utilization in 220 Clusters of Four Regions of Ethiopia

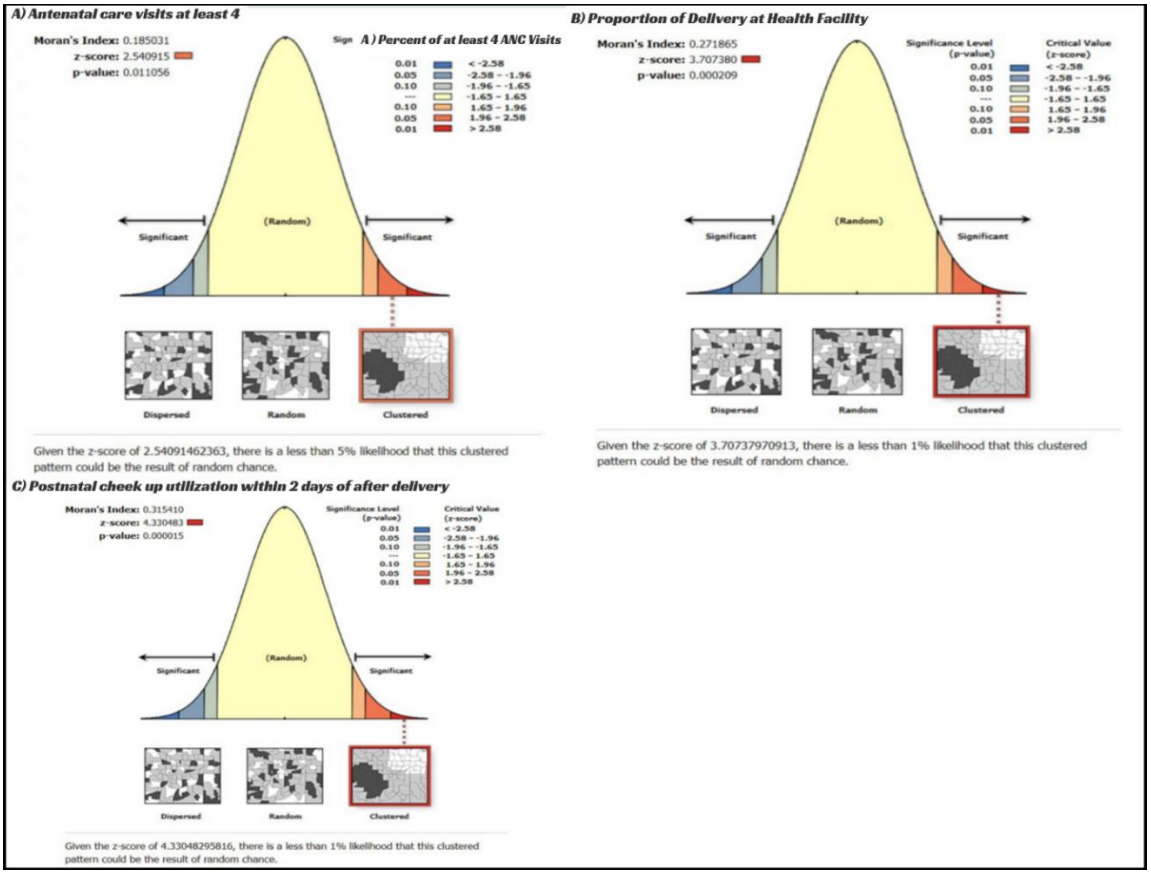

Figure 2: Spatial patterns of maternal health care utilization in 220 clusters in the four regions of Ethiopia. From the graphs show A) Antenatal care visits, B) Delivery at Health facility, and C) Postnatal cheek up visit.

3.3. Bivariate Logistic Regression

The results in Table 3 presented the bivariate logistic regression for the selected potential predictors. Based on the review of related literature, the study used a p-value < 0.2 as cut off value to consider the significant predictors as potential variables for further analysis in the multivariable logistic regression. Therefore, in ANC utilization for both urban and rural residences; except a variable called "autonomy health care utilization" the remaining variables considered in this bivariate logistic regression were taken for further analysis in multivariable regression analysis. In place of delivery, for urban residence except marital status all the remaining variables were considered in a multivariable regression analysis. But in rural settings; except women age and household size, all the remaining predictor variables in the bivariate logistic regression were taken for further analysis in a multivariable regression analysis. In PNC service utilization, for urban residence a predictor variables wealth index, husband education level, women working status, marital status, media exposure, ANC service utilization and place of delivery was considered for further analysis in the multivariable regression analysis. But for the rural setting; a predictor variables household wealth, husband education level, women working status, media exposure, ANC service utilization and place of deliveries were considered for further analysis in the multivariable regression analysis.

	ANC								Place of delivery								PNC							
	Urban				Rural				Urban				Rural				Urban				Rural			
	COR	p Value	95% CI		COR	p Value	95% CI		COR	p value	95% CI		COR	p value	95% CI		COR	p value	95% CI		COR	p value	95% CI	
Women Age	0.87	**0.00**	0.80	0.94	0.95	**0.02**	0.90	0.99	0.90	**0.01**	0.83	0.98	0.97	0.30	0.93	1.02	0.97	0.62	0.87	1.09	1.03	0.54	0.94	1.12
Household	0.71	**0.00**	0.61	0.84	0.69	**0.00**	0.61	0.77	0.83	**0.02**	0.70	0.97	0.97	0.56	0.86	1.09	0.92	0.49	0.74	1.15	1.00	0.97	0.82	1.23
Husband education level	1.19	**0.00**	1.06	1.33	1.39	**0.00**	1.29	1.48	1.44	**0.00**	1.25	1.66	1.41	**0.00**	1.31	1.52	1.14	**0.06**	1.00	1.31	1.13	**0.02**	1.02	1.25
Media Exposure	1.66	**0.00**	1.09	1.23	1.67	**0.00**	1.47	1.88	1.21	**0.00**	1.13	1.10	1.67	**0.00**	1.47	1.88	1.08	**0.03**	1.01	1.16	1.24	**0.02**	1.04	1.98
Autonomy health care utilization																								
No RC																								
Yes	0.80	0.35	0.51	1.26	0.74	0.18	0.48	1.15	2.43	**0.00**	1.45	4.07	1.10	**0.00**	1.46	3.03	1.39	0.34	0.71	2.75	1.38	0.31	0.75	2.54
wealth Index																								
poorest					RC								RC								RC			
Poorer	RC				1.63	**0.05**	1.00	2.64					1.78	**0.03**	1.05	3.03	RC				0.74	**0.47**	0.32	1.69
Middle					4.30	**0.00**	2.79	6.63					6.39	**0.00**	4.00	10.19					1.96	**0.05**	1.00	3.83
Richer	2.67	0.26	0.49	14.46	9.17	**0.00**	6.03	13.92	18.38	**0.00**	3.39	99.65	6.72	**0.00**	4.21	10.72	0.64	0.44	**0.20**	2.00	3.71	**0.00**	1.98	6.96
Richest	7.39	**0.01**	1.66	32.99	18.68	**0.00**	11.34	30.77	12.86	**0.00**	2.88	57.47	17.98	**0.00**	10.56	30.64	RC				6.06	**0.00**	2.86	12.82
women working status																								
not working RC																								
working	2.64	**0.00**	1.69	4.13	2.95	**0.00**	2.33	3.73	2.21	**0.00**	1.36	3.59	1.73	**0.00**	1.34	2.24	1.57	**0.19**	0.80	3.08	1.91	**0.00**	1.24	2.94
Marital status																								
Others RC																								
Married	2.64	**0.00**	1.69	4.13	2.95	**0.00**	2.33	3.73	0.98	0.96	0.51	1.88	0.69	**0.09**	0.46	1.05	0.55	**0.21**	0.21	1.40	0.84	0.69	0.35	2.00
ANC																								
No RC																								
yes									3.70	**0.00**	2.40	5.70	6.62	**0.00**	5.17	8.48	3.75	**0.00**	2.05	6.88	3.38	**0.00**	2.25	5.07
Place of delivery																								
No RC																								
yes																	56.20	**0.00**	7.62	414.	43.10	**0.00**	24.60	75.40

RC: Reference Category

Table 3: Bivariate Logistic Regression for Selected Predictors of Maternal Health Care Utilization in Urban and Rural Ethiopia

3.4. Predictors of Maternal Health Care Service Utilization

The study results in Table 4 revealed that odds of ANC service utilization increased by 1.09 times when the Media exposure increased (AOR = 1.09, 95% CI (1.02, 1.16)). In addition, rural settings women living in households with middle wealth index (AOR = 3.36 95% CI (2.05–54.9)), richer (AOR = 6.07, 95% CI (3.73, 9.87)), and richest (AOR =8.90, 95% CI (4.80, 16.48)) were more likely to utilize ANC service compared to those poorest wealth quintiles. The odd ratio of utilizing health facility delivery service were 3.19 times higher for women who had at least 4 Antenatal care (ANC) in urban settings compared to those who have < 4 ANC during their pregnancy in similar settings (AOR =3.19, 95% CI (1.99–5.13)). The result in rural settings also showed a positive association i.e., the odds of utilizing health facility delivery were 4.56 times higher for women who had ANC during their pregnancy compared to those who had not have ANC (AOR = 4.56, 95% CI (3.48–5.98)). Further, the odds of health facility delivery also increased by 1.13 times when the media exposure increased (AOR = 1.13, 95% CI (1.04–1.22)) in urban settings and this increase also revealed in rural settings i.e., we have found a positive association that indicates an increase of health facility delivery utilization by 1.18 times when the husband years of education increased (AOR = 1.18, 95% CI (1.03–1.37)).

The odd ratio of utilizing a postnatal care (PNC) were 47.6times for women who gave birth in health facilities compared to those who did not give birth in health facilities in urban settings (AOR=47.6, 95% CI (6.32-359.03)). But the result in the rural settings revealed a little bit increase i.e., the odd ratio of utilizing a PNC service were 49.87 times for women who gave birth in health facilities compared to those who did not give birth in health facilities in rural areas (AOR=49.87, 95% CI (26.54,92.72)). Additionally, the result in table-4 also indicates that the odds of utilizing a PNC service were 2.3 times for women who used ANC service during their pregnancy as compared to those who did not use ANC service in urban settings (AOR=2.3, 95% CI (1.15-4.60)) .Regarding PNC service utilization, wealth index middle (AOR = 3.36 95% CI (2.05–54.9)), richer (AOR = 6.07, 95% CI (3.73, 9.87)), and richest (AOR =8.90, 95% CI (4.80, 16.48)) were more likely to utilize ANC service compared to those poorest wealth quintile.

	AOR	p-value	95% CI		AOR	p-value	95% CI		AOR	p-value	95% CI		AOR	p-value	95% CI		AOR	p-value	95% CI		AOR	p-value	95% CI	
Women Age	0.97	0.27	0.84	1.05	0.98	0.51	0.93	1.04	0.92	0.21	0.82	1.05												
Household size	0.97	0.77	0.76	1.22	0.85	**0.03**	0.74	0.98	1.16	0.26	0.90	1.49												
Husband education level	1.08	0.26	0.94	1.25	1.09	0.08	0.99	1.19	1.26	**0.00**	1.04	1.22	1.09	0.07	0.99	1.20	1.01	0.77	0.87	1.21	0.91	0.22	0.78	1.06
Media Exposure	1.09	**0.02**	1.02	1.16	1.21	**0.00**	1.06	1.38	1.13	**0.00**	1.04	1.22	1.18	**0.02**	1.03	1.37	1.01	0.91	0.92	0.22	0.92	0.48	0.73	1.16
autonomy health care utilization																								
No [RC]																								
Yes									2.80	**0.00**	1.52	5.16	1.67	**0.02**	1.07	2.61								
women working status																								
not working [RC]																								
working	1.65	0.07	0.97	2.82	1.18	0.47	0.75	1.86	1.32	0.39	0.70	2.48	0.79	0.14	0.59	1.08	0.76	0.51	0.34	1.71	1.50	0.22	0.78	2.88
wealth Index																								
poorest					[RC]								[RC]								[RC]			
poorer	[RC]				1.57	0.08	0.96	2.58	[RC]				1.53	0.13	0.89	2.64	[RC]				0.55	0.35	0.23	1.69
Middle					3.36	**0.00**	2.05	5.49					3.82	**0.00**	2.26	6.47					0.65	0.30	0.58	5.87
Richer	1.82	0.52	0.30	11.09	6.07	**0.00**	3.73	9.87	4.94	0.09	0.77	31.69	3.64	**0.00**	2.12	6.24	0.56	0.40	0.15	2.16	1.21	**0.03**	1.11	12.66
Richest	3.16	0.15	0.67	14.89	8.90	**0.00**	4.80	16.48	2.28	0.31	0.46	11.24	5.88	**0.00**	3.03	11.42	RC				1.22	**0.07**	0.91	11.24
Marital status																								
Others [RC]																								
Married	0.96	0.91	0.49	1.89	1.09	0.73	0.69	1.72					0.81	0.37	0.51	1.29	0.44	0.17	0.14	1.41				
ANC																								
No [RC]																								
yes									3.19	**0.00**	1.99	5.13	4.56	**0.00**	3.48	5.98	2.30	**0.02**	1.15	4.60	0.76	0.34	0.44	1.33
Place of delivery																								
No [RC]																								
yes																	47.6	**0.00**	6.32	359.03	49.87	**0.00**	26.54	93.72
	AIC	543	BIC	579	AIC	1862	BIC	1924	AIC	466	BIC	501	AIC	1629	BIC	1682	AIC	231	BIC	259	AIC	484	BIC	536

RC: Reference Category

Table 4: Multivariable Logistic Regression for Selected Predictors of Maternal Health Care Utilization in Rural and Urban Ethiopia

3.5. Decomposition Analysis Result

The study used Blinder-Oaxaca decomposition for linear models to decompose utilization of maternal health services (ANC, place of delivery and PNC) difference between rural and urban areas. The results present in Table 5 indicates the average predicted ANC service utilization among women as :48% for those living in urban residences and 20% for those residing in rural settings, the average predicted place of delivery for women is 63 % for those residing in urban settings and 17% for those in rural areas and the mean predicted PNC service utilization among women's is also situated as 28% for those living in urban areas and 9% for those residences in rural settings. The rural urban disparity in maternal health care service utilization revealed as 28 % for ANC, 47 % for place of delivery, and 19 % for PNC. In general, for ANC about 142% (0.40/0.28) of the disparity was due to the different distribution of the predictors (endowments) of ANC, for place of delivery about 81% (0.038/0.47) of the disparity was due to the different distribution of the predictors of place of delivery and also for PNC about 58% (0.11/0.19) of the disparity was due to the different distribution of the predictors of PNC. Among the predictor wealth index contributed 64% (0.18/0.28) for ANC, 32% (0.15/0.47) for place of delivery, and 63% (0.12/0.19) for PNC. The study also shows, the differences in the level of observed covariates (the explained component) accounted for about 104% (0.29/.28) of the total disparity for ANC, 74% (0.35/.47) of the total disparity for please of delivery, and 137% (0.26/.19) of the total disparity for PNC. This component is the combination of "endowments" and "interaction" parts of the three-fold decomposition given Table 5.

	ANC						Place of delivery						PNC					
	Coef.	SE	Z	P-value	95% CI		Coef.	SE	z	P>z	95% CI		Coef.	SE	Z	P-value	95% CI	
overall																		
Urban	0.48	0.03	19.29	0.00	0.43	0.53	0.63	0.02	26.28	0.00	0.59	0.68	0.28	0.03	9.40	0.00	0.22	0.34
Rural	0.20	0.01	22.96	0.00	0.18	0.21	0.17	0.01	20.74	0.00	0.15	0.18	0.09	0.01	10.93	0.00	0.07	0.10
difference	0.28	0.03	10.76	0.00	0.23	0.34	0.47	0.03	18.33	0.00	0.42	0.52	0.19	0.03	6.23	0.00	0.13	0.25
endowments	0.40	0.04	10.37	0.00	0.32	0.47	0.38	0.04	10.53	0.00	0.31	0.46	0.11	0.04	3.03	0.00	0.04	0.18
coefficients	0.00	0.09	0.00	1.00	-0.17	0.17	0.12	0.08	1.41	0.16	-0.05	0.27	-0.07	0.12	-0.58	0.56	-0.30	0.16
interaction	-0.11	0.09	-1.24	0.22	-0.30	0.07	-0.03	0.09	-0.39	0.70	-0.20	0.14	0.15	0.12	1.28	0.20	-0.08	0.39
endowments																		
Husband education	0.00	0.01	0.03	0.98	-0.03	0.03	-0.01	0.01	-0.53	0.60	-0.03	0.02	0.01	0.01	0.51	0.61	-0.01	0.03
Women autonomy for their health care	-0.02	0.01	-2.49	0.01	-0.03	0.00	0.01	0.01	1.14	0.25	-0.01	0.02	0.00	0.00	0.77	0.44	0.00	0.01
Women education	0.08	0.02	3.78	0.00	0.04	0.12	0.09	0.02	4.36	0.00	0.05	0.12	-0.01	0.02	-0.79	0.43	-0.05	0.02
Women working status	0.01	0.00	2.48	0.01	0.00	0.01	0.00	0.00	-0.55	0.59	0.00	0.00	0.00	0.00	0.19	0.85	0.00	0.00
Marital status	0.00	0.00	-0.89	0.37	0.00	0.00	0.00	0.00	0.83	0.41	0.00	0.00	0.00	0.00	0.22	0.83	0.00	0.00
Media exposure	0.13	0.04	3.28	0.00	0.05	0.21	0.18	0.04	4.43	0.00	0.10	0.25	0.00	0.04	0.00	1.00	-0.07	0.07
Total children ever born	0.03	0.01	2.42	0.02	0.01	0.06	-0.02	0.01	-1.67	0.10	-0.05	0.00	0.01	0.01	0.37	0.71	-0.02	0.03
Wealth index	0.18	0.02	8.67	0.00	0.14	0.23	0.15	0.02	7.23	0.00	0.11	0.19	0.12	0.02	5.80	0.00	0.08	0.16
Household size	0.00	0.00	1.26	0.21	0.00	0.01	-0.01	0.00	-1.79	0.07	-0.01	0.00	0.00	0.00	-0.56	0.57	-0.01	0.00
Women age	-0.01	0.01	-1.94	0.05	-0.02	0.00	0.01	0.00	1.42	0.16	0.00	0.01	0.00	0.00	-0.66	0.51	-0.01	0.01
Region	-0.01	0.00	-2.98	0.00	-0.02	0.00	0.00	0.00	-0.69	0.49	-0.01	0.00	-0.01	0.00	-1.87	0.06	-0.01	0.00
coefficients																		
Husband education	0.01	0.03	0.28	0.78	-0.06	0.08	0.05	0.03	1.52	0.13	-0.01	0.11	0.04	0.04	1.08	0.28	-0.03	0.11
Women autonomy for their health care	0.00	0.01	-0.02	0.98	-0.01	0.01	0.01	0.01	1.13	0.26	0.00	0.02	0.00	0.01	-0.55	0.58	-0.02	0.01
Women education	-0.03	0.02	-1.07	0.29	-0.07	0.02	0.00	0.02	-0.08	0.93	-0.04	0.04	0.01	0.02	0.50	0.62	-0.03	0.06
Women working status	0.00	0.01	-0.21	0.83	-0.03	0.03	0.00	0.01	-0.01	0.99	-0.03	0.03	0.00	0.02	0.10	0.92	-0.03	0.04
Marital status	-0.02	0.08	-0.27	0.79	-0.18	0.13	0.06	0.07	0.76	0.45	-0.09	0.20	-0.15	0.11	-1.37	0.17	-0.36	0.06
Media exposure	-0.01	0.01	-1.91	0.06	-0.02	0.00	-0.02	0.01	-3.21	0.00	-0.03	-0.01	0.00	0.01	0.63	0.53	-0.01	0.02
Total children ever born	-0.15	0.23	-0.67	0.50	-0.60	0.30	-0.78	0.21	-3.70	0.00	-1.20	-0.37	-0.26	0.27	-0.99	0.32	-0.78	0.26
Wealth index	-0.04	0.11	-0.37	0.72	-0.26	0.18	-0.08	0.10	-0.76	0.45	-0.28	0.12	0.04	0.14	0.26	0.80	-0.24	0.31
Household size	0.10	0.23	0.45	0.65	-0.34	0.54	0.41	0.21	1.99	0.05	0.01	0.82	0.28	0.30	0.94	0.35	-0.30	0.87
Women age	-0.09	0.54	-0.16	0.87	-1.14	0.97	0.91	0.50	1.83	0.07	-0.06	1.89	0.45	0.59	0.76	0.45	-0.71	1.61
Region	0.17	0.08	2.33	0.02	0.03	0.32	0.02	0.07	0.30	0.76	-0.12	0.16	0.03	0.10	0.27	0.79	-0.16	0.21
_cons	0.06	0.47	0.12	0.91	-0.86	0.98	-0.46	0.43	-1.07	0.29	-1.31	0.39	-0.51	0.57	-0.90	0.37	-1.62	0.60
interaction																		
Husband education	0.01	0.03	0.28	0.78	-0.05	0.07	0.04	0.03	1.51	0.13	-0.01	0.10	0.03	0.03	1.07	0.28	-0.03	0.09
Women autonomy for their health care	0.00	0.01	-0.02	0.98	-0.02	0.02	0.01	0.01	1.13	0.26	-0.01	0.04	-0.01	0.01	-0.55	0.58	-0.02	0.01
Women education	-0.05	0.04	-1.07	0.29	-0.13	0.04	0.00	0.04	-0.08	0.93	-0.08	0.07	0.02	0.05	0.50	0.62	-0.07	0.11
Women working status	0.00	0.01	-0.21	0.83	-0.01	0.01	0.00	0.01	-0.01	0.99	-0.01	0.01	0.00	0.00	0.09	0.93	0.00	0.00
Marital status	0.00	0.00	0.27	0.79	-0.01	0.01	0.00	0.00	-0.72	0.47	-0.01	0.00	0.01	0.01	1.12	0.26	0.00	0.02
Media exposure	-0.10	0.05	-1.90	0.06	-0.20	0.00	-0.15	0.05	-3.19	0.00	-0.25	-0.06	0.03	0.05	0.63	0.53	-0.07	0.13
Total children ever born	0.03	0.05	0.67	0.50	-0.07	0.14	0.17	0.05	3.58	0.00	0.08	0.27	0.06	0.06	0.99	0.32	-0.05	0.16
Wealth index	-0.03	0.09	-0.37	0.72	-0.21	0.15	-0.06	0.08	-0.76	0.45	-0.23	0.10	0.03	0.12	0.26	0.80	-0.20	0.26
Household size	0.00	0.01	-0.45	0.66	-0.02	0.01	-0.02	0.01	-1.74	0.08	-0.04	0.00	-0.01	0.01	-0.89	0.38	-0.03	0.01
Women age	0.00	0.02	0.16	0.87	-0.03	0.03	-0.03	0.01	-1.75	0.08	-0.05	0.00	-0.01	0.02	-0.75	0.45	-0.04	0.02
Region	0.02	0.01	2.12	0.03	0.00	0.04	0.00	0.01	0.30	0.76	-0.01	0.02	0.00	0.01	0.27	0.79	-0.01	0.02

Table 5: Blinder-Oaxaca Decomposition for Selected Risk Factors of Maternal Health Care Utilization for Rural Urban Four Regions of Ethiopia

4. Discussion

This study has primarily aimed to assess the rural-urban inequality in maternal health care service utilization in four regions of Ethiopia. To the best knowledge of the authors, it is the first of its kind which provides comprehensive evidence on the three basic maternal health indicators in four regions of Ethiopia based on ecological and decomposition analysis. The Blinder Oaxaca decomposition results of the study indicated that there were unacceptably high rural-urban disparities in the utilization of maternal healthcare services in the study regions. This finding is consistent with a study done by Abosse et.al., which reported significant disparities in maternal healthcare utilization between urban and rural areas of Hadiya zone, Ethiopia [31]. The reason for the existence of the rural-urban disparity may be the poor set-up of medical facilities in most of the rural settings of Sub-Saharan Africa countries, that includes Ethiopia [32].

ANC is one of the most crucial MCH service to ensure better maternal and infant health outcomes. The proportion of women who had at least four visit of ANC services for the last birth within five years period in these four regions were very low compared to the national average (62%) [10]. In addition, there are disparity of ANC service utilization in all region of Ethiopia [10]. Like previous studies which shows the geographical disparity of the utilization of ANC service [18,23]. This result may be due to the scarcity of resource that can be used to expand or maintain a maternal health service. Further the existing health infrastructures that can be used for maternal and child health may weaken, due to the lower priority given by regions for such services, since they have overlapping other priorities in their health sector like prevention of communicable diseases [34].

Childbirth in a health facility is one of the essential MCH services which prevent stillbirths and improve the survival of newborns but the result for the utilization of health facility delivery in this study except Gambella in the remaining three regions show very low utilization below national average [10]. This study also revealed; there is a higher geographical clustering in the utilization of health facility delivery among the study regions similar with other study in Ethiopia [35]. This could be due to the mind-set of women's and their family which they believe home delivery has an important psychological advantage [36]. Further, since women supposes they will get ample support and care from their close relatives during and after birth if they made it in their homes. In addition, most women's and their families considered the health interventions provided in health facilities for childbirth is an extreme since, from their understanding and family customs; childbirth is a natural process that can be done with little assistance [37].

The Postnatal care is also the other vital MCH service which is given to mothers and child after birth. Sometimes, mothers and their newborn's encountered life-threatening complications in hours, days, or even weeks after delivery. Therefore, WHO recommended; all women should get their first PNC service in 48 to 72 hours after birth [7]. But this study revealed the proportion of women who received postnatal checkup within 2 days after delivery is lower mainly in Afar and Somali below national average [10]. This may be due to low utilization of ANC and health facility delivery and not getting adequate advice from healthcare providers [38]. Similar to the previous two maternal healthcare services, the PNC service utilization also shows geographical clustering among those four regions.

In addition, the study also identified different community and individual factors that affect the utilization of key maternal health services. Consistent with previous studies; this study also revealed wealth index is one of the factors that affect the utilization of maternal health care service utilization in rural areas [16,17,20]. Women from the higher wealth index are the higher maternal health care utilizer. Previous study also supported there is wealth related inequalities in the utilization of maternal health care services [16,17,20,39]. This could be service readiness in the government health facilities is very low and also the government does not have capacity to avail all essential medicine for 24 hours in the health facility [40]. The non-availability or limited availability of the maternal healthcare services discourage women to visit the existing maternal healthcare service providing public health facilities. This will push women from services utilization. In addition, this, leads them for an additional cost that may include transportation and other travel related costs which may not be affordable by women from poor/poorest households since some of the health facilities may be far from their residences [41,42].

The study also revealed; husband education status has a significant association with place of delivery in urban settings. This finding is a consistent with the previous studies [16,40]. The association of education and place of delivery is may be due to; fathers with higher education usually has a better income and they are also socially respected; which provides them a chance to stabilizes their wellbeing's and to get healthcare [43,44]. Further, Fathers with a better education status can understand and calculate risks in pregnancy. They also share a responsibility i.e., they are not give pregnancy as his supposes responsibility only [40].

This study found ANC utilization is one of a predictor for place of delivery in both rural and urban settings in those four regions of Ethiopia. Even more, ANC also found as a predictor for a PNC service utilization in urban settings. This result of the study is consistent with various previous studies findings [16,18,20,45,46]. This result could be due to an opportunity pregnant women's will have during their antenatal care attendance to have adequate information's on health facility delivery and PNC i.e., during ANC, health care providers give a comprehensive counseling that informs women on the risks and mitigation's during pregnancy, childbirth and postnatal. And further they further consult women's the benefits of facility delivery and attendance of PNC after birth [45,46].

The study also reveals place of delivery as a predictor for a PNC utilization in both urban as well as rural settings. This result of the study is also consistent with a previous study done in Malawi and Zambia [47,48]. This result could be due to the exposure that the women's will have during health facility delivery i.e., there are others who attend PNC service when they were in the health facility for delivery. Further the health care provides also gives those mothers health education during their attendance to delivery that promotes PNC services and its benefits. Usually, the topics covered by the health providers includes; how to access, the timing (by when), the advantage of PNC utilization etc. [47,48].

This study has several strengths. Among these, we used data from Ethiopian Demographic and Health Surveys (EDHS) which is a representative household survey that collected data nationally from all women in the reproductive age that includes the four study regions. The data collection instruments used to collect EDHS-2016 data were internationally validated and used in different countries. Moreover, data analysis was done based on group data (i.e., EA level) which can help to identify community level factors. The use of a decomposition analysis helps to better understand the observed and unobserved rural-urban disparity in service utilization among women. As a result, the findings of this study can add to the body of knowledge on inequalities of maternal health care service utilization in marginalized regions of Ethiopia and other similar settings contexts. This study can be used by policymakers and stockholders as a reference when they engaged in the development of relevant policy/strategy for the efficient promotion of maternal health care utilization for those disadvantaged regions of the country. It can also serve as an input for the baseline information for the maternal healthcare programs which are planned in those four regions of Ethiopia. Further, this study can be used as a reference by academicians and other scholars as a base for their further. Regardless of its strengths; this study has some limitations that could be considered while interpreting its findings. The data analysis of this study is limited to included variables which are found in EDHS data set. Variables such as husband altitude, availability of service, and distance to the health facility not included due to data limitations. As the data were generated using cross-sectional survey design, establishing temporality among the variables is difficult.

5. Conclusion

The utilization of maternal health care services in the four regions of Ethiopia has an urban-rural inequality. Among the predictor variables of this study, household wealth index, education level of the husband and regions were pertinent predictors of ANC utilization. The household wealth index, husband education level, regions and ANC utilizations were significant predictors of place of delivery. In addition, household wealth index, women's working status, region, ANC service utilization and place of delivery were predictors of PNC service utilization. In addition, there are significant rural-urban inequalities in the utilization of maternal health care services in the four regions of Ethiopia. Therefore, policymakers and all other concerned stakeholders needs to develop a relevant policy/strategy that would help the efficient maternal healthcare utilization in the four regions of Ethiopia.

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Author Contributions

Tigist Shumet was involved in the study conceptualization, designing, analyzing, and interpreting the data, drafting, and final writing of this manuscript. Nigatu Regassa Geda provided the necessary guidance during the draft preparation, reviewing and revising the paper. Both authors read and approved the final manuscript.

Declarations

Ethics Approval and Consent to Participate

Participants in the research provided consent to participate throughout the initial data capture phase, which also adhered with 2016 EDHS requirements for ethical approval. https://dhsprogram.com/methodology/Protecting-the-Privacy-of-DHS-Survey-Respondents.cfm. We sought administrative authorization to acquire and utilize the raw data of the 2016 EDHS in order to use it for this publication. Via the ICF international/DHS program's platform, we were able to obtain this permission https://dhsprogram.com/data/new-user-registration.cfm.

Availability of Data and Materials

The secondary data used for this manuscript is accessible online through the ICF International/DHS program https://dhsprogram.com/data/new-user-registration.cfm.

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