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Research Article

Determinants of Delivery Care Utilization in Ilu Aba Boor Zone, South West Ethiopia

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ABSTRACT

Introduction: Globally, maternal morbidity and mortality remained a major public health challenge. A home birth is a birth that takes place in a residence rather than in a hospital or a birthing center. Delivering at home is associated with a higher risk of maternal deaths. Although institutional delivery has been promoted in Ethiopia, home delivery is still common, primarily in hard-to-reach areas. Therefore, the aim of this study was to estimate the determinant of home delivery and its associated factors in Ilu Ababor Zone.

Methods: A simple random sample of 215 women aged 15–49 years who a delivered recently was conducted in a simple random sample from the districts of Darimu, N/sale, Alle, Alge and Halu. Data were collected using an interviewer administered questionnaire. Chi-square tests were used to explore association between variables. Using odds ratios with 95% confidence intervals with $p < 0.05$ taken as statically significant association. Multilevel logistic regression with Bayesian approach was used to explore the major risk factors and woreda variations in delivery care in Ilu Ababor Zone. The Deviance Information Criterion model selection criteria were used to select the appropriate model

Results: A total of 140 (65.1 %) mothers delivered at home. The percentage of home delivery at their last birth was high in Halu and Alge districts (77.14% and 75%, respectively) while 56.67% women who lived in N/Sale delivered at home. Living in rural areas, being uneducated, distance from the health center, not visiting antenatal care, not using contraceptive and being poor are predictors of home delivery at 5% level of significance.

CONCLUSION

Based on our analysis home delivery was high in Ilu Ababor Zone which is greater than the average of home delivery in Ethiopia. Place of Residence, no having ANC follows up, educational status of mothers, distance from health facility, not using contraceptive and lack of enough health profession was the risk of home delivery. To reduce home delivery, access to health facility by pregnant mothers need to be improved.

Key words: Bayesian approach, Delivery care, Ilu Ababor, multilevel regression model

INTRODUCTION

Background of the study

Globally, an estimated 287 000 maternal deaths occurred in 2010, a decline of 47% from levels in 1990, 295,000 maternal deaths occurred in 2017, with an overall Maternal Mortality Ratio (MMR) of 462 in low-income countries versus 11 per 100,000 live births in high-income countries. Globally, over 20 million mothers become pregnant every year, and about 15% of these mothers develop obstetric complications such as bleeding

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during pregnancy, childbirth and postnatal period, infection, prolonged and obstructed labor and toxemia.

The risk of dying from pregnancy in Africa is 1 in 16; in Asia, 1 in 65; and in North America, 1 in 3,700. Maternal health is a central concern both globally and nationally. Despite all the efforts by Ethiopian federal ministry of health, the central government, donor funding agencies and all other stake holders to improve maternal, neonatal and child health care services there is no significant reduction in maternal morbidity and mortality in Ethiopia, still around 74% and 81% of mothers gave birth at home in Ethiopia and Oromia regional state respectively. Thus, improving maternal survival was one of the eight Millennium Development Goals and focuses of Sustainable development goals (SDGs) (1-3). Ethiopia is one of the ten countries that comprised 58% of global maternal deaths estimated in 2013. Based on data in the 2011 Ethiopia Demographic and Health Survey, the MMR was estimated at 676 maternal deaths per 100,000 live births . This makes it very difficult to achieve the Millennium Development Goal.

The burden of maternal morbidity and mortality is high in Ethiopia. Different study show as skilled delivery service use is one of the proven interventions in the reduction of maternal and child morbidity and mortality Despite these deliberate interventions by the government, it's still not clear why mothers would deliver at home. Home delivery is associated with young maternal age, low educational attainment, rural residence, low socioeconomic status, high birth order, the absence of ANC services, distance to health facilities and complications during delivery. There were different study conducted by different authors said that in most developing countries including Ethiopia, most deliveries occur at home in the absence of skilled birth attendants. As study conducted in Northern Ethiopia showed as In Ethiopia, the situation is even worse nine in ten women give birth at home . In Ethiopia seventy four (74%) percent of live births in the 5 years before the survey were delivered in a home . Study developed in rural western Ethiopia, the proportions of births attended by skilled personnel were very low 15% and Oromia region 14.7% . One factor associated with maternal and neonatal mortality is home delivery. These deliveries are largely unplanned, accidental and supported by unskilled health professionals. The home environment as a place of delivery in developing countries is shown too unsafe and may have adverse neonatal and maternal outcomes. Still, many studies show that mother's awareness of danger signs of pregnancy is poor and affected by educational status, occupation and residential area. Improved health facility and quality of care during pregnancy and delivery are one of the main concerns in low and middle-income countries like Ethiopia, where the maternal mortality rate is high and yet delivering at health facility is low.

Though there are studies conducted on the place of delivery and its association factors, most of them were limited to a single or few referrals or primary hospitals collected from secondary data which are limited with some variable located in cities and there is no study conducted in Ilu Ababor Zone. Therefore, there is a need to conduct the study on home of delivery and associated factors in Ilu Ababor zone which is based on primary data collected from five districts of the zone, by using Bayesian multilevel logistic regression model

Generally, Maternal and child mortality are two of the major health problems challenging healthcare organizations, especially in developing countries. Ethiopia is one of the developing countries with high level of maternal and child Mortality. Particularly lack of Utilization of health care is one of the top factors that lead to high risk of mortality. Utilizing the data for this study we want to find Determinants of Delivery Care Utilization in Ilu Aba Boor Zone in order to provide policy makers with base line of data important for planning and intervention. The main objective of this study was to investigate the existence variations due to the random effects at women and districts levels and subsequently, to determine the associated factors of women's delivery place in Ilu Aba boor Zone.

METHODOLOGY

Study design, area and population

The study was conducted in Ilu Aba Boor zone, western Ethiopia. Ilu Aba Boor (or Ilu Aba Boor, Ilu Aba Boor) is one of the zones of the Oromia Region of Ethiopia. Ilu Aba Boor is named for the former province Ilu Aba Boor. It is bordered on the south by the Southern Nations, Nationalities and Peoples Region, on the southwest by the Gambela Region, on the west by Kelem Welega Zone, on the north by Bedele, and Benishangul Gumuz Region, on the northwest by Misraq Welega Zone, and on the east by Bedele.

Ilu Aba Boor Zone is a green land, forestry and economy is based on agriculture especially production of coffee. It is mostly known for its vegetation coverage, suitability for coffee, crop, livestock and bee production. The dominant crops being Maize, Teff, Coffee, Sorghum, Barley, Wheat, different pulse crops, finger millet, fruits, vegetables, spices and rice. Ilu AbaBoor Zone was one of the highest home delivery rates from Oromia Region. In Ethiopia home deliveries decreased from 95% in 2000 to 90% in 2011, and 73% in 2016. However in Ilu Aba Boor Zone the Delivery rate among those aged 15-49 years has been reported as 83.6% in home delivery and 16.4% Health facilities

Data collection procedures

The data was collected by using the structured questionnaire which is developed for the purpose of data collection after intensive reviewing of relevant literatures The questionnaire in the beginning was prepared in English and then translated into Afaan Oromo and back to English to ensure consistency, but finally administered in Afaan Oromo. Ilu Ababoor Zone Has twelve districts and one city administration from this we took five districts; simple random sampling techniques was used to enroll women who gave birth in the recent preceding data collection. Among this group, women who gave birth at home were considered as interested variable. Training was given for 5 data collectors for each district and two supervisors by the principal investigators for two days on the purpose of the study and procedures of data collection. A week prior to the actual

data collection the questionnaire was pre- tested and so that modifications were made to the questionnaires accordingly. Data collectors were instructed to check the completeness of each Questionnaire at the end of each interview.

Study Variables

Dependent variable

The response variable in this study is Delivery care coded as 0= home), 1= Health facilities).

$$Y_{ij}=\begin{cases}1 \text{ if the } i^{th} \text{ women is deliver at HF in the } j^{th} \text{ districts}\\ 0 \text{ if the } i^{th} \text{ women in the } j^{th} \text{districts Deliver at home}\end{cases}$$

Independent variable

Depending on the demonstrated related literature reviews, the variables included in this study are listed as follows: Age of mother, wealth index, educational level, antenatal care, religion, and availability of health professional, contraceptive, occupation of mothers, residence and distance to a health facility. Maternal age was categorized into 15-19, 20-29, 30-39 and 40-49. Wealth index was categorized as poor, medium and rich. Educational level was categorized as illiterate, primary, secondary and preparatory and diploma and above. Antenatal visit was categorized as no antenatal visit and yes antenatal visit.

Method of Data Analysis

Statistical model that is appropriate for this data analysis is multilevel logistic model with Bayesian approach. The data collection procedure is hierarchical level or structures that means the levels are nested one another; Thus why the reason for selecting this model. MLwiN software was adopted for the analysis of this study.

Multilevel Logistic Regression Model

Multilevel analysis is a methodology for the analysis of data with complex patterns of variability, with a focus on nested sources of variability. The best way to the analysis of multilevel data is an approach that represents within group as well as between groups relations within a single analysis; where group refers to the units at the higher levels of the nesting hierarchy. In this study, multilevel binary logistic regression model was adopted to determine Delivery care Service in Ilu Ababor zone. The multilevel logistic regression analysis considers the variations due to hierarchy structure in the data. Hence, the study was helps for examining the effects of group level and individual level variation of observations.

Multilevel models are statistical models which allow not only independent variable at any level of hierarchical structure but also at least one random effect above level one group. A multilevel logistic regression model can account for lack of independence across levels of nested data (i.e., individuals nested within districts). For simplicity of presentation, two-level models were used for this study, i.e., models accounting for women-level and districts -level effects.

In this data structure, level-1 is the women level and level-2 is the districts level. Within each level-2 unit there is in the districts.

To provide a familiar starting point, we were first considered a two-level model for binary outcomes with a single explanatory variable. Suppose we have data consisting of women, (level one) grouped into districts (level two). Let be the binary response for place of Delivery care among women in districts j and be an explanatory variable at the women level.

The standard assumption is that, Yij has a Bernoulli distribution. Then, the two level models are given by:

$$\text{logit}(\pi ij) = \log\left[\frac{\pi ij}{1-\pi ij}\right] = \beta 0j + \sum_{h=1}^{k} \beta hjXijk \quad \text{----------} \quad (1)$$

i = 1, 2... nj, h = 1; 2... k, j = 1, 2... 5

$$\beta 0j = \beta 0 + U0j, \beta 1j = \beta 1 + U1j, \ldots, \beta kj = \beta k + Ukj$$

$$\text{logit}(\pi ij) = \log\left[\frac{\pi ij}{1-\pi ij}\right] = \beta 0 + \sum_{h=1}^{k} \beta hjXijk \quad \text{----------} \quad (2)$$

The Bayesian fitting of random effects logistic regression (RELR) models involves as usual in the Bayesian approach. It updates posterior distributions for the parameters from prior via appropriate likelihood functions. In this study we have seen the three model of multilevel which is Bayesian Multilevel Logistic Regression Analysis of Empty Models, random intercept model and random coefficient model.

Bayesian Multilevel Analysis of Empty Model (Null Model)

The empty two-level model for a dichotomous outcome variable refers to a population of groups

(level-two units (districts)) and specifies the probability distribution for group-dependent probabilitiesin = without taking further explanatory variables into account.

The logit linear predictor is given as:

$$\text{logit}\,(\pi j) = \beta_0 + u_{0j} \quad \text{----------} \quad (3)$$

In this case, the likelihood function is given as:

$$L(\pi_{ij} = y_{ij}) \prod_j \pi_{ij}^{y_{ij}} (1-\pi_{ij})^{1-y_{ij}} \quad \text{----------} \quad (4)$$

Prior Distribution: the prior distribution for the parameter and given as follows:

P uniform distribution (1)

P () =Gamma () where are fixed constant parameter.

Posterior Distribution: After finding the likelihood and prior function, the next step is to find the random parameter of empty model from the posterior distribution P which is given as follows; the full conditional distribution for parameter is:

$$p\left(\beta_0/\sigma_u, y_{ij}\right) \propto \prod_j \left(\frac{e^{\beta_0+U_{0j}}}{1+e^{\beta_0+U_{0j}}}\right)^{y_{ij}} \left(\frac{1}{1+e^{\beta_0+U_{0j}}}\right)^{1-y_{ij}} \quad \text{----------} \quad (5)$$

Bayesian Multilevel Analysis of Random Intercept Model

In the random intercept logistic regression model the intercept is the only random effect meaning that the groups (district) differ with respect to the average value of the response variable.

The logit of is a sum of linear function of explanatory variables and given as:

$$logit(\pi_{ij}) = \log\left[\frac{\pi_{ij}}{1-\pi_{ij}}\right] = \beta_{0j} + \beta_1 X_{1ij} + \ldots + \beta_k X_{kij} = \beta_{0j} + \sum_{h=1}^{k} \beta_{hij} \quad \text{---------- (6)}$$

Where the intercept term is assumed to vary randomly and is given by the sum of an average intercept and group-dependent deviations that is + as a result.

$$Logit(\pi_{ij}) = \beta_0 + \sum_{h=1}^{k} \beta_{hj}\, x_{hij} + U_{0j} \quad \text{---------- (7)}$$

Where +is the fixed part of the model and is the random or stochastic part of the model.

Bayesian multilevel Random Coefficients Model

The random coefficients builds up on the random intercept model by allowing the effects of individual predictors to vary randomly across level 2, that is , level 1 slope coefficients are allowed to take on different values in different aggregate groupings. In the random coefficient model both the intercepts and slopes are allowed to differ across the districts.

Consider a model with group specific regression of logit of the success probability logit() on a single level -one explanatory variables X

$$logit(\pi_{ij}) = \log\left[\frac{\pi_{ij}}{1-\pi_{ij}}\right] = \beta_{0j} + \sum_{h=1}^{k} \beta_{hij} + U_{0j} + \sum_{h=1}^{k} U_{hj}\, X_{hij} \quad \text{---------- (8)}$$

The term can be regarded as a random interaction between group and the explanatory variables. This model implies that the groups are characterized by two random effects: their intercepts and their slopes. It assumes that, for different groups the pairs of random effects (,, h= 1,2,...,k) are independent and identically distributed. The random intercept variance, Var() = , the random slope variance , Var() = and the covariance between the random effects, Cov(;) = are called variance components (Snijders and Bosker, 1999).

RESULTS AND DISCUSSION

The outcome of interest of this study is DC service utilization. Thus, the response variable is binary, indicating whether or not a mother delivers at home or health facilities. The results of this study showed that home delivery was very high in the study population. As we have seen that the results of this study showed, home delivery was very high in the study population. This study was similar with Hadiya Zone, Southern Ethiopia (74.5%), EDHS 2016 report (73.3%) and Gozamin District in Amhara region (75.3%).

The association between socio-demographic characteristics, death of mother during pregnancy and knowledge about danger signs of pregnancy of mothers in relation to Home Delivery were first assessed using bivariate and logistic regression models. Among the potential determinants explored for the use of DC service, having taken health education on maternal health; educational status being Illiterate , grade one to eight, grade nine to twelve, Diploma, Degree; Mothers occupation "other than farming" and perceived walking time to the nearest health facility being >20km; were found to be significantly associated with DC service use. A total of 225 households were selected for the sample, of which 215 were found to be occupied during data collection. In the interviewed households 215 eligible women were identified for individual interview; complete interviews were conducted for 215, yielding a response rate of 86%.

The variables included in this study are based on consideration in previous studies. The dependent variables of the study are specified to only DC service utilizations.

A woman is considered to have used DC if she was delivered by a health professional (doctor, nurse or midwife) during delivery period.

Delivery Care Service is coded as 1, if a mother delivered at Health Institution and 0, if a mother delivered at Home.

Multilevel Logistic Regression Model

This study employs data which have been collected by using preparing questioner and interview; in such samples, the individual observations are in general not completely independent. The problem of dependencies between individual observations occurs in survey research, if the sample is not taken at random but cluster sampling from geographical areas is used instead. A multilevel logistic regression model can account for lack of independence across levels of nested data (i.e., individuals nested within woreda.

Table 1: Percentage distribution of women by background characteristics and Delivery care place

Characteristics	%	All women	p-values	Chi-square	Delivery care place	
Mothers age at last birth	18.6	40	0.03	12	Home	HF
	39.1	84			29	11
	32.6	70			56	28
15-19	9.8	21			43	27
20-29					12	9
29-39						
40-49						
Educational level	31.6	68	0.004	12.8	41	27
	45.6	98			63	35
No education	14.4	31			21	10
	8.4	18			15	3
Primary						
Secondary and preparatory						
>=Diploma						
Occupation	60	129	0.002	9.5	84	45
	28.3	61			37	24

House wife	7	15			11	4
Employment	4.7	10			8	2
Merchants						
Labor force						
Religion	26	56	0.8	2.2	36	20
Orthodox	41.4	89			55	34
Protestant	29.3	63			45	18
Muslims	3.3	7			4	3
Traditional/ Others						
Household monthly income	66.0	142	0.02	8.8	88	54
<=1000	23.7	51			33	18
1001-2500	10.2	22			19	3
>2500						
Residence	83.3	179	0.001	23.7	111	68
Rural	16.7	36			29	7
Urban						
ANC	41.4	89	0.001	19.6	46	43
Yes	58.6	126			94	32
No						
Contraceptive Use	40.0	86	0.56	3.4	58	28
Not use	60.0	129			83	47
Distance from health center	20.9	45	0.001	15.6	33	12
1-10km	38.1	82			47	35
11-20km	41	88			60	28
>20km						
Marital status	85.6	184	0.005	18	117	67
Married	4.7	10			8	2
Unmarried	4.7	10			6	14
Separated	5.1	11			9	2
Widowed						
Availability of health center	45.6	98	0.001	20	73	28
Yes	54.4	117			67	47
No						
Districts	14	30	0.02	15.6	17	13
S/Nono	20	43			26	17
Allee	34.9	75			46	29
Darimu	14.9	32			24	8
Alge	16.3	35			27	8
Halu						

A total of 215 mothers aged 15 to 49 years participated in the study. About 39.1% and 32.6% mothers were from age 20-29 and 30-39 years old, respectively. Majority (41.4%) of the study participants were protestant followers, followed by Muslim (29.3%), and orthodox (26%). Regarding the occupational status of the mothers more than half (60%) were house wife. Corresponding marital status majority (85.6%) of the study participants were married. Majority of study participant (40%) were >20km far from health facility in their locality as well 66% mothers average of monthly income were <1000 ETB. An overwhelming majority of the respondents were rural residents, consisting of 83.6% of the total respondents, and the rest 16.4% were from urban areas. As indicated in table 1, the highest proportions of women were from Darimu Districts (34.7%), while the least proportion of women were included from S/Nono(14%). In the overall sample, almost (60%) of women were not using contraceptive methods and the left 40% of them were used contraceptive methods. The majority of the women (83.3%) were in rural areas of the districts. Conversely, relatively higher proportions (51.6%) of women in rural areas were delivering at home and 31.62% of them were delivered at Health facilities, (Table 1). The majority of women in the overall sample had never been visited antenatal care (43.72%). Notable variations in their occupation were observed between the method of their deliverance (Home and Health facility). Accordingly, 39.06 % of women occupations were house wife those who were delivered at home and 20.93% were delivered at health facilities. With regard to their wealth index, the results of Univarite analysis in table 1. Showed that most women were in the poorest wealth quintile, (<1000) accounting for almost 66%. Women who deliver at home and who deliver at HF belong to the poorest wealth quintile were 40.93 and 25.11%, respectively (Table 1). Urban-rural disparities with respect to women's delivery place showed that almost 51.11 % of women in rural were delivered at home and 13.49% were delivering at HF.

Notable variations in ANC utilization between women in urban and rural areas were observed. Accordingly, 58.6 % of women received ANC compared to 41.4 % of women not take ANC.

DELIVERY CARE UTILIZATION

Among the total women (215) included in the study, 140 (65.1%) had delivered at their home. Out of whom 88 (62.85%) were <1000 ETB monthly income, 33 (23.57%) were between 1001-2500 ETB monthly income and 19 (13.57 %) were >2500 ETB monthly income. Among women who deliver at home (140), 60 (42.85%) of them far from the health center >20km compare as the others. Corresponding their ANC most of the women cannot use ANC and among 215 women 126 (58.6%) of them were not use ANC. From 126 women 94 (74.6%) of them were deliver at their home and the left 32 (25.4%) of them those who were not visited ANC were deliver at health facility. This indicated that why maternal mortality was high in our country. Even some women visited Antenatal care service they cannot birth at health facility as we have observed from this study. Among the age group of the mother who deliver at home 56 (40%) of them were from the age category of 20-29 years old, followed by 43 (30.71%) from the age category of 30-39 years old, 29 (20.71%) from the age group of 15-19 years old and 12 (8.57%) were from 40-49 years old. On the other hand from 140 women who delivered at home educational status were 41 (29.28%) of them were illiterate and 63 (45%) of them had primary educational level. Among the occupation of the women who were deliver at home, 84 (60%) of them were house wife, 37 (26.42%) from government employments, 11 (7.85%) merchant and 8 (5.71%) from daily labor force. On the other hand among 140 women those who delivered at home 111 (79.28%) from the rural part of the districts and 29 (20.72%) were from urban parts of the districts. In other case most women who delivered at home 73 (52.14%) of them said that there is no health center in our area, which mean that the health center is far apart from them. Regarding the question asking "have you used contraceptive method" most women who delivered at home 82 (58.57%) said that they didn't use contraceptive methods.

Bayesian Multilevel Logistic Regression Analysis

Bayesian multilevel logistic analysis procedure was used to make inference about the parameters of a multilevel logistic model. 15000 burn-in terms discarded and the Metropolis hasting algorithm was implemented with 50,000 iterations. The researcher use non-informative uniform prior distribution with scale parameter (0, 1) for the fixed effect and gamma distribution with a scale of 0.001 and shape 0.001 . In the multilevel analysis, a two-level structure is used with districts as the second-level units and women as the first level units. This is basically with the expectation that there would be a difference in place of delivery among woreda. Under this section we revealed three Bayesian multilevel model; empty model, intercept model and coefficient model to identify the appropriate model which fit our data. The nesting structure is women within districts with a total of 215.

Bayesian Multilevel Logistic Regression Analysis of the Empty Model

The simplest important specification of the hierarchical linear model is a model in which only the intercept varies between level two units and no explanatory variables are entered in the model. The empty model contains no explanatory variables and it can be considered as a parametric version of assessing heterogeneity of home delivery among districts. The variance of the random factor is not significant which indicates that there are no districts differences in place of delivery of women those who delivered at home.

Table 2: Bayesian Multilevel Logistic Regression of Empty Model

Model	Coefficient	SD	MCSE	95%CI
Fixed intercept (βoj)	0.989	0.482	0.1603	(0.215, 1.878)
Random intercept var(Uoj)=	1.29	1.533	0.0077	(0.279, 4.637)

From the results presented in Table 2 above show that the overall mean of home delivery is estimated that = 0.989 found to be insignificant, suggest that no evidence of district effects on home delivery. Coming to districts variation tests; Here the null hypothesis tested is = 0. i.e., there is no districts variation in home delivery in Ilu Ababor Zone. Based on the above result data the values are insignificant at 95% credible interval which means that the interval is not greater than zero, therefore, the null hypothesis has not to be rejected indicating strong evidence that the between districts variance is not greater than zero.

Bayesian Multilevel Logistic Regression Analysis of the coefficient model

It is possible to generalize the model so that the effect of level-1 covariates is different in each woreda. This can be done by adding random coefficients in front of some of the individual-level covariates of the model. In the random intercept model, we allowed the intercept only to vary across woreda by fixing explanatory covariates. From the output of the random coefficient Bayesian multilevel model presented in Table 3 below, we interpret the results as follows. Age of the mothers is one of the predictor variables under this study. The odds of women who deliver at home under age 20-29 was (OR=2.18) times more likely than the odds of women who deliver at home under the age of 15-19, and the odds of women who deliver at home under age 30-39 was (OR=3.34) times more likely than the odds of women who deliver at home under the age of 15-19. Additionally the odds of women who deliver at home under age 40-49 was (OR=1.825) times more likely than the odds of women who deliver at home under the age of 15-19. Regarding too antenatal care the odds of women follow antenatal care who deliver at home was (OR=0.32) times less likely than that of no visit at all. Another finding of this study was the odds of women delivered at home whose marital status were not married (OR=0.6) less likely than who married, separated (OR=3.18)

more likely than who married and widowed (OR=0.157) less likely than that of married. Regarding to the residence of the women, the odds of women live in urban who deliver at home was (OR=0.84) less likely than who live in rural. Another variable were educational level, the odds of women who deliver at home whose educational level is primary was (OR=0.59) less likely than who were illiterate, the odds of women delivered at home whose educational level secondary and preparatory was (OR=0.58) less likely than who were no education. The odds of women who have Diploma and above educational level who delivered at home was (OR=0.29) less likely than who have no education by assuming other variable constant. From the variable of occupation the odds of women who were Government employment delivered at home was (OR=0.08) less likely than who were house wife, and the odds of women who were daily labor force who deliver at home was (OR=0.49) less likely than who were house wife by assuming other variable constant. Continuously based on the selected variable we interpret that the odds of women those whose home were far from health center (10-20km) who delivered at home was (OR=3.8) more likely than whose home were far from health center 1-10km by assuming other variable constant. Another finding of this study indicates that the antenatal visit of individual women is significantly associated with place of delivery (home delivery) with 95% credible interval and wealth index of the women was another variable which was significantly associated with home delivery of our mother in Ilu Ababor Zone with 95% CI. Particularly, the odds of women delivered at home with wealth index of middle was OR=0.858 less likely than poor and the odds of women delivered at home with wealth index of rich was OR=0.58 less likely than the women whose wealth index categorized as poor. Another variable which considered in our study was existence of enough health profession, which mean that the odds of women who said there were no enough health profession delivered at home was OR=2.4 more likely than who said there were enough health profession.

Table 3: Bayesian Multilevel Logistic Regression of Coefficient Model

Fixed effect	Categories	Estimates	SD	MC error	95% CI
Intercept		-4.561	1.267	0.0979	(-6.757, -2.407)
Age of mother	15-19(ref)				
	20-29	0.783	0.069	0.0018	(-0.353, 1.55)
	30-39	1.208	0.071	0.0021	(-.072, 1.34)
	40-49	0.602	0.087	0.0015	(-0.032, 1.05)
Ante.visit	yes (ref)				
	not visit	-1.02	0.04	0.0009	(-1.48, -0.51)
Marital status	Married(ref)				
	Not married	-0.51	0.113	0.0014	(-0.93, 0.732,)
	Separated	1.16	0.073	0.0008	(-1.58, 2.305)
	Widowed	-1.847	0.105	0.0011	(-2.054, 0.234)
P residence	Rural(ref)				
	Urban	-0.165	0.077	0.0037	(-0.192, -.098)
E attainment	No educ (ref)				
	Primary educ	-0.524	0.044	0.0008	(-0.837, 0.012)
	Sec.and prep	-0.542	0.065	0.001	(-0.671, -0.413)
	>=Diplo	-1.212	0.141	0.0034	(-1.486, -0.91)
Wealth index	Poor(ref)				
	Middle	-0.153	0.051	0.0012	(-0.171, -0.131)
	Rich	-0.634	0.153	0.0011	(-1.23, 0.034)
Contraceptive	Not use(ref)				
Occupation	Use	-0.178	0.043	0.0009	(-0.62, -0.093)
Distance	House wife	-2.521	0.049	0.0025	(-4.97, 0.210)
Health prof	Gov't Eploy	-0.643	0.084	0.0012	(-1.86, 0.383)
Health center	Merchant	-0.702	0.049	0.0008	(-.904, -0.56)
Religion	Labor	1.334	0.063	0.0017	(1.214, 1.45)
	1-10km	1.44	1.76	0.0014	(-0.266, 2.33)
	11-20km	0.717	0.040	0.0007	(-0.038, 1.795)
	>20km	0.260	0.045	0.0009	(0.172, 0.347)
	Yes	-0.203	0.044	0.008	(-0.289, 0.117)
	No	-0.624	0.049	0.0007	(-0.719, 0.026)
	Yes	-0.554	0.337	0.0039	
	No				
	Orthodox				
	Protestant				
	Muslim				

	Other			(-1.284, 0.169)
Random effect	27.633	38.37	0.025	(17.32, 36.85)

Model Comparison

From the result of Table 4 below, the DIC diagnostics of random intercept Bayesian multilevel logistic regression model is reduced by 3717.33 from the Bayesian multilevel logistic regression of an empty model. This show as adding covariate variables to the model indicates how the variable is determined home delivery. Thus; Bayesian multilevel logistic regression for random intercept was the better model as compared to Bayesian multilevel for an empty model. The DIC diagnostics of Bayesian multilevel logistic regression of random coefficient model is reduced by 1133.29 from Bayesian multilevel for random intercept so, this Bayesian multilevel random coefficient model is a great improvement suggesting that this model is the appropriate model than a Bayesian multilevel empty model and Bayesian multilevel for intercept model to determine the home delivery factors.

Table 4: Bayesian Deviance Information Criterion (DIC)

Bayesian Deviance Information Criterion (DIC) for model comparison				
Model		**D()**	**Pd**	**DIC**
Null model	28214.41	28208.39	6.01	28220.42
Random intercept	24467.27	24431.45	35.82	24503.09
Random coefficient	23337.02	23304.24	32.78	23369.80

Assessment of Model Convergence

The Monte Carlo Standard Error (MCSE) is an indication of how much error is in the estimate due to the fact that MCMC is used. As the number of iteration increased the MCSE was decreased as we have seen from the graph. The following figures were some parts of Convergence for some parameter.

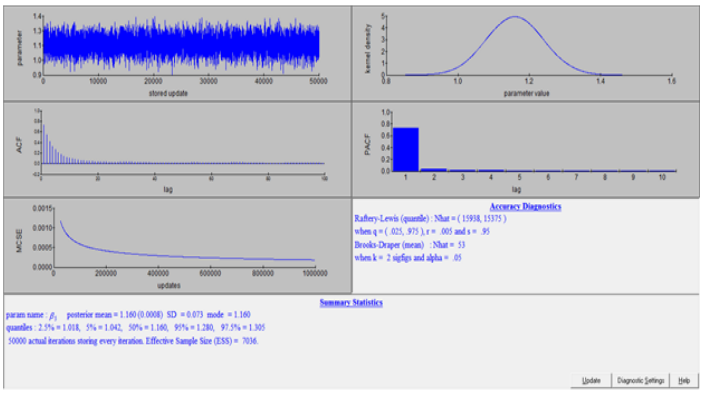

Figure 1: convergence of

DISCUSSION

This study focused to determine factors influencing the delivery place among mothers reproductive age group communities of Ilu Ababor Zone. Accordingly, the descriptive method and Bayesian Multilevel logistic regression were used in the analyses. Overall, the proportion of women who had health facility delivery was only 34.9%. The variables, having the significant association with home delivery (based on Chi-square test of association) age of mother at birth, Antenatal care, Place of residence, woreda, mothers education, Marital status, Wealth index, Contraceptive, distance of health center, a source of health profession and occupation. In order to explain the district difference in home delivery and to identify which model is the best model to fit the data, we applied three different Bayesian multilevel models for the response variables. By considering the appropriate model which fit our data we identify the significant variable. From the descriptive statistics the probability of home delivery for Halu and Alge was high as compared to the other Districts and also the number of home delivery for urban women is less likely than that of rural, women who visited Antenatal care in health facilities who delivery at home was less likely than who was not visited ANC. Coming to the inference parts the analysis of the final model indicated that one of the significant factors of home delivery in this study was the residence of the women. The odds of women live in urban who deliver at home was (OR=0.84) less likely than who live in rural. This show as the women who live in rural part of the zone delivered at home has more likely than whom live in urban part of the zone. Another finding was showed that wealth index was an important determinant of home delivery. This indicates as income is one of the significant factors for delivery place. The home delivery of mother from the low-income family has more likely than that of from high income or rich family the result for household wealth index being significant is also consistent with the previous study by . Additional variable which the researcher considers under this study was the age of women. The odds of women who deliver at home under age 20-29 was (OR=2.18) times more likely than the odds of women who deliver at home under the age of 15-19, and the odds of women who deliver at home under age 30-39 was (OR=3.34) times more likely than the odds of women who deliver at home under the age of 15-19..

The result of Bayesian multilevel logistic regression model comparison indicates that the random coefficient Bayesian multilevel logistic regression model best fits the model than the null model and random intercept model of the Bayesian multilevel logistic regression model. therefore the researcher suggests that Bayesian multilevel logistic regression for random coefficient were the best fit of the data and the interpretation was depend on random coefficients.

CONCLUSION AND RECOMMENDATION

The study data was taken by using primary data collection method by preparing questioner and distributing to women of selected woreda by selecting proportional sampling techniques. An inference is a fully Bayesian multilevel model based on

recent Markov chain Monte Carlo techniques. The study was identified some socio-economic, demographic and environmental proximate variables as determinants of home delivery in the Ilu Ababor Zone and the gap from classical by checking the level of variation within and between the districts. From those determinant factors wealth index, place of residence, educational attainment of the mother, health center, contraceptive, Distance of health center were the significant variables as a determinant of place of delivery in this data. From the methodological aspect, it was found that Bayesian multilevel random coefficient model is better compared to empty (null) model and random intercept model in fitting the data and in explaining the variations of home delivery across woreda of the Ilu Ababor Zone. In addition from the empty model and random intercept model, the overall variance of the constant term was found to be statistically insignificant, implying there is no existence of a difference in home delivery among the districts of the Zone.

The findings of this study have some important policy implications and the identification of factors those are significantly associated with a home delivery. Depending on the above important findings, the researcher suggests the following recommendations for researchers and policymakers: Although the variation across the woreda has been addressed with this study, the distribution for the prevalence of home delivery and the issue of identifying the hot-spot-area is not covered here. Therefore, the researchers are recommended to extend this study with the application of spatial models. The government and other concerned bodies should have to take attention to control the significant factors that lead to home delivery like mothers' educational level have to upgrade, Mothers have to be encouraged to increase the behavior of using contraceptive method and attitude toward antenatal visit has to be raised and the government and non-government should take the high responsibility to overcome this significant variable to reduce the home delivery of our child giving mother's.

Declarations

Ethics approval and consent to participate

Ethical clearance was obtained from the ethical review board of Mettu University College of Natural and computational science. Written informed consent was obtained from the study participants. The confidentiality of information obtained from respondents was ensured.

Consent for publication

"Not applicable"

Availability of data and materials

The data sets analyzed for this study is available from the corresponding author on reasonable request.

Competing interests

The authors declare no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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Authors' Contribution

Dabala wrote the protocol, design the study, organized data collection process, analyzed the data and wrote the manuscript and **Dereje** and **Shibiru** were reviewing and editing the manuscript. The authors read, critically reviewed and approved the final version of the manuscript for publication and agreed to be accountable for all aspects of the work.

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