

PREDICTORS OF MATERNAL DELAYS FOR INSTITUTIONAL DELIVERY AMONG PARTURIENTS IN GAMO ZONE OF SOUTHERN ETHIOPIA: THE GENERALIZED ESTIMATING EQUATIONS (GEE)

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ABSTRACT

BACKGROUND: Delay in institutional delivery refers to the time interval from the first onset of labour to start receiving the first healthcare. This study aimed to assess the associated factors of the maternal delays for institutional delivery service utilization in Selected Gamo Zone Health Centres, Southern Ethiopia in 2019.

METHODS: A retrospective study was conducted in rural districts of the Gamo zone. A total of 394 postnatal mothers were selected by simple random sampling. The Generalized Estimating Equations (GEE) was used to examine associations between outcome maternal delay time and independent variables.

RESULTS: The age of respondents was distributed at the mean (\pm standard deviation) is 29 ± 4.609 years (range from 19 to 40 years). Out of the total 391 mothers, 266 (68.03%) were unemployed and 125 (31.97%) were employed. The unemployed mother had $\text{Exp}(0.5572)=1.75$ times higher odds of being maternal delay compared to employed. Similarly, mothers whose poor knowledge on danger signs of pregnancy and childbirth had $\text{Exp}(0.5216)=1.68$ times higher odds of being maternal delay as compared to whose good knowledge. The odds of being the husband decision maker for institutional delivery service utilization ($\text{Exp}(0.8006)=2.23$) times higher odds of being maternal delay compared to jointly.

CONCLUSIONS: The maternal delay time is significantly determined by the mother's occupation, number of children, final decision maker for institutional delivery service utilization, mother's knowledge on danger signs of pregnancy and childbirth and delay time. Therefore, due attention needs to be given to encourage unemployed mothers, promoting couples in involvement in decision making for institutional delivery service utilization, and creating awareness on danger signs of pregnancy and childbirth.

KEYWORDS: Maternal Delays, Generalized Estimating Equations, Institutional Delivery Service Utilization, Parturient

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INTRODUCTION

Delay in institutional delivery refers to the time interval from the first onset of labour to start receiving the first healthcare¹. Timely referrals and access to appropriate health care had a great impact on reduction to maternal deaths and disabilities. Maternal delay is one of the contributing factors for high maternal mortality in developing countries²⁻³. About 1,000 women die from pregnancy/childbirth related complications around the world every day and more than half a million women die each year; of these, 99% occur in low-resource countries^{1, 3-4}. In Ethiopia, Maternal deaths account for 30 percent of all deaths to women age 15 - 49 and the maternal mortality ratio was estimated to 676 maternal deaths per 100,000 live births⁵. Sixty-two percent (62%) of women had ANC visits during pregnancy but only 26% of women gave birth in the health facility⁶.

Antenatal care follow-up, residence and education were significantly associated with institutional delivery service utilization⁷. Place of residence, traveling time takes to reach health institution which provides delivery service, husband's attitudes towards institutional delivery, and counseling about where to deliver during ANC visit were found to have significant association with institutional delivery⁸. Limited knowledge about the pregnancy and the advantage of institutional delivery in women, husband involvement, inaccessibility to health services and poor infrastructure of the health system contributed to low utilization of facility delivery⁹.

Ethiopia has one of the lowest rates of facility delivery and is promoting birth preparedness among pregnant women through its community health services to increase the rate of institutional delivery and reduce maternal mortality. Institutional delivery was more common among women who were considered well prepared (57%) versus those who were considered not well prepared (19%)¹⁰. Mothers' knowledge level of obstetric complications and experience of complications during the last

birth was the factors associated with higher odds of receiving delivery care from decentralized local facilities¹¹. Furthermore, lack of knowledge on danger signs and benefits of maternal health services, lack of decision-making power of women, lack of privacy and perceived costs of maternal health services were the main factors causing the maternal delay¹².

Despite the government's efforts to expand health institutions to promote facility-based child delivery, home delivery and maternal mortality are still widespread problems in Ethiopia and even if the number of studies conducted in the country were identified factors associated with maternal delays for institutional delivery service utilization, there is still information gap as well as minimal evidence on maternal delays for institutional delivery service utilization. Therefore, this study aimed to assess the associated factors of the maternal delays for institutional delivery service utilization in Selected Gamo Zone Health Centres, Southern Ethiopia in 2019.

METHODOLOGY

Study area and design

The study was conducted from March 1, 2019-April 30, 2019 in the Gamo zone which located 450kms from Addis Ababa, Ethiopia. Gamo zone is one of the zones of Southern Ethiopia. There are four primary hospitals and one general hospital, 53 health centers, and 299 health posts. Facility based a retrospective study design was conducted in rural districts of the Gamo zone, Southern Ethiopia.

Population

All postnatal mothers who gave birth at public health facilities of the Gamo zone were source population whereas all postnatal mothers who give birth at public health facilities during the data collection period were the study population. But women who were severely ill during the data collection period and women who utilized maternal waiting home were excluded.

Sample size determination and sampling technique

The calculation of the required sample size for this

study is calculated by using Open-Epi 7.02 with the assumption of 95% confidence level ($Z_{\alpha/2}=1.96$), 80% power ($Z_{\beta}=0.84$). The magnitude of first, second, and third maternal delays in utilizing institutional delivery service were 37.8%¹³, 29.7%¹⁴, and 34.7%² respectively. Considering a 10% non-response rate, the maximum sample size requires for this study was found to be 394 postnatal mothers (for first delay), 352 postnatal mothers (second delay), and 383 postnatal mothers (third delay). Since the sample size calculated for the first delay was greater than the second and third delays, 394 postnatal mothers were involved in the study. To get the study participants, first, two districts (Dita and Chenchu Zuriya districts) were selected randomly from the nine rural districts. All public health centers in the two selected districts were included and the sample size was proportionally allocated to all public health centers based on their monthly delivery load. Then, by using a simple random sampling method study participants were selected and interviewed in each health center.

Study variables

The response variable considered for this study was the maternal delay. It was measured at three time points. First maternal delay: was the time interval between recognition of the labor and make decision to seek institutional delivery service. Time is taken ≥ 1 hr to make decision to seek care was considered as delay and < 1 hr considered no delay. Second maternal delay: was time interval from starting to reach health facilities after decision has made. Time is taken ≥ 1 hr to reach the facility considered as delay and < 1 hr considered no delay. Third maternal delay: was the time interval between reaching the facility and the delivery care service received. Time is taken ≥ 1 hr to receive delivery service considered as delay and < 1 hr considered no delay. So, the maternal delay was recorded at three time points.

The covariate variables are assumed to influence the maternal delays of the mother included in the model are maternal age, educational status of the mother, husband's education status, occupation of mother, occupation of husband, household monthly

income, maternal religion, maternal residence, women decision-making power, ANC follow-up, ANC frequency, number of children, previous pregnancy related problem, birth preparedness, consultation, mother's knowledge on danger signs of pregnancy and childbirth, and delay time.

Data collection procedures

The data were collected by using face-to-face interviewer administered and pre-tested structured questionnaires. The questionnaire was partly adapted from the survey tools developed by JHPIEGO maternal and neonatal health program¹⁵. Initially, it was prepared in English. It was translated to the local language (Gammoto). The questionnaire was pre-tested on 20 respondents (5% of sample size) in Chenchu primary hospital which was one of unselected health facilities to ensure clarity, wordings, logical sequence and skip patterns of the questions. Based on the pretest, the time needed to complete an interview and the total number of days needed for data collection was estimated. An appropriate training for data collectors and supervisors that include a briefing on the data collection process of the study, discussing the contents of the questionnaire were carried out.

Data processing and analysis

The statistical software used in this study was the SAS version 9.4.

Generalized Estimating Equations (GEE)

The binary outcome variable maternal delay contains measured at visits 1, 2, and 3. Since measurements are taken from the same subject over time, observations cannot be considered as independent. For binary response, a linear mixed model was difficult to be fitted with the maternal delay as random effect, since the maternal was delayed ($Y_{ij}=1$) or not delayed ($Y_{ij}=0$). In this study, a GEE logistic regression model used for analyzing binary data because GEE models were useful for situations when the data are correlated¹⁶. GEEs were developed as a means of analyzing longitudinal data when correlation is present^{17, 18}. This method requires only the correct specification of working assumptions

about the correlations structure. One may assume independence, compound symmetry, unstructured and user defined correlation structure for modelling the correlation structure¹⁹. The comparison of empirical and model based standard errors for the parameter estimates obtained was performed based on the working correlation assumptions²⁰.

Suppose that Y_{ij} is a binary response, taking values of 0 (failure) and 1 (success), and it is of interest to relate changes in $E(Y_{ij})=Pr(Y_{ij}=1)$ to the covariates. Then a marginal model for the probability of success is related to the covariates by a logit link function (Fitzmaurice). Letting $Y_{ij}=1$ if the i^{th} mother is classified as delayed at the j^{th} visit, and $Y_{ij}=0$ if the i^{th} mother is not delayed at j^{th} visit, then the marginal probability of delayed at each visit follows the logistic model:

$$\log \left(\frac{\Pr(Y_{ij} = 1)}{\Pr(Y_{ij} = 0)} \right)$$

$$\begin{aligned} &= \beta_0 + \beta_1 * \text{religion} + \beta_2 * \text{mother's_occ.} + \beta_3 \\ &* \text{residence} + \beta_4 * \text{Mother's_educ.} + \\ &\beta_5 * \text{previous_pregnancy} + \beta_6 * \text{ANC_follow_up} + \\ &\beta_7 * \text{number of children} + \beta_8 * \text{decision_maker} \\ &+ \beta_9 * \text{birth_preparedness} + \beta_{10} * \text{mother's_} \\ &\text{knowledge} + \beta_{11} * \text{delay time} \end{aligned}$$

where $i=1, \dots, 391$; $j=1, 2, 3$

Ethical considerations

Before the study conducted ethical clearance obtained from Arba Minch University, College of Medicine and Health Sciences institutional review board with the reference number of CMHS/12033814/111. Written informed consent was obtained from study participants for those aged 18 and above. For those participants, less than 18 years of age written informed consent was obtained from a parent or guardian using standard disclosure procedures. The confidentiality and privacy of participants were actively protected.

RESULTS

Exploratory Data Analysis

In this study, a total of 391 mothers were included and the maternal delay was measured 3 times. The mean age of respondents was 29 years (range from 19 to 40 years). Table 1 exhibits some characteristics of respondents; out of the total 391 mothers, 266 (68.03%) were unemployed and 125 (31.97%) were employed. Most of the respondents, 339 (86.70%) were lived in rural and 201 (51.41%) of respondents' mothers were also illiterate. About 60 (15.35%) of the study mothers had previous pregnancy related problem and 331 (84.65%) were not experienced. In addition, 146 (37.34%), 108(27.62%), and 137 (35.04%) respondents were final decision makers for institutional delivery service utilization by husband, jointly and women respectively. Moreover, the majority of the mothers 239 (61.13%) had birth preparedness.

Table 1: Characteristics of study participants in selected rural districts in Gamo zone, 2019 of maternal delay data.

Variable	Category	Frequency (n)	Percentage (%)
Religion	Orthodox	229	58.57
	Protestant	162	41.43
Mother's occupation	Unemployed	266	68.03
	Employed	125	31.97
Husband occupation	Unemployed	248	63.43
	Employed	143	36.57
Residence	Urban	52	13.30
	Rural	339	86.70
Mother's education	Illiterate	201	51.41
	Literate	190	48.59
Paternal education	Illiterate	226	57.80
	Literate	165	42.20
Previous Pregnancy Related Problem	Yes	60	15.35
	No	331	84.65
ANC follow-up	Yes	333	85.17
	No	58	14.83
Final Decision Maker for Institutional Delivery Service Utilization	Husband	146	37.34
	Jointly	108	27.62
	Women	137	35.04
Birth Preparedness	Not well-prepared	152	38.87
	Well-prepared	239	61.13
Mother's Knowledge on Danger Signs of pregnancy and childbirth	Poor	182	46.55
	Good	209	53.45

Results of the Generalized Estimating Equations (GEE)

For the data from the maternal delay study, the estimated correlation is relatively modest assuming an exchangeable correlation, the estimated correlation is 0.124. The comparison of empirical and model based standard errors for the parameter estimates obtained was performed based on the working correlation assumptions (appendix, see Table 4). Exchangeability (compound symmetry) working correlation assumption was found to be more plausible, since the two standard errors were close.

Table 2: Tests of fixed effect of study participants in selected rural districts in Gamo zone, Southern Ethiopia, 2019.

Source	GEE Analysis		
	DF	Chi-Square	Pr > ChiSq
Religion	1	0.78	0.3765
Mother's occupation	1	9.15	0.0025
Residence	1	3.41	0.0647
Mother's education	1	2.64	0.104
Previous Pregnancy Related Problem	1	2.63	0.1046
ANC follow-up	1	0.38	0.5367
Number of Children	1	5.5	0.0191
Final Decision Maker	2	15.77	0.0004
Birth Preparedness	1	2.01	0.1566
Mother's Knowledge on Danger Signs.	1	4.47	0.0344
Delay Time	1	22.97	<.0001

Table 2 presents the score statistics for testing the fixed effect. It can be clearly seen that the p-value for covariates mother's occupation, number of children, final decision maker for institutional delivery service utilization, mother's knowledge on danger signs of pregnancy and childbirth and delay time were significant at 5% level of significance. However, variables religion, residence, mother's education, previous pregnancy related problem, ANC follow-up, and birth preparedness had no significant effect on maternal delay.

The parameter estimates, standard errors and p-values for the generalized estimating equations are depicted in Table 3. Based on the regression parameter estimates and empirical standard errors from the GEE with exchangeable correlation, there is the suggestion that the pattern of change in maternal delay differs by the mother's occupation group ($Z=3.05$, $P\text{-value}=0.002$). The unemployed mother had $\text{Exp}(0.5572)=1.75$ times higher odds of being maternal delay compared to employed. Similarly, mothers whose poor knowledge on danger signs of pregnancy and childbirth had $\text{Exp}(0.5216)=1.68$ times higher odds of being maternal delay as compared to good knowledge on danger signs of pregnancy and childbirth. The variable number of children has a positive, significant coefficient, meaning that between the two populations with different numbers of children, the population with the many numbers of children had a higher expected probability of maternal delay. The odds of being the husband decision maker for institutional delivery service utilization ($\text{Exp}(0.8006)=2.23$) times higher odds of being maternal delay compared to jointly. The negative coefficient for delay time indicates that the probability of maternal delay decreases as delay time increases.

Table 3: Parameter Estimates, St.Error, Wald, and p-value for GEE with an Exchangeable correlation of maternal delay data

Parameter	Variable	Estimate	St.Error	Wald	P-value
Intercept		-1.439	0.3618	-3.98	<.0001
Religion	Orthodox	0.1341	0.1514	0.89	0.376
	Protestant				
Mother's occupation	Unemployed	0.5572	0.1829	3.05	0.002
	Employed(ref.)				
Residence	Rural	0.47	0.261	1.8	0.072
	Urban(ref.)				
Mother's education	Illiterate	-0.218	0.1348	-1.61	0.106
	Literate(ref.)				
Previous Pregnancy Related Problem	Yes	-0.361	0.2206	-1.64	0.102
	No(ref.)				
ANC follow-up	No	0.144	0.2357	0.61	0.541
	Yes(ref.)				
Number of Children		0.1314	0.0544	2.42	0.016
Final Decision Maker	Husband	0.8006	0.2016	3.97	<.0001
	Women	-0.005	0.1949	-0.02	0.981
	Jointly(ref.)				
Birth Preparedness	Not well-prepared	0.3565	0.2473	1.44	0.149
	Well-prepared(ref.)				
Mother's Knowledge on Danger Signs.	Poor	0.5216	0.2394	2.18	0.029
	Good(ref.)				
Delay Time		-0.383	0.0797	-4.8	<.0001

DISCUSSION

The objective of this study was to assess the associated factors of the maternal delays for institutional delivery service utilization in Selected Gamo Zone Health Centres, Southern Ethiopia in 2019.

We found that the mean age of respondents was 29 years (range from 19 to 40 years). Out of the total 391 mothers, 266 (68.03%) were unemployed and 125 (31.97%) were employed. The GEE result showed that the mother's occupation, number of children, final decision maker for institutional delivery service utilization, mother's knowledge on danger signs of pregnancy and childbirth and delay time were found to be significantly associated with maternal delays.

The result of this study showed that the maternal delay in the utilization of institutional delivery service was significantly influenced by the occupation of the mother. Unemployed mothers were more likely to had maternal delays in the utilization of institutional delivery service than employed mothers. This finding is inconsistent with the study findings in Bahir Dar, Amhara region³. The study conducted at Jimma also showed that unemployed mothers have been delayed employed ones²⁷.

The present study shows that mothers whose poor knowledge on danger signs of pregnancy and childbirth more likely to experience the maternal delay of institutional delivery service as compared to those who had good knowledge. This finding in line with a study conducted in Tanzania²¹.

The variable number of children has a positive, significant coefficient, meaning that between the two populations with different numbers of children, the population with the many numbers of children had a higher expected probability of maternal delays. This finding is consistent with the findings from studies in Yem special district, Southern Ethiopia, Bangladesh and Nigeria²²⁻²⁴. This might due to women who have many numbers of children, develop experience and confidence on

child-birth, and hence might delay to utilize delivery services.

Final decision power about the place of delivery was found to be a strong predictor of institutional delivery. Mothers whose husband made decisions for institutional delivery service utilization were more likely maternal delay compared to mothers who decided with their husbands. This finding was also consistent with studies done in Hadya zone and Oromia in Holeta town^{25, 26}. Further, this study is similar to those of studies conducted in Bahir Dar, Amhara region and Yem special district, Southern Ethiopia^{3, 22}. This might be due to husband's dominance in decision making and hence, increase the risk of delay.

CONCLUSION

The maternal delay time is significantly determined by the mother's occupation, the number of children, final decision maker for institutional delivery service utilization, mother's knowledge on danger signs of pregnancy and childbirth and delay time. Therefore, due attention needs to be given to encourage unemployed mothers, promoting couples in involvement in decision making for institutional delivery service utilization, and creating awareness on danger signs of pregnancy and childbirth.

DECLARATIONS

Author Contributions

All authors contributed to data analysis, drafting and revising the article, gave final approval of version to be published and agree to be accountable for all aspects of the worker.

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Competing interests

The authors declare that they have no competing interest Availability of data and materials

Consent to publish

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Table 4: Regression: Model Based and Empirical Standard Errors for GEE with Exchangeable Correlation Estimated.

Variable	Empirical(St. Error)	Model Based(St. Error)
Intercept	0.3618	0.3453
Religion	0.1514	0.1531
Mother's occupation	0.1829	0.1767
Residence	0.261	0.2499
Mother's education	0.1348	0.1344
Previous Pregnancy	0.2206	0.212
ANC follow-up	0.2357	0.2268
Number of Children	0.0544	0.0518
Final Decision Maker	0.2016	0.1992
Delivery Service Utilization	0.1949	0.2037
Birth Preparedness	0.2473	0.2249
Mother's Knowledge on Danger Signs.	0.2394	0.2173
Delay Time	0.0797	0.0766

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