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Factors affecting institutional delivery in Ethiopia: A multi-level analysis

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ABSTRACT

Background: Childbirth is a complex process that requires the safest care to prevent maternal and neonatal complications. The proportion of births occurring at health institutions in Ethiopia is still below expected (26%), which significantly contribute to a large number of maternal deaths. Hence, identifying factors affecting institutional delivery is crucial.
Objectives: The main objective of this study was to assess factors affecting institutional delivery among women who had a live birth in Ethiopia within five years preceding Ethiopian Demographic and Health Survey 2016.
Method: The 2016 Ethiopian demographic and health survey data were used to identify factors associated with institutional delivery. As the data has nested structure, a multilevel logistic regression model was used for analysis by taking a nationally representative sample of 7193 women nested within 645 clusters.
Result: A significant heterogeneity was observed between clusters for institutional delivery which explains about 53.5% of the total variation. Individual-level variables: higher-level women education (AOR = 5.74; 95% CI 2.7–9.73), parity 5, and more (AOR = 0.39; 95% CI 0.32–0.49) and the number of ANC visit four and greater visit (AOR = 6.74; 95% CI 4.11–11.04) were significantly associated with institutional delivery. Community-level variables, Community media exposure (AOR = 1.80; 95% CI 1.31–2.4) and community antenatal coverage (AOR = 1.97; 95% CI 1.18–3.30) had a significant effect on institutional delivery.
Conclusion: The effort to promote institutional delivery should pay special attention to multiparous and less educated women.

1. Background

Childbirth is a complex process, and it is essential to remember to provide everything that is needed to ensure both the mother and newborn child receive the safest care (WHO (WHO), 2015b). According to WHO, globally up to 15% of births develop life-threatening complications during pregnancy, delivery, or the postpartum period (FMOH, 2013). Between 1990 and 2015, approximately 830 women died every day worldwide from maternal causes.

There is a great disparity in maternal mortality ratio between developing countries and developed countries. The probability that a 15-year-old woman will eventually die from a maternal cause was 1 in 4900 in developed countries versus 1 in 180 in developing countries (CWF, 2018). In 2015, 303 000 maternal death occurred globally out of which 66.3% (201 000) deaths were recorded in the sub-Saharan Africa region (Alkema, 2016) (see Table 1).

Almost 60 percent of African women give birth without a skilled attendant. Two in three women who need emergency obstetric care do not receive it (Alkema, 2016). Though each year 30 million women become pregnant, and about 250,000 of them die from pregnancy-related causes in Africa. Sub-Saharan Africa (SSA) had the highest neonatal mortality rate which is 27 deaths per 1,000 live births of which 75% die with in the first week of life (WHO, 2019).

In Ethiopia, based on national Maternal Death Surveillance and Response (MDSR) annual reports in 2015/16 about 633 mothers died due to maternal causes (WHO, 2017). There are improvements in

Abbreviations: ANC, Antenatal Care; CAPI, Computer Assisted Personal Interview; EA, Enumeration Area; EDHS, Ethiopian Demographic Health Survey; ICC, Intra-Class Correlation Coefficient; IESO, Integrated Emergency Surgery Obstetrics; MDSR, Maternal Death Surveillance and Response; MMR, Maternal Mortality Ratio; OR, Odds Ratio; PCV, Proportional Change Variation; PNC, Post Natal care; PHC, Population Health Census; WHO, World Health Organization.

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Table 1
Sociodemographic characteristics of women who had live births within five years preceding (EDHS) 2016, Ethiopia.

Socio demographic Characteristics (level 1)	N(%) un-weighted	N (%) weighted
Maternal age		
15–19	35 (4.98%)	339(4.47%)
20–29	3,509 (48.78%)	3,630(47.83%)
30–39	2,675 (37.19%)	2,867 (37.78%)
40–49	651 (9.05%)	753 (9.92%)
Place of Residence		
Urban	1,512 (21.02%)	968 (12.77%)
Rural	5,681(78.98%)	6,621 (87.23%)
Marriage		
Never married	58(0.81%)	56(0.74%)
Married	6662(92.62%)	7109 (93.66%)
Widowed	106 (1.47%)	95 (1.26%)
Divorced	367(5.1%)	330(4.35%)
Women Educational level		
No education	4,359(60.60%)	4,792(63.12%)
Primary	1,942(27.00%)	2,149 (28.32%)
Secondary	577(8.02%)	419 (5.53%)
Higher	315(4.38%)	230(3.02%)
Wealth index		
Poor	3,607 50.15	3306(43.55%)
Middle	1,028 (14.29%)	1,588 (20.93%)
Rich	2558 (35.56%)	2696(35.52%)
Media Exposure		
Not at all	4,646 (64.59%)	4,969 (65.47%)
less than once a week	951 (13.22%)	1,134 (14.95%)
At least once a week	1,596 (22.19%)	1,486 (19.58%)

maternal and child health care in Ethiopia. For example, the proportion of women who received antenatal care from a skilled provider has increased from 27% in 2000 to 34% in 2011, and 62% in 2016 (CSA, 2016). However, the proportion of births occurring at health institutions is below the expected (26%) which significantly contributes to a large number of maternal deaths 412 deaths/100,000 live births (CWF, 2018; Solomon, Mark, Merijn, Yilma, & Michael, 2013). Therefore this study was conducted to assess factors affecting institutional delivery among women age 15–49 that had a live birth in Ethiopia within five years preceding Ethiopian Demographic and Health surveys (EDHS 2016) by incorporating communal and individual-level factors.

2. Methods

A cross-sectional study using the 2016 EDHS data was conducted. According to the 2007 population and housing census (PHC), there were 84,915 enumeration areas/clusters in Ethiopia of these 67,730 were rural clusters and 17,185 were urban clusters and a total of 15,411 559 households were counted. An Enumeration Areas (EA) is a geographic area that covers an average of 181 households. These enumeration areas were used as a sampling frame for the 2016 EDHS survey which survey was conducted from January 18, 2016, to June 27, 2016, in all the nine regions and two administrative councils of Ethiopia (CSA, 2016). The study population for this research was childbearing age women who gave birth five years before EDHS 2016 survey within selected enumeration areas or clusters. The sample was stratified and selected in two stages. Each region was stratified into urban and rural areas which have 21 strata. The proportional allocation was achieved at each of the lower administrative levels by sorting the sampling frame within each sampling stratum before sample selection, according to administrative units at different levels, and by using a probability proportional to size selection at the first stage of sampling.

In the first stage, a total of 645 EA (202 EAs in urban areas and 443 EAs in rural areas) were selected with probability proportional to the EA size from a complete list of 84,915 enumeration areas (Abera et al., 2014) created for the 2007 PHC. After the selection of 645 EAs household listing operation was carried out from September to December 2015. In the second stage of selection, a fixed number of 28 households per cluster were selected. All women age 15–49 years were included in the sample.

2.1. Patient and public involvement

No patient involved.

2.2. Variables of the study

2.2.1. Dependent variables

Place of delivery.

2.2.2. Independent variables

Socio-economic and demographic characteristics: age, marital status, educational level, wealth index and residence.

Maternal characteristics: parity, Duration of pregnancy, time at 1st ANC visit (month), number of ANC visit, pregnancy wanted, history of miscarriage/abortion/stillbirth, media exposure.

Second level communal factors: Community ANC coverage, community women education, Community poverty status, community media exposure.

History of miscarriage/abortion/stillbirth: any death/interruption of conception/fetus/before any sign of live births.

2.3. Operational definition

Community antenatal coverage: The proportion of women age 15–49 in the EA/clusters who received at least one antenatal care (ANC) from a skilled provider during the pregnancy of last delivery (and the coverage considered low coverage (if aggregated value ≤65%) and (high if ≥ 66%).

Community wealth status: the proportion of households who are beyond the middle-level wealth quintile within the community. If aggregated values >50% label as high or wealthiest community, if values ≤50% label as poor community.

Community-women education: the proportion of women with a minimum of primary level of education (high or educated community if mean value ≥40%, low if mean value ≤39%).

Community media exposure: the proportion of women exposed to at least one media source out of three (television, radio, or newspaper) per week within clusters (if aggregated values with cluster ≥35.4% =high, if values ≤35.3% label as low).

Institutional delivery: is defined as the number of women who gave birth in a health facility under the supervision of skilled birth attendants.

2.4. Data collection

A research proposal was submitted to the MEASURE Demographic and Health Surveys (DHS) program to use the survey datasets; data were accessed from the database following the approval and were used only for the registered research. Women aged 15–49 in selected households were interviewed using tablets computers in 2016 EDHS. Computer-assisted personal interviewing (CAPI) data collection systems were employed by trained data collectors. Electronic data files were transferred to the CSA central office.

For variable selection, the DHS7 record manual and guide were used. Selected variables filtered using STATA version 14 commands.

2.5. Data analysis technique

Since EDHS data are hierarchical; households are nested within the community, this violates the assumption of flat models; the assumption of independence among individuals within the same community and the

assumption of equal variance across the community are violated in the case of nested data. Therefore the use of flat models could underestimate standard errors of the effect sizes and leads to bias (loss of power or type I error), which consequently can affect the decision on the null hypothesis.

Therefore to account for the hierarchical nature of the EDHS data, a multilevel logistic regression model was used to analyze and test the effect sizes of individual and community-level factors on women's decision to place of delivery.

During analysis, the characteristics of women were taken as individual level (level-1) and characteristics of clusters were treated as community level (level-2).

$$\text{Logit}(p) = \log(p/1-p) = \beta_{0j} + \beta_{1j}X_{1ij} + \beta_{2j}X_{2ij} + \ldots\ldots\beta_{qj}X_{qij}$$

Since $B_{0j} = \gamma_{00} + \gamma_{0s}Z_{sj} + u_{0j}$

$$B_{qj} = \gamma_{q0}X_{qij} + \gamma_{qs}Z_{sj}X_{qij} + u_{qj}X_{qij}$$

$$\text{Or Logit}(p) = \gamma_{00+}\gamma_{0s}Z_{sj} + \gamma_{q0}X_{qij} + \gamma_{qs}Z_{sj}X_{qij} + u_{0j} + u_{qj}X_{qij}$$

where we have *"q"* explanatory variables at the lowest level and *"s"* explanatory variables at the highest level,

j = subscript indicates that this case belongs to the *j*th group
ij = subscript indicates that *i*th individual within *j*th group
γ_{00} = the overall intercept (fixed part)
B_{oj} = is the random intercept varying at the community level (group-specific intercept)
Level one employs β s, while level two employs γ s regression coefficient
U_{0j} = Error term of the intercept or deviation from the average intercept
U_{qj} = Error term of slope β_{qj} or deviation from average slope βq due to level-2 explanatory variable Z_{sj}

The intercept γ_{00} and slopes γ_{0s} and γ_{qs} are fixed effects whereas u_{oj}, u_{qj} are random effects of level-2.

To test random variability and to estimate the intraclass correlation coefficient (ICC), we fitted Model I (Empty model) without explanatory variables (Alhaj et al., 2019).

$$\text{The intra-class correlation (Alhaj etal.)}\ \rho = \frac{\sigma 2\text{uo}}{\frac{\pi^2}{3} + \sigma 2\text{uo}}$$

where σ^2_{uo} = variance due to group-level error term (u_{oj}) and $\pi^2/3$ is level-1 variance.

Model II, Model III and Model IV examined the effects of individual-level, community-level and both individual and community level characteristics respectively. Variables with a p-value of <0.25 in the bivariable analysis were used in the multivariable regression model. Log-likelihood was used to compare the best-fitted model to the data among the four models. AOR with its 95% CI was taken as a statistically significant association with the outcome variable. The p-value < 0.05 was considered statistically significant.

3. Results

3.1. Description of individual-level characteristics

Among women who had ANC visits, 56.5% of them took their visit during the second trimester and from all births, 73.4% of the women wanted to get pregnant for their last child before they give birth. The majority of the women practice home delivery (66.7%) (Table 2).

Table 2
Maternal and community characteristics of women who had live births within five years preceding (EDHS) 2016, Ethiopia.

Maternal Characteristics(level 1)	N(%) un-weighted	N (%) weighted
Parity (live children ever born)		
1	1,470 (20.44%)	1,434 (18.90%)
2–4	3,090 (42.96%)	3,189 (42.02%)
5 or more	2,633 (36.61%)	2,966 (39.08%)
Pregnancy wanted for last delivery		
Wanted	5,741 (79.81%)	5,574(73.43%)
Wanted later	991 (13.78%)	1,321(17.41%)
Wanted no more	461(6.41%)	695(9.16%)
Number of ANC visit during last delivery		
No visit	2,481(34.49%)	2,818(37.13%)
One Visit	342 (4.75%)	335 (4.41%)
Two-Three Visit	1,750(24.33%)	2,007(26.45%)
Four and greater Visit	2,620 (36.42%)	2,429(32%)
Time of 1st ANC checkup for last delivery (in month)		
First trimester	1,813(38.48%)	1,549.7439 (32.48%)
Second trimester	2,460(52.21%)	2,694.9504 (56.48%)
Third trimester	412(8.74%)	495.370184 (10.38%)
Don't know	27 (0.57%)	31.4308978 (0.66%)
Ever had terminated pregnancy (Abortion, stillbirth and miscarriage)		
No	6,556 (91.14%)	6,909.5643(91.04%)
Yes	637(8.86%)	680.206206(8.96%)
Place of delivery		
Home	4,395(61.10%)	5,066.281 (66.75%)
Institution	2,798(38.90%)	2,523.4896 (33.25%)
Level two characteristics	**Delivery**	
	Home (%)	**The institution (%)**
Community women education		
Low	3,688(8.6%)	879(11.6%)
High	1,378(18.2%)	1,644(21.66%)
Community Wealth/poverty		
Low	2,391(31.50%)	556(7.32%)
High	2,675(35.3%)	1,968(25.92%)
Community Media exposure		
Low	3,688(48.60%)	982(12.93%)
High	1,378(18.16%)	1,541(20.31%)
Community ANC coverage		
Low	3,391(44.7%)	583(7.67%)
High	1,675(22.07%)	1,941(25.57%)

3.2. Multilevel logistic regression analysis

3.2.1. Individual-level effects

Women's educational level, residence, parity and antenatal visit significantly affect delivery in the health facility. Women who had primary education were 1.61 times (95% CI: 1.35–1.90) more likely to give birth at health institutions as compared to those who had no education. The institutional delivery of women aged 20–29 years decreased by 40% (AOR = 0.60; 95% CI 0.42–0.85) as compared to women aged between 15 and 20 years. Women of parity 2–4 have lower odds of delivering at health institution than women of parity one, that is (AOR = 0.42; 95% CI: 0.34–0.52) and women of parity 5 and more are less likely to give birth at a health facility (AOR = 0.45; 95% CI: 0.33–0.60) as compared to women of parity one. Women who live in rural residences have a lower likelihood of using health care facilities for delivery as compared to women who live in urban (AOR = 0.15; 95% CI: 0.09–0.24). Women who had two to three visits were 3.55 times (95% CI: 2.58–4.88) and those who had 4 and more visits 3.67 times (95% CI: 2.52–5.36) more likely to give birth in a health facility as compared to those who had no visit during pregnancy (Table 3).

Table 3
Multilevel logistic regression analysis of individual and community-level factors.

Individual-level factors	Null Model I	Model IIAOR (95%CI)	Model III AOR(95%CI)	Model IV AOR (95%CI)
Maternal age				
15–19 years (R_f)	–	1		1
20–29 years	–	0.72 (0.51–1.002)		0.60 (0.42–0.85)*
30–39 years	–	0.79 (0.54–1.16)		0.64 (0.42–0.94) *
40–49 years	–	0.44 (0.28–0.70) **		0.36 (0.22–0.58) **
Marriage				
Never married (R_f)		1		
Married		1.003 (0.47–2.13)		
Widowed		0.52 (0.18–1.50)		
Divorced		0.64 (0.29–1.45)		
Women Educational level				
No education (R_f)		1		1
Primary		1.56 (1.33–1.85) **		1.61 (1.35–1.90) **
Secondary		3.98 (2.75–5.76) **		4.37 (3.00–6.35) **
Higher		5.05 (2.69–9.49) **		5.70 (2.97–10.92) **
Residence				
Urban(R_f)		1		1
Rural		0.087 (0.056–0.13) **		0.15 (0.09–0.24) **
Wealth Index				
Poor(R_f)		1		
Middle		1.15 (0.96–1.37)		
Rich		1.32 (1.08–1.60) *		
Media exposure				
Not at all(R_f)		1		
Less than once per week		1.03 (0.84–1.24)		
At least once a week		1.12 (0.90–1.39)		
Parity				
1(Rf)		1		1
2–4		0.41 (0.33–0.50) **		0.42 (0.34–0.52) **
Five and more		0.42 (0.32–0.55) **		0.45 (0.33–0.60) **
Last delivery wanted				
Wanted(Rf)		1		
Wanted later		0.96 (0.79–1.16)		
Wanted no more		1.16 (0.89–1.51)		
Number of ANC visit				
No visit(R_f)		1		1
One visit		1.87 (1.30–2.70) **		1.26 (0.73–2.18)
Two-three visit		4.37 (3.57–5.34) **		3.55 (2.58–4.88) **
4 and More than four visit		7.02 (5.76–8.56) **		3.67 (2.52–5.36) **
Community women education				
Low(R_f)			1	
High			2.64 (1.90–3.66) **	
Community wealth				
Low(R_f)			1	
High			1.68 (1.22–2.33) *	
Community Media exposure				
Low(R_f)			1	1
High			2.70 (1.95–3.74) ***	1.86 (1.32–2.64)* **
Community antenatal coverage				
Low(R_f)			1	1
High			6.79 (4.93–9.37) **	1.98 (1.27–3.11) *
Cross level interaction	**Null Model I**	**Model II**	**Model III**	**Model IV**
ANC visit #Com ANC coverage				
One visit # high				2.34 (1.08–5.08) *
Two-three visit # high				1.69 (1.05–2.73) *
More than four visit # high				3.17 (1.86–5.38) **
Random Part	**Null Model I**	**Model II**	**Model III**	**Model IV**
Var(con) (σ^2_{u0})	3.78	1.43	1.34	0.72
Var (ANC visit) (σ^2_{u1})	–	–	–	0.12 (0.08–0.19)
Var(Parity) (σ^2_{u2})	–	–	–	0.12 (0.07–0.20)
ICC	53.5%	30.3%	28.9%	17.9%
PCV	Rf	62.2%	64.1%	81%
Model Fitness	**Null Model I**	**Model II**	**Model III**	**Model IV**
Log likelihood	−3699.1	−3070.7	−3478.3	−2985.1
AIC	7402.2	6187.4	6968.6	6012.1

Notes: *$p < 0.05$; ***$p < 0.001$, Rf = Reference category, Confidence intervals are in parenthesis

3.3. Community-level effects

Women living in communities with a high concentration of antenatal uptake are1.98 times to giving birth at the facility than women living in communities with low antenatal care coverage. Concerning media exposure women living in communities with a high concentration of media exposure have 1.86 higher odds of giving birth at the facility than women living in communities with a low concentration of media exposure (95% CI: 1.32–2.64).

3.4. Random effects and cross-level interaction

The intra-class correlation coefficients for institutional delivery nearly halved when individual-level factors were taken into account in the model (Table 3). About 62.2% of variations in institutional delivery were explained by adding lower-level variables to the model. Both lower and higher-level variables in the last model (model IV) explain 81% of the variation of institutional delivery as indicated by the proportional

change variation coefficient.

4. Discussion

This study demonstrates that the probability of giving birth in health facilities was higher for women living in urban communities than women living in rural communities and supported by other studies (Tsegay, Aregay, Kidanu, Alemayehu, & Yohannes, 2017; Worku, Jemal, & Gedefaw, 2013). Access to health facilities in rural areas is more difficult than in urban areas because of distance and low accessibility of appropriate health facilities (CSA, 2016). This may be probably due to improper implementation of health extension program in rural area as evidenced by a study in Tigray (Medhanyie et al., 2012).

Women whose age is above 19 years were less likely to use institutions for childbirth as compared to younger women aged between 15 and 19. This inverse relation of maternal age and institutional delivery was also supported by studies (Lwelamira & Safari, 2012; Tadele & Lamaro, 2017; Teferra, Alemu, & Woldeyohannes, 2012). This might be because of the fear of younger women's child birth-related complications.

The result of these studies showed that women who had one and more antenatal visits were more likely to give birth at health institutions which are supported by previous studies (Mekonnen, Lerebo, Gebrehiwot, & Abadura, 2015; Sagna & Sunil, 2012; Shimazaki, Honda, Dulnuan, Chunanon, & Matsuyama, 2013; Singh, Kumar, Rai, & Singh, 2013; Weldemariam & Welday, 2018). This indicated that health promotion and disease prevention measures are given to pregnant women during antenatal care which in turn promote institutional delivery (WHO, 2015a).

Primiparous women have a higher tendency of using institutional delivery than women of more than one parity. These results are consistent with other findings (Tekelab, Yadecha, & Melka, 2015; Tsegay et al., 2013; Worku et al., 2013). Risk perception of first pregnancy could increase the use of obstetric health services (Waters, McQueen, & Cameron, 2013).

Similar to different studies (Kruk et al., 2015; Mekonnen, Lerebo, Gebrehiwot, & Abadura, 2015; Tekelab, Yadecha, & Melka, 2015; Weldemariam & Welday, 2018; Worku et al., 2013) women's education has a strong influence on institutional delivery in this study. Attending higher education increases the odds of giving birth at the health institution. It could be associated with knowledge of pregnancy-related complications, increases awareness of maternal health care, and decision-making power of the women (Namdeo, 2017).

This study found that women residing in communities with a high concentration of media exposure were found to have a higher chance of institutional delivery than women residing in communities with low media exposure. The likelihood of institutional delivery among women living in communities with a high antenatal care utilization was higher than women living in communities with a low antenatal care utilization which is supported by other studies (Mekonnen et al., 2015; Sagna & Sunil, 2012). This shows community maternal health services utilization influences women's health service utilization which could be considered as a re-enforcing factor for institutional delivery.

To conclude, the result showed that institutional delivery in Ethiopia operates at multiple levels indicating the need of addressing individual and household levels factors.

5. Limitation of the study

As a limitation, this study uses clusters as the higher-level unit of analysis, yet the numbers of individual women within some clusters were too small to create aggregated community characteristics for the cluster. There is still a significant unexplained variation of the model. Due to data limitations, a measure of distance to health care facilities was not taken into account in this study, which would be more appropriate to explain the community-level variance of institutional delivery.

6. Authors' contributions

AG contributed to the design of the study, analysis, interpretation and writes up of the manuscript. GDK, YB and BM contributed to the design of the study, drafting and edition of the manuscript. All authors critically revised the manuscript and have approved the final manuscript.

7. Ethics approval

Data accessed from MEASURE DHS database at http://dhsprogram.com/data/available datasets.cfm after getting permission to use the dataset from DHS program. As the study used secondary data ethical approval and participant consent were not applicable. However, we obeyed the terms and conditions of data sharing policy; data kept confidential, used for the current study only and was not passed to other researchers.

8. Consent for publication

Not applicable.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijans.2021.100331.

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