

Factors Associated with Protection of Last Live Birth against Neonatal Tetanus among Mother Age 15-49 in Ethiopia: A Multilevel Analysis Using EDHS 2016

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Research article

Keywords: Protected at birth against neonatal tetanus, Factor associated, Context, EDHS 2016

Posted Date: June 18th, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-27865/v1>

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Abstract

Background

Ethiopia has the highest neonatal tetanus mortality and morbidity rates in the world due to low TT immunization coverage coupled with the high amount of deliveries taking place at home. This study aimed to identify individual and community-level factors associated with protections of last live birth against neonatal tetanus among mothers age 15–49 in Ethiopia.

Methods

The P-value of less than 0.05 in the final model was considered as statistically significant. The interclass correlation coefficient and proportional change in variance were used to quantify the magnitude of the general contextual effect. The relative goodness-of-fit test was conducted using Akaike's information criterion.

Result

Home delivery (AOR = 0.83; 95% CI: 0.72, 0.96), at least one ANC visits (AOR = 12.35; 95% CI: 10.42, 14.62) and wealth index (poorer (AOR = 1.27, 95% CI: 1.04, 1.54) and richer (AOR = 1.53, 95% CI: 1.21, 1.93). were the individual factors that had an association with the utilization of protection of last live birth against neonatal tetanus.

Conclusions

Utilization of protection of last live birth against neonatal tetanus is affected both by the individual and community level factors with high state variation.

Background

Tetanus is a bacterial disease caused by the bacterium *Clostridium tetani* that disease cannot be eliminated as *C. tetani* spores exist in the environment[1]. Globally, an estimated 3.3 million neonatal deaths occur each year and about 9,000 babies die each day of which neonatal tetanus shares a high number of death in developing countries where home delivery is common[2]. The immunization of pregnant women or women of childbearing age with two or above doses of tetanus toxin (TT) vaccination may reduce the neonatal tetanus mortality by 94% [3]. In about 25 countries neonatal tetanus is still a major public health problem, mainly in Africa. However, the utilization of the intervention, like TT immunization remains low in the Sub-Saharan African countries [2].

Ethiopia has the highest neonatal tetanus mortality and morbidity in the world due to low TT immunization coverage and a high amount of deliveries taking place at home in unsanitary conditions[4]. In Ethiopia, only 49% of the pregnant mothers received two and above tetanus toxin doses in 2016 [5].

There are some studies concerning protections of neonatal tetanus undertaken in Ethiopia in different settings. However, these studies were analyzed using single-level analysis which does not consider the hierarchical structure of the data and are limited in scope and context.[6–11]. Therefore; this study aimed to assess the individual and community level factors associated with protections of last live birth against neonatal tetanus among mothers in Ethiopia using multilevel analysis of the Ethiopia Demographic and Health Survey (EDHS) 2016 data. The EDHS data has a nested structure which makes it best suited for multilevel analysis.

Methods

The data for this study was extracted from the 2016 Ethiopia DHS [12]. The EDHS was conducted in all regions of Ethiopia, Ethiopia has nine geographical regions and two administrative cities [13]. The study population was all mothers of the reproductive age group who had given birth in the last 5- years before the EDHS 2016.

Measurements

Protection of last live birth against Neonatal Tetanus was the dependent variable and was dichotomized in to “protected” or “not protected”. Protected at birth was measured when mothers during pregnancy had received ≥ 2 TT dose unless considered as not protected at birth. The independent variables includes individual factors (socio-demography variables, and obstetric history) , community factors (place of residence, region, community media exposure, community poverty). Community media exposure was categorized as “exposed” if the proportion of women in the community exposed to media was $\geq 19.35\%$ and unless categorized as “not exposed” to media. Community poverty status was defined as the proportion of poor or poorest mothers was and classified as “high” if the proportion of women was $\geq 25\%$ and as “low” if the proportion was 0-25%. Community-women education was classified as high if the proportion of women in a community attending at least primary-school and above was $\geq 33.3\%$ and as low if the proportion was 0-33.3%.

Statistical Analysis

The analysis was done using STATA version 14. Frequencies and percentages were used to describe the categorical variables. Multilevel binary logistic modeling was used to assess the associated factors with the dependent variables. The multilevel model involves two levels (individuals nested in communities). Four models (model I-IV) were fitted. Model I (null model) was run to test the inter-group (community) variability on neonatal tetanus and to decide whether the data is fit for multilevel modeling or not. Model II includes individual-level factors only. Model III includes community-level factors only. Model IV includes the mixed model with both individual and community level factors. The model has a fixed or deterministic part and the random part. Proportional Change in Variance (PCV) and Intra-class Correlation Coefficient (ICC) were calculated and compared between each models. Information Criteria (AIC) was used to compare and select the model that best fits the data [14].

Results

Characteristics of the study subjects

This study extracted a total weighted sample of 7193 mothers age 15-49 (individuals) nested within 643 EAs (communities) from the EDHS 2016. The median ages of women nested per community were 28. Out of 4359 not educated women's, 1445(34.9%) of them were protected their last live birth against neonatal tetanus. Most, 1797(63.2%) poorest women were not protected their last live birth against neonatal tetanus. Out of 4712 mothers, 2753 (56.9%) of them were visits health facility and protected their last live birth against neonatal tetanus (**Table 1**).

Characteristics of the community

This study included 643 clusters in which all the mothers among the age group of 15-49 years had lived. Out of 5,679 rural resident women, 3587(61.3%) of them were not protected their last live birth against neonatal tetanus. Above six out of ten 3650(64.2%) of the clusters were from communities with a low proportion of media exposure and not protected their last live birth against neonatal tetanus. About half 1508(49.3%) of the clusters were from communities with a high proportion of women education. About 1808(56.3%) were from communities with high proportion of community poverty.

The proportion of last live birth protection against neonatal tetanus was 43.8% in Ethiopia of which Afar and Gambela were the least protected (**Fig 1**).

Contextual factors associated with the protection of last live birth against neonatal tetanus

In this final fixed-effect model where both individual and community-level factors are adjusted, ANC visits of mothers, wealth status and place of delivery of mothers from individual-level factors whereas region and community media exposure from community-level factors were associated factors with protected last live birth against neonatal tetanus (**Table 2**).

Random effect results

The random effects were explained in terms of the ICC and PCV. The community variation in the odds of protection of last live birth against neonatal tetanus has continued to be statistically significant ($V_0 = 0.28, p < 0.001$). The ICC found from this mixed model showed that 7.89% of the total variance in the odds of neonatal tetanus could be attributed to community characteristics. A PCV of 74.33% implies that 74.33% of the variation in the log-likelihood of protection of last live birth against neonatal tetanus between communities was explained by both individual and community level variables included in the model.

Discussion

This study aimed to identify both the individual and community level factors of protection of last live birth against neonatal tetanus based on the data from EDHS 2016. ANC visit, wealth status and place of delivery were individual-level factors that associated with protection of last live birth against neonatal tetanus in Ethiopia. The community-level variables that could explain the variation in the protection of neonatal tetanus among communities were regional variation and community media exposure.

The current study revealed that women's who utilized ANC had higher odds protection of last live birth against neonatal tetanus than those women who had not utilized ANC visits. This is similar with studies conducted in SNNP of Ethiopia, Northern Ethiopia and Eastern Ethiopia [8–10]. This might be due to health professionals provide women who come to health facilities for ANC visits with health education including the advantages and schedule of mother's vaccination.

The odds of neonatal tetanus were higher among mothers having wealth of richer than women's having poorest wealth status. This is in line with studies conducted in north India, Pakistan[15, 16] and Ethiopia [12, 13]. This could be due to the reason that having good income uses to get health access and more informed to the health facility to get tetanus vaccination.

This study shows that women who gave birth at home were less likely to protect their last birth as compared to those mothers who have given birth at the health facility. This is similar to the Indonesian, Pakistan, and Ethiopia study's [9, 16, 17]. The possible reason might be because of the opportunity for health education and advice and the provision of the mother with at least the first dose of TT just immediately after delivery procedures.

Region of residence was revealed to be a significant predictor of neonatal tetanus in the current study. Mothers from Oromia, Hariri, and Diredawa regions had higher odds of protections of neonatal tetanus as compared to those from the Addis Ababa region. Tigray region had lower odds of protection of last live birth against neonatal tetanus. The reason could be due to geographical difference and access of health service as of studies in Africa [18, 19]. Another reason might be due to a lack of uniform performance commitment to implement Tetanus Toxoid vaccination services in all regions of the country.

The odds of protections of last live birth against neonatal tetanus were higher in those who were from a community with a low proportion of media utilization. This finding is similar to the study conducted in Sub-Saharan African countries [8, 9, 20]. This might be due to media programs play a great role in delivering information for the large population.

Conclusions

This study found that both the individual and community level factors determine the protections of last live birth against neonatal tetanus in Ethiopia. At an individual level,ANC utilization, place of delivery and wealth status of the household was significantly associated with neonatal tetanus. At community-level,regional variation was significantly associated with neonatal tetanus. Therefore, addressing both the individual and community level factors, improving access, quality of antenatal and delivery service is

important. A specific region like the Afar region needs also a special support from the Ministry of Health to improve coverage of TT vaccination.

Limitations

In this study, there was a problem of missing observations. Even some variables were totally with missing observations. DHS data has no cluster level weighting. Therefore, better to consider this in interpretation of this study finding.

Abbreviations

AIC: Akaike Information Criterion; AOR: Adjusted Odds Ratio; AUC: Area under the ROC curve; ANC: Antenatal Care; BIC: Bayesian information criteria; COR: Crude Odds Ratio; CSA: Central Statistical Agency; EA: Enumeration Area; EDHS: Ethiopian Demographic and Health Survey; HEW: Health Extension Worker; ICC: Intra – Class- Correlation -Coefficient; NT: Neonatal Tetanus; PCV: Proportional Change in Variance; ROC: Receiver Operating Characteristics and TT: Tetanus Toxin.

Declarations

Ethics approval and consent to participate

For DHS data, ethical approval has obtained from the individual national institution's review board and by ICF international institutional review board for women. We obtain permission to use the data from the DHS program and the data set used for this study is available from www.dhsprogram.com.

Consent for publication

Not applicable.

Availability of the data and materials

The data set used for the current study available from <https://www.dhsprogram.com>.

Competing interests

The authors declare that they have no competing interests.

Funding

No funding was obtained for this study.

Author's contributions

GK, GF, AB, KA and RShad made substantial contributions to the conception and design of the study. GK has designed the study, participated in analysis, interpretation, and write-up, drafted the manuscript and critically revised it. GF and AB has participated in study design, analysis, interpretation, and critically

revised the manuscript. KA and RS participated in the reanalysis of the study findings, interpretation, and critically revised the manuscript. All authors read and approved the final manuscript.

Acknowledgment

We greatly acknowledge the DHS program for the data used in this study was obtained from <https://www.dhsprogram.com>.

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Tables

Table 1: Distribution of protection of last live birth against neonatal tetanus by individual-level characteristics of mothers age 15-49 in Ethiopia, EDHS 2016 (n=7193)

Individual variable	Protection of neonatal tetanus (%)		Total, n(%)
	Protected, n(%)	Not protected, n(%)	
Maternal age			
15-19	156(42.3)	202(57.7)	358(100)
20-29	1553(43.4)	1956(56.6)	3509(100)
30-39	1071(40.4)	1603(59.6)	2674(100)
40-49	210(31.6)	442(68.4)	652(100)
Maternal education			
No education	1445(34.9)	2914(65.1)	4359(100)
Primary	1010(49.1)	932(50.9)	1942(100)
Secondary	333(59.5)	244(40.5)	577(100)
Higher	202(61.6)	113(38.4)	315(100)
Maternal employment status			
Not employed	534(36.8)	900(63.2)	1434(100)
Nonagricultural	836(47.8)	846(52.2)	1682(100)
Agricultural	1620(40.0)	2457(60.0)	4077(100)
Wealth index			
Poorest	631(30.6)	1797(69.4)	2428(100)
Poorer	479(37.3)	700(62.7)	1179(100)
Middle	431(38.7)	597(61.3)	0281(100)
Richer	459(47.2)	485(52.8)	944(100)
richest	990(55.7)	651(44.3)	1641(100)
Place of delivery			
Home	1363(34.2)	3032(65.8)	4395(100)
Health facility	1627(54.9)	1171(45.1)	2798(100)
Marital status			
Living together	2783(41.1)	3937(58.9)	6720(100)
Not living together	207(39.8)	266(60.2)	473(100)
ANC visit			
None	237(14.3)	2244(85.7)	2481(100)
At least one visits	2753(56.9)	1959(43.1)	4712(100)
Mode of delivery			
No	2819(40.6)	4118(59.4)	6937(100)
Yes	146(61.4)	115(38.6)	261(100)
Parity			
<=2 children	1407(45.7)	1539(54.3)	2946(100)
3-4 children	814(39.7)	1202(60.3)	2016(100)
>4 children	769(36.8)	1462(63.2)	2231(100)

Table 2: Individual and community-level factors associated with protections of last live birth against neonatal tetanus among mothers age 15-49 in Ethiopia, EDHS 2016 (n=7193)

Individual-level variables	Protection of neonatal tetanus frequency (%)			
	Protected	Not protected	Bivariate result (COR [95%CI])	Multivariable-Model 4 (AOR [95%CI])
Wealth index				
Poorest	631(30.6)	1797(69.4)	1	1
Poorer	479(37.3)	700(62.7)	1.77 [1.48, 2.11]***	1.27 [1.04, 1.54]*
Middle	431(38.7)	597(61.3)	1.93 [1.59, 2.32]***	1.22 [0.99, 1.52]
Richer	459(47.2)	485(52.8)	2.75 [2.26, 3.35]***	1.53 [1.21, 1.93]***
Richest	990(55.7)	651(44.3)	4.20[3.48, 5.07]***	1.22 [0.94, 1.58]
Place of delivery				
Health facility	1627(54.9)	1171(45.1)	1	1
Home	1363(34.2)	3032(65.8)	0.36 [0.32, 0.41]***	0.83 [0.72, 0.96]**
ANC visit				
No ANC visit	237(14.3)	2244(85.7)	1	1
At least one ANC visit	2753(56.9)	1959(43.1)	14.42 [12.25, 16.97]***	12.35[10.42, 14.62]***
Community variables				
Region				
Addis -Ababa	229(61.7)	146(38.3)	1	1
Tigray	298(41.2)	474 (58.8)	0.35[0.23, 0.54]***	0.55 [0.38, 0.79]**
Afar	151(28.1)	496(71.9)	0.15[0.97, 0.24]***	0.78[0.51, 1.18]
Amhara	265(35.7)	499(64.3)	0.31 [0.21, 0.48]***	0.83 [0.56, 1.21]
Oromo	417(41.4)	614(58.6)	0.43 [0.27, 0.61]***	1.54 [1.06, 2.23]*
Somali	254(32.2)	552(67.8)	0.23 [0.15, 0.35]***	1.38 [0.93, 2.05]
Benishangul-Gumuz	250(44.4)	326(55.6)	0.40 [0.29, 0.72]**	1.23 [0.82, 1.84]
SNNPR	395(44.3)	498(55.7)	0.48 [0.32, 0.73]**	1.15 [0.79, 1.66]
Gambela	228(49.2)	306(50.8)	0.46 [0.29, 0.72]**	1.39 [0.94, 2.08]
Harari	267(63.9)	114(36.1)	1.42 [0.87, 2.31]	2.54 [1.69, 2.42]***
Diredawa	384(63.3)	148(36.7)	1.02 [0.63, 1.65]	1.62 [1.09, 2.42]*
Community media exposure				
High	862(51.0)	553(49.0)	1	1
Low	2128(35.8)	3650(64.2)	0.31 [0.26, 0.37]***	0.79 [0.65, 0.96]*

NB: * = p<0.05; ** = p<0.01; *** = p<0.001; ANC = Antenatal Care; AOR = Adjusted Odds Ratio; CI = Confidence Interval; COR = Crude Odds Ratio; SNNPR = Southern Nations Nationalities and Peoples Region; 1= Reference.

Figures

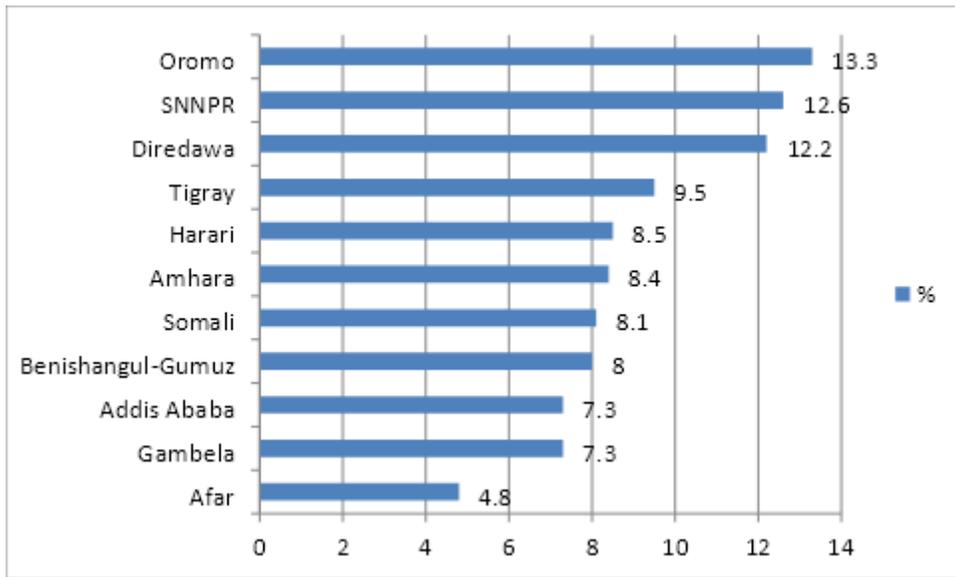


Figure 1

Proportion of last live birth protection against neonatal tetanus among regions of Ethiopia, EDHS 2016 (n=7193)