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Title: Prevalence and associated factors of under-five mortality in Ethiopia: further analysis of Ethiopian Mini Demographic and Health Surveys 2019

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Abstract

Introduction: Over decades, much have been said and done regarding under-five mortality in Ethiopia. The country has been following the lead of sustainable development goals and UNICEF with its transformation plan targets. However, unless the efforts supported by status assessing studies, it might be difficult for the country to progress. Thus, the current study was directed to identify prevalence and associated factors of under-five mortality in 2019.

Methods: According to the study criteria, we extract and cleaned data in STATA v. 15.0. The data then weighted as per the sampling weight, primary sampling unit, and strata before analyzing in STATA 15.0. Data management consisted of descriptive (mean, standard deviation, and proportion or percent) and association statistics. Binary logistic regression was deliberated for this analysis and we checked each variable at 0.25 p-values to include in the model. The final p-value to declare association was p <0.05 and AOR with 95% CI was also applied to describe the results. The data source was Ethiopian Mini Demographic Health Survey (EMDHS) 2019. EMDHS collected the data from 8,885 in a face-to-face manner with 99% response rate.

Results: From 5,527 numbers of weighted women with under-five analysed in this study, the proportion of under-five mortality was 277.23(5.02%). Factors like 2nd birth order 0.52(0.35, 0.79), 3rd-4th 0.49(0.28, 0.84), 1-2 ANC visits 0.24(0.12, 0.49, ANC visit three' 0.14(0.07, 0.28), ANC visit four and above 0.22(0.14, 0.36), in marriage mother 0.43(0.19, 0.96), '1-2 under-five children 0.02(0.011, 0.03), and greater than three under-five children 0.007(0.0007, 0.004) were all negatively associated with under-five mortality rate.

Conclusion: To obtain the exalted outcome out of this study, the government might need to increase antenatal care, women education, institutional delivery, and the modern contraceptive methods use through enhanced community mobilization, health education using community

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health workers, increasing access to essential cares of mothers and children, and the policy commitment for the issues related to family size, birth order, and birth interval.

Keywords: under-five; mortality; demographic health survey data; Ethiopia

Introduction

According to the Sustainable Development Goal (SDG) target 3.2, the under-five mortality is 25 deaths or below per 1,000 live births and 12 deaths or below per 1000 live births for neonatal by 2030 (1). Previously from 1990 to 2015, Ethiopia has done very well with millennium development goals and able to reduce child mortality by 67%; This proportion is still very high, despite the change(2-4). For the commencement of the current United Nation Children Fund (UNICEF) plan, the country appeared not good enough as per the recent status. Ethiopia as a developing African country has many limitations to achieve the UNICEF plan that includes resource availabilities, access to service, and attitude of the service takers, knowledge, and health-seeking behaviors(3,4). Struggling with these problems, the country has been working very hard to achieve the plans. As analysis of the Ethiopian Demographic Health Survey (EDHS) 2016 indicated, child mortality in the country was 46.7%. Factors like Vaccination; currently using contraceptives; antenatal care; fathers whose level of education is secondary or above; mothers who completed their primary school; mothers who have birth interval greater than 36 months and age of the mother at first birth is greater than 16 years incur less mortality(6). A machine learning prediction indicated the under-five mortality ranges between 46.3 and 67.2% and it was non-random throughout the country. Family size, distance from water, breastfeeding status, births birth in the preceding 5 years, child sex, birth intervals, antenatal care, birth order, type of water source, and mother's body mass index played an influencing role(7,8). The risk of

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under-five mortality increases as household size approaches seven. Higher wealth index and age of the mother decreased child deaths(8).

A multilevel negative binomial analysis indicated that mothers attained higher education, female-headed household, age of household head, preceding birth interval ≥48 months, a child who had a history of diarrhea, multiple birth type, mothers who delivered in the health facility, residents of Addis Ababa, and Amhara region had impacted under-five mortality(9). According to a study conducted in Tigray, most deaths of the child occurred in early the time of neonate. Primipara, prematurity, low birth weight, perinatal asphyxia, respiratory distress syndrome, congenital anomalies, neonatal sepsis, and duration of hospital stay increased the deaths(7,8). Maternal age, rural residence, ever terminated pregnancy, and place of delivery were increased perinatal deaths, while husband education, higher wealth index, longer birth interval, female household leader, and the number of antenatal care (ANC) inversely related(12). The under-five mortality showed clustering in the country in Benishangul- Gumuz, Afar, Gambella, and the South Nation Nationality and People (SNNP) Regions until the year 2016(13). In the rural part of the country similar factors like regions difference, education of parents, singleton, health facility delivery, occupation of parents, mothers age >16 at first birth, breastfeeding, use of a contraceptive method, child vaccination, high family size, repeated antenatal visits, and preceding birth interval played the role(14).

In another study, children with 2-3 years and 3 years and above preceding birth interval showed less death before their fifth, all other factors remained the same(15). In the high under-five mortality region of the country, it was 74 per 1000 live births and the highest amongst twin births (262 per 1000 live births)(16). Under-five mortality was experienced by 27.2% of women in another study and there was no much difference in associated factors from the aforementioned

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studies(17). The residential inequality spatial analysis in 2016 indicated that the under-five mortality was decreased by 3.2% in the previous years(18).

In Africa, the impact and the exact reason of the magnitude for the problem were poorly understood because of the fragmented evidence in the literature. Ethiopia as one country in the continent has impact-level targets of HSTP (Ethiopian health sector transformation plan) to reduce under-five year, infant, and neonatal mortality rates 30, 20, and 10 per 1,000 live births by 2020(2). Thus, as the time limit of the plan was completed, it worth a detailed assessment of the magnitude and associated factors the under-five mortality in the country.

Methods and Materials

Data source and participants

We used Ethiopia Interim Demographic Health Survey (EIDHS) 2019 cross-sectional data; the country is located at (3o-14oN, 33o – 48°E). EIDHS is carried out between EDHSs and has a country representative sample. Data collection used the nine regions and two city administrations. Contextually, these regions were categorized as agrarian (Benishangul-Gumuz Amhara, Southern Nations, Nationalities, and People (SNNP), Gambela, Oromia, Harari, and Tigray Regions); pastoralists (Afar and Somali); city administrations (Addis Ababa and Dire-Dawa). We salvaged the data from the DHS website: www.dhsprogram.com after we allowed doing so by the measure program.

The sampling procedure for EMDHS was carried out in similar fashion to EDHS by EPHI (Ethiopian public health institute) in coordination with CSA. The 9 regions and 2 city administrations were stratified into rural and urban to yield 21 strata where enumeration areas (EA) were sampled independently in each stratum. Probability proportional allocation was carried out before selecting the sample as per the size of units. In the first stage, 305 EAs were

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selected with probability proportional to EAs size and the household listing was carried out in each EA. In the second stage, 30 households per cluster were selected with equal probability systematic selection. From the 9,012 eligible women for the interview, 8,885 women have completed the interview to make the response rate of 99%. The interview was conducted on the respondents who either permanent residents or visitors who stayed the last day in residence in a face-to-face manner(19). We extracted 5,527 numbers of weighted women with children aged 0-4years from the dataset. Socio-demographic characteristics, reproductive healthcare variables, child vaccination, death, and illness were included in the questionnaire.

Study variables

The outcome variable for this study was the death of under-five children. We coded as "0" if the child is alive and "1" if the child has died.

Independent (covariates) variable: sex of the child, type of birth, mother's age at first birth of the child, family size, breastfeeding status, preceding birth interval, mother's education, father's education, area of residence, vaccination, ANC, marital status, income of the mother relative to her husband, and source of drinking water, region, and type of place of residence.

Data management and analysis

Statistics were presented as descriptive (weighted frequencies, mean, standard deviations, and percentage or proportions. Since we used a large dataset with many variables, we also check multi-colinearity using the mean Variance inflation factor (VIF) which was 4.64 indicating within range inflation.

Data processing and analysis

According to the study criteria, we cleaned data in STATA v. 15.0. The data then weighted as per sampling weight, primary sampling unit, and strata before analyzing in STATA 15.0

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Data management consisted of descriptive and association statistics using STATA 15. As the data were collected from different regions, initially we planned to conduct multilevel logistic regression with spatial analysis. However, we discovered that there was no enough between clusters variation (ICC=0.13) and there was also a discrepancy between initial and final deviance negatively which formed unstable models. Thus, a binary logistic regression was deliberated for this analysis and we checked each variable at 0.25 p-values to include in the model. The final p-value to declare association was p <0.05 and AOR with 95% CI was also applied to describe the results.

Ethical considerations

We kept all information regarding respondents confidential and no household or individuals information was not identified during analysis or publication. For the EMDHS data collection, permission from the Ethiopian Health Nutrition and Research Institute (EHNRI) Review Board and the National Research Ethics Review Committee (NRERC) at the Ministry of Science and Technology was acquired. After clearing the purpose of the study, verbal informed consent for participation was collected.

Result

Descriptive statistics

We pooled 5,527 numbers of weighted women with under-five children from the EMDHS dataset. The socio-demographic characteristics of the respondent were presented in table 1. The proportion of under-five mortality was 277.23(5.02%). The average age of the children was 29.24±0.23 months, while the larger age of the respondents was 25-29 and 30-34 years with 31.72% and 21.57% proportions respectively. The 57.46% birth interval reported by the respondents was over 30 months followed by 34.27% 15-30 months, while most of the participants were from Oromo (40%), SNNP (20%), and Amhara (19%). The educational

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achievements of the participants were no education (53.66%) and primary education (35.32%). The poor wealth index magnitude was accounted for 45.53% and 75.27% of participants were also from rural residences. Women who reported no ANC and contraceptive uses were 47.31% and 59.94% respectively, while the proportion of home delivery was 52.46% among the respondents; (table 1)

Table 1: The socio-demographic factors of the participants in under-five mortality in Ethiopia, EMDHS 2019

Variables	Weighted frequency (%)	Variables	Weighted frequency (%)
Age in 5yrs group		**Region**	
15-19	263.58(4.77)	Tigray	371.30(6.72)
20-24	1,027.40(18.59)	Afar	85.93(1.55)
25-29	1,753.31(31.72)	Amhara	1,049(19.00)
30-34	1,191.98(21.57)	Oromia	2,210(40.00))
35-39	814.93(14.74)	Somali	408.51(7.39)
40-44	368.62(6.67)	Benishangul	67.26(1.22)
45-49	107.38(1.94)	*SNNPR	1,105.91(20.01)
		Gambela	24.70(0.45)
		Harari	16.38(0.30)
		Addis Adaba	156.21(2.83)
		Dire Dawa	29.83(0.54)
Highest educational level		**Religion**	
No education	2,965.56(53.66)	Orthodox	1,859.77(33.65)
Primary	1,952.34(35.32)	Protestant	1,469.30(26.58)
Secondary & Higher	415.04(7.51)	Muslim	2,100.47(38.00)
Above higher	193.98(3.51)	Others	97.38(1.76)
Marital status		**ANC visits**	
Single	22(0.41)	No visit	2,614.60(47.31)
Married	5,292.07(95.75)	1-2 visit	422.43(7.64)
Divorced	65.58(1.19)	3 visit	801.14(14.50)
Divorced	146.82(2.66)	≥4 visits	11,688 (30.55)
Contraceptive methods		**Place of delivery**	
No	3,312.93(59.94)	Home	2,899.56(52.46)
Yes	2,214.00(40.06)	Health facility	2,627.37(47.54)
Place of residence		**Child alive**	
urban	1,366(24.73)	No	277.23(5.02)
rural	4,160.03(75.27)	Yes	5,249(94.98)

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Source of drinking water		**Types of toilet facility**	
Improved	1,986 (35.94)	Improved	4,640.58(83.96)
Unimproved	3,540.72(64.06)	Unimproved	886.35(16.04)
Birth interval		**Number of U5 children**	
<15	277.53(6.45)	No <5 child	200.52(3.63)
15-30	1,431.48(33.25)	1-2	4,587.16(83.00)
>30	2,596.63(60.31)	≥3	739.24(13.38)
Wealth status		**Sex of the child**	
Poor	2,519.04(45.58)	Male	2,842.10(51.42)
Middle	1,041.19(18.84)	Female	2,684.83(48.58)
Rich	1,966.69.4(35.58)		

Factors associated with under-five mortality

During binary logistics analysis: birth order, the current age of the child, antenatal care (ANC), marital status, number of under-five children, and birth interval were linked with under-five child mortality. Compared to first birth, children of birth order 2nd and 3rd-4th had 51% and 48% reduced odds of death before the fifth birthday with AOR of 0.49(0.28, 0.84) and 0.52(0.35, 0.79) respectively. The odds of death among children whose mother followed ANC was significantly decreased compared to' no ANC' with AOR of 0.24(0.12, 0.49) for 'visit 1-2'; 0.14(0.07, 0.28) for 'visit three'; 0.22(0.14, 0.36) for 'visit four and above'. Compared to any other marital status, the odds of death was decreased by 57% for children whose mother was in a marriage with AOR of 0.43(0.19, 0.96). The odds of death of under-five children for families with '1-2 children' was decreased by 98% and by 99% for families who had greater than three under-five children with AOR of 0.02(0.011, 0.03) and 0.007(0.0007, 0.004) respectively. Children with birth interval within 15-30 months had 62% reduced under-five mortality, while those with birth interval >30 moths had 81% reduced under-five mortality with AOR of 0.38(0.24, 0.60) and 0.19(0.12, 0.31) respectively compared to those who have no under-five children

Table 2: factors associated with under-five mortality in Ethiopia, data from EMDHS 2019

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Variable	p-value	AOR	Lower 95%	Upper 95%
Birth order				
1st birth	1			
2nd birth	0.01	0.49	0.28	0.84
3-4 birth	0.002	0.52	0.35	0.79
>4 birth	Omitted			
Current age of the child(age since death)	0.012	0.98	0.97	0.997
Antenatal care visits		0.53	0.29	0.97
No ANC	1			
1-2 visits	0.000	0.24	0.12	0.49
3rd visit	0.000	0.14	0.07	0.28
≥4th visit	0.000	0.22	0.14	0.36
Marital status				
Single	1			
Married	0.037	0.43	0.19	0.96
Divorced	0.41	0.50	0.10	2.56
Divorced				
Number of U5 children				
No <5 child	1	0.02	0.011	0.03
1-2	0.000			
≥3	0.000	0.007	0.0007	0.004
Birth interval				
<15	1	0.38	0.24	0.60
15-30	0.000			
>30	0.000	0.19	0.12	0.31

Discussion

Descriptive statistics

From the total 5,527 study population extracted and weighted from the EMDHS dataset, we found that the under-five mortality was 5.02%. The finding was completely different from previous results where the proportion was 67% from EDHS 2016(7,20); 27.2% from another study of EDHS(18); 46.7% from the additional study in the country(6); however, it is consistent with 5.1% of machine learning prediction in 2016. The reason might be the issues related to

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sampling, area difference, and study criteria. The proportion was 55 per 1,000 live births in 8,885 total participants from the report of EMDHS itself indicating the sampling reduction factor mattered(19). The educational achievement of the participants was dominated with 'no education' (53.66%) followed by 35.32% 'primary education'. Despite all efforts made in previous decades and reports of amplified educational status in the country(2), women's education remained lagging behind the expectations. The finding is consistent with the studies conducted in the country with 66.08% participants lacking formal education from EDHS 2016 and poor educational achievement identified in the whole sub-Saharan countries(21,22,23). It might mean that educational achievements cannot be effected in a short time. And enlighten the need of a long time to have a visible impact on socio-demographic characteristics of the mothers. Studies associate maternal education as one of the facts to increase under-five mortality(6,15,24). Educational status might be critically affected by the economic status of the households and the behavioral factors could play a larger portion of its limitations.

In the last 20years, Ethiopia put forth all available resources to increase ANC and family planning proportions; however, from the current analysis, we found that 'no ANC' and 'no contraceptive' uses were accounted for 47.31% and 59.94% fraction of the participants respectively. Our study had a better ANC than the finding in Northeast Ethiopia (29.3%) in 2016 and 42.8% in Ambo Town in 2014(25,26); however, it is lower than72.6% in the Gedeo zone and 78.5% in Debre Berhan(27,28). Similarly, contraceptive use was higher than 34.7% in EDHS 2016(14,29) and lower than that of 60% in South Africa(30). In all the cases, access, availability, and awareness might be played advanced roles which need considerations. The worrying fact was the proportion of home delivery which was 52.46%. Despite the lack of sufficient evidence to show its relationship in the current study, the proportion must draw the

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attention of policymakers for more cutting-edge interventions. Previous studies also reported an average of greater than 50% home deliveries(31) and it was contributing to more than half of the child deaths(6).

Factors associated with under-five mortality

Higher birth order child carries the lower risk of under-five death from our analysis. This is relatively consistent with EDHS 2011(8) and EDHS 2016(20) findings that showed the risk decreased as birth order increase. Advancing experience and learning from the past event as well as increasing in the skill of handling child issues while the problems still exist from mothers as their age increase could be the possible reasons. As the age of the child increased, the chance to survive to the fifth birthday increased. This finding was also evidenced by the study in Nigeria which showed that at any age from gestation to less than 5years after birth, mortality of children decreased(32). The reason might be advancement in immunity and ability of children to indicate their needs and problems might reduce mortality.

The children whose mother followed ANC had decreased risk of dying before the fifth birthday as many other studies also confirmed the same findings(16). The reason might be the exposure to health professionals' advice and their position to access treatments. In other words, households with a higher number of under-five children had a very limited risk of child death before five years of age. There was no enough evidence to support this finding as it was insignificant in most literatures in the country (33). And as birth interval increased, the risk of death before the fifth birthday was significantly abridged and was also supported by EDHS 2016 finding(17). Finding time and space to care with full attention on the timely born child might be the reason for the reduction in death. Although the findings of this study are crucial for policy decision, using third-party data, disproportionate sampling, and cross- sectional nature of the study was the

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limitation of the study. We weighted the data before the application and tried to search for more literature to minimize the limitations.

Conclusion

The prevalence of the under-five child death was very low below the reports of the same year; however, the finding cannot be for granted as the small sample size used here which was also weighted to represent the country might decrease the death. In that occasion, a better sample size like EDHS is necessary to declare the status of the country. Antenatal care, marital status, number of under-five children, birth order, age of the child, and birth interval were all inversely associated with under-five mortality. Low proportion was also observed in contraceptive method use, educational achievements, and home delivery. To acquire the exalted outcome, the government might need to increase antenatal care, women education, institutional delivery, and the modern contraceptive methods use through enhanced community mobilization, health education using community health workers, increasing access to essential cares of mothers and children, and the policy commitment for the issues related to family size, birth order, and birth interval were required.

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Availability of data and materials

The data used in this study are the third-party data which is Demographic and Health Survey available at (http://www.dhsprogram.com). To access the data, someone needs to follow the steps and protocol outlined under the methods section.

Authors' contributions

GG developed the proposal, writing results, and drafting the manuscript while SH was involved in the conception, analysis, and reviewing of the document.

Consent for publication

Not applicable

Disclosure

The authors declare that they have no competing interests.

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