

Rural residence increases susceptibility of under-five children to the self-reported sign of acute respiratory tract infection: Evidence from 2016 Ethiopian demographic and health survey

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Short Report

Keywords:

Posted Date: September 21st, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-10801742/v1>

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Additional Declarations: No competing interests reported.

Abstract

Objective

To estimate the prevalence of a self-reported sign of acute respiratory tract infection (ARI), defined as fast breathing, and identify associated factors among under-five children in Ethiopia using nationally representative data.

Results

We analyzed data from 8,680 mother–child pairs included in the 2016 Ethiopian Demographic and Health Survey. The survey employed a stratified, two-stage sampling design, and analyses incorporated sampling weights, clustering, and stratification. Overall, 9.3% (95% CI 8.6–9.9) of under-five children had a reported sign of ARI. In multivariable logistic regression analysis, children living in rural areas had higher odds of reported ARI signs than those in urban areas (adjusted odds ratio [AOR] 1.45, 95% CI 1.05–2.02). The odds were also higher among children reported as wanted later (AOR 1.32, 95% CI 1.08–1.62) and those whose mothers wanted no more children (AOR 1.77, 95% CI 1.36–2.31). Households headed by women had lower odds of reported ARI signs (AOR 0.76, 95% CI 0.61–0.94). Khat chewing was not associated with reported ARI signs (AOR 0.94, 95% CI 0.74–1.19). Targeted health information and preventive interventions should prioritize rural and male-headed households and children with unintended pregnancies.

Background

The major manifestation of acute respiratory tract infection is cough accompanied by short and rapid breathing which is usually associated with death(1). The fourth Millennium Development Goal was dedicated to reduce child mortality by two-thirds in between 1990 and 2015. However, nearly 29,000 under-five children were died worldwide every day mainly because of preventable diseases between 1990–2005(2, 3). More recently in 2016, lower respiratory tract infections caused 652, 572 deaths of under five children worldwide(4). But, the overall global child mortality rates have been declined consistently over the last decades, though the preventable infectious diseases continue still and require sustained attention. Infectious diseases were the most significant causes of under-five mortality in the last decades that accounts for 68% of all under-five mortality(5). Of infectious diseases, acute respiratory tract infection was a leading cause of mortality in under-five children(6). Globally, ARTI among under-five children remains the second common cause of morbidity and mortality. But in developing countries including Ethiopia, ARTI is the highest burden(7). In such low and middle-income countries, 6.9 million children were died in 2011 and about one in five of those deaths were caused by an acute lower respiratory tract infections (ALRTI)(8). According to UNICEF report, ninety-seven percent of respiratory tract infections occur in the developing world. Of which, seventy percent of those cases occurred in south Asia and sub-Saharan Africa alone(9).

In Ethiopia, about 3.4 million children suffer from ARTI annually that laid the country among the top 15 countries with the highest burdens of ARTI(10). In statistics, the prevalence of childhood ARTI in Ethiopia ranges from 16% up to 33.5% (11–15). Studies identified some factors that have been associated with increased susceptibility to ARTI in the general population. Those factors include alcohol abuse(16), cigarette smoking(17), air pollution(18), and hypo-albuminaemia(19). Two studies indicated that household air pollution (HAP) linked with childhood ALRTI (20, 21). The main sources of indoor air pollution might be use of wood for meal preparation especially in low income countries(22). Use of wood as a source of fuel is a common practice in almost all rural parts of Ethiopia, and even in some of the urban dwellers. Assessing the prevalence of ARTI is important because of the costly medical care and high mortality rate associated with the disease. In addition, the studies conducted on the prevalence of sign of acute respiratory tract infection (fast breathing) in the whole Ethiopia among under-five children are limited. The aim of this study was to assess the national prevalence of ARTIs sign and its associated factors in Ethiopia.

Methods

Data collection period, and study population

The data collection period for the 2016 EDHS was from January 18 to June 27, 2016. The 2016 Ethiopian Demographic and Health Survey (EDHS) data was used for this further analysis. The 2016 EDHS data was the fourth survey conducted in Ethiopia. The survey collected information on household's and respondent's characteristics, child health, infant and child mortality, malaria, maternal health, maternal mortality, nutrition, tobacco use, women's empowerment, anemia, domestic violence, environmental health, family planning, female genital cutting, fertility and fertility preferences, and etc. The purpose of the EDHS is to give up-to-date estimates of the key demographic and health indicators of the population(23). The survey included reproductive age group women, under-five children, and productive age group men (aged 15-59 years)(23, 24).

Sampling technique and study design

The 2016 EDHS data collected using a stratified two stage sampling method to select a representative sample for the country. All the regions of the country were stratified into urban and rural areas. From all the 11 administrative states, 21 sampling strata were yielded. The samples of enumeration areas (EAs) were selected independently in each stratum in to two stages.

The explicit stratification and proportional allocation were achieved at each of the lower administrative levels by sorting the sampling frame within each sampling stratum before sample selection using the administrative units at different levels. A probability proportion to size was used to select the clusters at the first stage of sampling. The 2016 EDHS's data were collected by selecting 645 EAs (clusters) with a probability proportional to the EA size and with independent selection in each sampling stratum. The EA size is the number of residential households in the EA that was determined in the 2007 Ethiopian Population and Housing Census.

According to the 2016 EDHS procedures, a household listing operation was implemented in the selected EAs, and the resulting lists of households served as the sampling frame for the selection of households in the second stage. The data collectors interviewed only the pre-selected households. In the EDHS, there were no replacements or changes of the pre-selected households in the implementing stages to prevent bias. All the under-five children, who were usual members of the selected households or who spent the night before the survey in the selected households were eligible for the child survey(24). After managing the missing data, 8680 respondents that had under-five children were included in this study, though the 2016 EDHS data collected from 10641 children.

Data collection tools, procedures and variables

The EDHS usually use five groups of questionnaires in conducting the survey. Those questionnaires are the Household questionnaire, the woman's questionnaire, the man's questionnaire, the biomarker questionnaire, and the health facility questionnaire. The questionnaires were adapted from the DHS program's standard demographic and health survey questionnaires in a way to show the population and health issues relevant to Ethiopia. Questions that stated about children were integrated to woman's questionnaire or write-down separately.

The outcome variable of this study was sign of acute respiratory tract infections. The independent variables that measured in this study were socio-demographic variables of both children and mothers, health services provided to children and the wider community, and substance use, and those independent variables were selected by considering the availability of the variables in the 2016 EDHS data.

Definition

Sign of acute respiratory tract infection (ARTI): Complain of mothers about their child's fast and rapid breathing history before two weeks of the 2016 EDHS data collection.

Data analysis

The data analysis started with a summary of socio-demographic characteristics, and other relevant factors of the respondents using descriptive statistics. Weighting the data, adjusting the data for cluster and strata were the first priority to get a representative sample as well as appropriate to population size estimates. A logistic regression model was used to assess the association of sign of ARTI and independent variables. A statistically significant association was determined at a p-value of less than 0.05.

Results

Demography of the respondents and their children

In this study, a data of 8680 respondents were analyzed. Regarding the husbands' occupation, 4720 (54.4%) had agricultural job, and 5348 (61.6%) mothers didn't work. Of the 8680 households, 7154 (82.4%) were headed by men. The distribution of the data indicated that respondents were more concentrated in rural areas, in which 7175 (82.7%) respondents were from the countryside. The data indicated that 5612 (64.7%) mothers were unable to read and write. As per the 2016 EDHS categorization, 4387 (50.5%) of the respondents were a follower of Muslim Religion. Regarding child birth history, 6918 (79.7%) children were wanted and 8675 (99.9%) of children were lived with their mothers. The practice of Khat chewing and Cigarette smoking among the respondents were 1032 (11.9%) and 83 (1.0%) respectively (Table1).

Sign of Acute respiratory tract infection

The age of respondents (mothers) varied from 15-49 years old with a standard deviation of 6.45 ((29.28±6.45) ($\bar{x}$ ±SD). Among the 8680 mothers, the mean numbers of ever born children were 4.29±2.50 ($\bar{x}$ ±SD). The minimum number of children who belong to the respondents was 1, and 14 children were the maximum number. However, the mean number of living children was 3.91±2.22 ($\bar{x}$ ±SD). The minimum and maximum number of children, and reproductive age group women in a household was 0 and 6, and 1 and 9 respectively.

The prevalence of sign of ARTI (fast breathing) among under-five children was 9.3%, 95% CI (8.6%, 9.9%).

Factors associated with sign of acute respiratory tract infection

In the bivariable logistic regression analysis, wealth index, region, residence, cigarette smoking, religion, wantedness of the child, sex of head of household, and age of children associated with the sign of ARTI. However, some of the study variables were not fulfill the assumption of logistic regression. On the multivariable analysis; rural residence, (AOR, (95% CI)), (1.45, (1.05, 2.02)), wanted latter child (1.32, (1.08, 1.62)), wanted no more child (1.77, (1.36, 2.31)), and under 48months old children were increasing the odds of ARTI sign whereas households with female sex head (0.76, (0.61, 0.94)) was decreasing the odds of ARTI sign. However, Khat chewing was not associated with ARTI sign (0.94, (0.74, 1.19)) (Table2).

Discussion

The aim of this study was to assess the prevalence and associated factors of sign of ARTI (fast breathing) among under-five children in Ethiopia. The prevalence of ARTIs sign among under-five children was 9.3% (95% CI, (8.6%, 9.9%)). This prevalence was higher than a study, that conducted in Tigray and showed a total prevalence of ARTI sign as 5.53%(25). The variation might be as a result of socio-demographic difference between the Tigray region, and the other wider Ethiopian communities. The current study was also higher than the 2011EDHS data based study, 7%(26). The 2010 to 2014 ILINO caused drought might increase the prevalence of respiratory tract infection sign by lowering the

immunity of children as a result of famine(27, 28). The present study reports a lower prevalence of ARTI sign than many other countries. For example the prevalence of ARTI sign in Congo was 39.8%, Gabon (38.1%), Lesotho (35.2%), Tanzania (35.2%) and Zambia (34.2%) (29). This high prevalence of ALRTI sign in other African countries might be as a result of frequent outbreaks of respiratory diseases than Ethiopia(30). The present study's prevalence is lower than studies conducted in India (41.6%)(31), Cameroon (54.7%)(32), Nigeria (64.9%)(33), Kenya (69.7%)(34), and Bangladesh(70%)(35). The study also has a lower prevalence than many local studies conducted in Ethiopia; Gondar (26.3%)(12), southern Ethiopia (21%)(13), and Addis Ababa (23.9%)(15). The possible justification might be the study period difference, sample size difference, and study population variation. This study identified that rural residence (AOR = 1.45, 95%CI (1.05, 2.02)) increased occurrence of ARTI sign that is supported with earlier studies (29, 36–39). The similarity might be as a result of low socio-economic status in rural regions(40), and rural areas are more exposed to various risk factors of ARTI(41).

This study showed that children under 48months old (birth-12, 12–24, 24–36, and 36–48 months old) had associations with the sign of ARTIs than 48 -59months old children. This indicates that the sign of ARTI decreased when the child age increased. The finding is not in lined with a study that reported the probability of getting ARTI sign is higher in younger ages (24-35months and 36-47months) compared to (48–59 months)(42). However, a number of other studies indicated that ARTI sign was associated with younger children. For example a study from Nigeria(43), Ethiopia(36), and Ghana(44), reported a similar result with the present study. A study from 2011EDHS based data reported a 50% reduction in the odds of ARTI sign in children aged 48–59 months as compared with children under 6 months of age(45). All the above three referred studies found a high likelihood of having ARTI sign in 12–23 months old children. The similarity might be because of having weaker innate immunity in those younger children (less than 48months) compared to 48-59months old. Children from households with female head (0.76, (0.61, 0.94)) had lower risk of ARTI sign than the counter parts. This was consistent with a study that conducted in Ghana, which reported that most children with sign of ARTI were from male headed households (46). In addition, wanted latter child (1.32, (1.08, 1.62)), and wanted no more child (1.77, (1.36, 2.31)) had associations with sign of ARTI than a planned child (wanted then) child. The justification why unwanted child had associations with sign of ARTI might be due to the care difference provided for planned and unplanned child. Mothers who planned their pregnancy might also prepare all the necessities in prenatal, intra-partum, and post-natal period including their psychological well-being. Unlike a previous studies(46, 47), maternal smoking was not associated with sign of ARTI in this study. This difference might be due to variance in the study period and time caused socio-demographic changes which might contribute for better awareness on the negative impacts of smoking cigarette during pregnancy.

Conclusions

The prevalence of ARTI sign is not considerably high in Ethiopia even the data was subjective report. Rural residence, wontedness of the child, and age of children increased susceptibility of children to ARTI sign whereas female sex of household head decreases susceptibility of children to ARTI sign. However

maternal Khat chewing and cigarette smoking were not associated with ARTI sign. Health information disseminations on acute respiratory tract infections should target rural residents, male headed households, and households that have unplanned/unwanted child to reduce the occurrence of acute respiratory tract infections sign and their consequent complication like severe pneumonia.

Limitations

The first limitation of this study might be missing pertinent independent variables while refining the data. Due to this missingness of important factors, the association of ARTI sign and possible predictors might not be exhaustive. The second limitation might be recall bias since the outcome measured by asking mothers about their children's history of fast breathing. The third limitation might be measurement error in which mothers might report fast breathing inappropriately (false positive and negative).

Abbreviations

AOR- adjusted odds ratio; CI – confidence interval; SPSS-statistical package for social science, ARTI- Acute respiratory tract infection, EDHS- Ethiopian Demographic and Health Survey, EA- Enumeration areas, SNNPR- Southern nations, nationalities, and people of Ethiopia

Declarations

Ethics approval and consent to participate

This further EDHS data base analysis used a collected data from the online library by email request, DHS. Thus, the ethical issue is usually waived. The 2016 EDHS data is a reviewed and approved document by the Federal Democratic Republic of Ethiopia, Ministry of Science and Technology, and the Institutional Review Board of ICF International.

Authors' contributions

For this study MWK, TMN, STM, and WZT conceived the title and designed the study, preparing a complex data for analysis, analyzing the complex data, revising the work and writing the final manuscript. All the authors read and approved the final version of this manuscript and agreed to be accountable for all aspects of this work.

Acknowledgements

We would like to acknowledge the central statistical agency of Ethiopia for the data (EDHS) they collected and provide it online in collaboration with the USAID. We also acknowledge the USAID for supporting the project, publishing the data online, and allow researchers to use it for free.

Consent for publication

Not applicable

Availability of data and materials

The data source we used in this research is already online in the DHS database online at [https://www.dhsprogram.com/\(48\)](https://www.dhsprogram.com/(48)).

Competing interests

The authors declare that they have no conflict of interests

Funding

Not applicable

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Tables

Table1: Socio-demographic characteristics of care givers and their children in studying ARTIs signs in Ethiopia, 2016 (n=8680).

Variables	Categorization	Frequency	Percent
Husband occupation	Did not work	1367	15.7
	professional/managerial	618	7.1
	Clerical	59	0.7
	Sales	672	7.7
	agricultural employee	4720	54.4
	Service	318	3.7
	Skilled manual	567	6.5
	Unskilled manual	359	4.1
Maternal occupation	Did not work	5348	61.6
	professional/managerial	149	1.7
	Clerical	39	0.4
	Sales	884	10.2
	agricultural employee	1716	19.8
	Service	157	1.8
	Skilled manual	270	3.1
	Unskilled manual	117	1.3
Head of household	Male	7154	82.4
	Female	1526	17.6
Residence	Urban	1505	17.3
	Rural	7175	82.7
Maternal age	15-19	296	3.4
	20-24	1749	20.1
	25-29	2626	30.3
	30-34	1966	22.6
	35-39	1352	15.6
	40-44	529	6.1
	45-49	162	1.9
Maternal education	No education	5612	64.7

	Primary	2196	25.3
	Secondary	571	6.6
	Higher	301	3.5
Region	Tigray	844	9.7
	Afar	858	9.9
	Amhara	851	9.8
	Oromia	1325	15.3
	Somali	1183	13.6
	Benishangul	728	8.4
	SNNPR	1115	12.8
	Gambella	555	6.4
	Harari	450	5.2
	Addis Ababa	353	4.1
	Dire Dawa	418	4.8
Religion	Orthodox	2527	29.1
	Catholic	52	0.6
	Protestant	1560	18.0
	Muslim	4387	50.5
	Traditional	86	1.0
	Other	68	0.8
Wealth index	Poorest	3197	36.8
	Poorer	1529	17.6
	Middle	1238	14.3
	Richer	1093	12.6
	Richest	1623	18.7
Readiness of mothers	Wanted then	6918	79.7
	Wanted later	1245	14.3
	Wanted no more	517	6.0
Cigarette smoking	No	8597	99.0

	Yes	83	1.0
Chat chewing	No	7648	88.1
	Yes	1032	11.9
Anemia	Severe	163	1.9
	Moderate	891	10.3
	Mild	2055	23.7
	Not anemic	5571	64.2
Type of birth	Single birth	8478	97.7
	1 st of multiple	107	1.2
	2 nd of multiple	95	1.1
With whom the child lives	Mother	8675	99.9
	Else other	5	0.1
Sex of the child	Male	4439	51.1
	Female	4241	48.9
Child age	Birth to 12	2129	24.5
	12 to 24	1665	19.2
	24 to 36	1681	19.4
	36 to 48	1648	19.0
	48 to 59	1557	17.9

Table2: The association of childhood ARTI signs with maternal, environmental, childhood, and household related factors in Ethiopia, 2016

Variable	Categories	Sign of ARTI (n=8680)		OR		95% CI		P-value
		No	Yes	COR	AOR	Lower	Upper	
Wealth index	Poorest	2946 (37.4)	251 (31.3)	1.06	0.85	0.61	1.17	0.32
	Poorer	1359(17.3)	170(21.2)	1.55*	1.16	0.83	1.63	0.38
	Medium	1101(14.0)	137 (17.1)	1.55*	1.15	0.81	1.63	0.43
	Richer	969(12.3)	124(15.4)	1.59*	1.19	0.84	1.68	0.33
	Richest	1502(19.1)	121(15.1)	1	1	–	–	–
Residence	Rural	6475(82.2)	700(87.2)	1.47*	1.45	1.05	2.02	0.03
	Urban	1402(17.8)	103(12.8)	1	1	–	–	–
Head of households	Male	6457(82.0)	697(86.8)	1	–	–	–	–
	Female	1420(18)	106(13.2)	0.69*	0.76	0.61	0.94	0.01
Was child wanted	Wanted then	633 (180.4)	587 (73.1)	1	1	–	–	–
	Wanted latter	1104(14.0)	141(17.6)	1.38*	1.32	1.08	1.62	0.01
	Not wanted	442(5.6)	75(9.3)	1.83*	1.77	1.36	2.31	0.001
Khat chewing	No	7046(89.5)	717(89.3)	1	1	–	–	–
	Yes	831(10.5)	86(10.7)	1.02	0.94	0.74	1.19	0.60
Child sex	Male	4025(51.1)	414(51.6)	1	1	–	–	–
	Female	3852(48.9)	3852(48.9)	0.98	0.96	0.83	1.11	0.58
Child age in months	Birth to 12	1893(24.0)	236(29.4)	2.14*	2.22	1.72	2.88	0.001
	12 to 24	1468(18.6)	197(24.5)	2.31*	2.39	1.83	3.11	0.001
	24 to 36	1538(19.5)	143(17.8)	1.59*	1.63	1.24	2.15	0.001
	36 to 48	1507(19.1)	141(17.6)	1.62*	1.63	1.23	2.15	0.001
	48 to 59	1471(18.7)	86(10.7)	1	1	–	–	–

*P-value < 0.05