Active Trachoma and Associated Factors among Children (Aged 1-9 years) in Haramaya District, Eastern Ethiopia

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Abstract

Background: Trachoma is a major public health problem in Ethiopia. Though various strategies were implemented, the problem remains rampant. Little has been known about the burden of active trachoma specifically in a study setting. Therefore, this study aimed to determine the prevalence of active trachoma and its associated factors among children (aged 1-9 years) in the Haramaya District, Eastern Ethiopia.

Methods: A community-based cross-sectional study was conducted in children (aged 1–9 years) from August 30 to October 30, 2017, among children (aged 1–9 years). A multistage sampling technique was applied to select a total of 760 children. Data were collected through parental/ guardian interviews, environmental inspection, and conducting a standard ophthalmic examination by three experienced optometrists. Active trachoma was measured as the presence of either trachomatous inflammation follicles or intense. Data were analyzed using STATA software version 17. Both bivariable and multivariable Poisson regression analyses were performed to determine factors associated with active trachoma.

Results: In this study, 27% (95%CI: 23.9, 30.2) of children aged 1-9 years had active trachoma. Traveling more than 30 minutes to fetch water (APR=1.53; 95% CI: 1.13,2.06), lack of latrine facilities (APR=1.22; 95% CI:1.01,1.47), living with animals in the same house (APR=4.20; 95% CI: 3.18,5.56), unclean face (APR=4.11; 95% CI: 2.46, 6.87), and presence of flies on the face within 3 seconds of observation (APR=2.15; 95%CI: 1.46,3.16) were found to be independent predictors of active trachoma.

Conclusion: The study revealed that about a quarter of children had active trachoma in the study setting, indicating that trachoma continues to be a public health concern. Traveling more than 30 minutes to fetch water, lack of toilet facilities, sharing a home with animals, and the appearance of flies on the face within 3 seconds of observation were factors associated with active trachoma. Therefore, strengthening interventions that emphasize access to water sources, adequate facial and environmental hygiene, and latrine availability should be the mainstay to reduce the risks of active trachoma.

Keywords: Active Trachoma; Children; Haramaya District; Eastern Ethiopia

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Introduction

Trachoma is a Neglected Tropical Disease (NTD) and the leading cause of preventable blindness. It is caused by the bacterium *Chlamydia trachomatis* among people who live in socioeconomically deprived areas. The transmission of trachoma is known to occur via personal touch including through hands, clothes, or bedding and flies that meet discharge from an infected person's eyes or nose to spread the infection. When eye lashes are drawn due to infection, they can rub against the surface of the eye, causing irritation and discomfort as well as permanent damage to the cornea (DHS, 2011; Habtamu *et al*., 2015; Ayelgn *et al*., 2021). Globally, trachoma is responsible for 1.4% of blindness. Around 40.6 million people who live in trachoma-endemic areas suffer from active trachoma (DHS, 2011; Mitra and Mawson, 2017; Ayelgn *et al*., 2021). According to the world health organization (WHO), trachoma is a public health issue in 44 countries. Overall, Africa is the most severely affected continent, with 27.8 million cases of active trachoma (Muluneh *et al*., 2016). Approximately, 48.5% of the global burden of active trachoma is found in Ethiopia, India, Nigeria, Sudan, and Guinea (DHS, 2011; Ayelgn *et al*., 2021).

Several factors are associated with the risk of active trachoma including nasal and ocular discharge and unclean faces of children (Harding-Esch *et al*., 2008; Hagi et al., 2010; Ferede *et al*., 2017; Gebrie *et al*., 2019),

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and frequency of face washing (Nigusie *et al*., 2015; Ayelgn *et al*., 2021). Moreover, environmental conditions such as improper disposal of animal waste products, keeping animals in the living room, less access to a water source, and using water from unprotected sources (Yalew *et al*., 2012; Nigusie *et al*., 2015), absence of the latrine (Alambo *et al*., 2020), overcrowded living conditions, and poverty (Nigusie *et al*., 2015)

Active trachoma remains a major public health problem in Ethiopia among children aged 1–9 years (Anteneh and Getu, 2016). The Ministry of Health has made substantial efforts to implement and scale up a strategy consisting of Surgery for trichiasis, Antibiotic therapy, Facial Cleanliness, and Environmental enhancement (SAFE) (MoH, 2016). In addition, the Ministry has been training allied eye health professionals and general health professionals to increase the effectiveness of the national trachoma program. But, the problem remains rampant (Amin *et al*., 2021). Despite numerous studies that have been done on other health problems so far, it was unknown how common active trachoma was in the study setting (Gudata *et al*., 2021). In addition, the high burden of trachoma in the Oromia region calls for collecting further district-specific risk factors of trachoma for designing, expanding, and executing context-based intervention (Beroa *et al*., 2016). Therefore, this study aimed to determine the prevalence and associated factors of active trachoma among children (aged 1-9 years) in the Haramaya District, Eastern Ethiopia.

Materials and Methods

Study Setting, Design, and Period

A community-based cross-sectional study was conducted among children (aged 1–9 years) in the Haramaya District, East Hararghe Zone of the Oromia Regional State, eastern Ethiopia from August 30 to October 30, 2017. The total population of Haramaya District is 271,394. Of which, males constituted 138,376 (51%) while females were 133,018 (49%). The total number of children (aged 1–9 years) was 7696. The district contains 4 urban and 33 rural kebeles which are the smallest administrative unit in Ethiopia (DHS, 2011).

Population, Inclusion/ Exclusion Criteria

All children of age 1-9 years who lived in the selected kebeles and were present at home during the time of the study were included in the study. Those who had an eye injury were seriously sick, and were absent from their home during the study were excluded.

Sample size Determination and Sampling Technique

The sample size was calculated using single population proportion formula with the assumption of a 95 % confidence interval, 5% margin of error, the prevalence of active trachoma was 36.7% in a previous study (WoldeKidan *et al*., 2019), and design effect of two. The final sample size was 760. Two kebeles from the urban (Kebele 01& 02) and four kebeles from the rural area (Tinike, Gobe Chala, M.Balina, and Korke) were randomly selected and the sample size was proportionally allocated for selected kebeles based on the total number of children aged 1-9 years. Then systematic random sampling was used to select the household in which the children were residing. In the selected household with two or more eligible children, one child was selected randomly using the lottery method.

Data Collection Procedure and Measurement

Multiple data collection procedures were employed. Data related to socio-demographic characteristics, and environmental and behavioral factors (time required for fetching water, source of water, and access to a latrine were collected using structured interviewer-administered questionnaires. Data about solid waste disposal system, sharing the same home with animals, frequency of face washing, cleanliness of the face, presence of flies on the face within 3 seconds of observation, and child squinting during twilight) were collected through observation.

After completing the face-to-face interview, and observation, each child underwent an ocular examination by qualified optometrists based on the World Health Organization's five-signs grading system (Solomon *et al*., 2020): Trachomatous inflammation-intense (TI), Trachomatous Inflammation-follicular (TF), Trachomatous Conjunctival scar (TS), Trachomatous Trichiasis (TT), corneal opacity (CO), and eyelid eversion (turning out). Each eye was examined separately, with the examiner sitting in front of the study participant in daylight using a binocular loupe (×2.5) and torch, and eye examination of each child was performed by careful inspection of the eyelashes, cornea, limbus, and eversion of the upper lid and inspection of the tarsal conjunctiva, with the examiner cleaning their hands with alcohol-based antiseptic between each examination.

Operational Definitions

Active trachoma: The presence of either Trachomatous inflammation follicles or intense. Trachomatous inflammation is defined as the presence of five or more follicles at least 0.5 mm in size in the upper tarsal conjunctiva. Trachomatous inflammation-intense is present when inflammatory thickening obscures more than 50% of the deep tarsal vessels. No active trachoma was assumed in the absence of TF and TI (Anteneh and Getu, 2016).

Facial cleanliness: The absence of nasal and ocular discharge on the eyes, or nasal discharge on the cheeks at the time of the visit (Gebrie *et al.*, 2019).

Latrine accessibility: the access to latrines which is at least improved type and permits the possibility to reach, enter, and use without any difficulty(Getahun *et al.*, 2022).

Unavailable solid waste disposal: Disposing of solid waste in an area where it is not permitted to do so or dumping rubbish in an open field (The Carter Center et al., 2004).

Protected water sources: The sources of water which are covered by stonework, concrete, or other materials that prevent the entry of physical, chemical, and biological contaminants, whereas unprotected water sources are those with no barrier or other structure to protect the water from contamination (World Vision Ethiopia *et al.*, 2016).

Data Quality Control

The questionnaire was prepared in English, translated into the local language, Afan Oromo, and back-translated into English to maintain consistency.The questionnaire was pretested before data collection in Damota kebele and necessary modifications were made accordingly. The three-day training was provided for Optometrists, supervisors, and data collectors. Trained health extension workers interviewed the heads of households and observed the house environment. Three Optometrists who have been trained and participated in the national active trachoma survey conducted the standard eye examinations. Each Optometrist made ophthalmic examinations twice for each child to see intra-observer agreement, and supervised by a senior ophthalmologist. However, the variations were insignificant. The principal investigator also closely supervised the overall data collection process daily for completeness, accuracy, and clarity.

Data Processing and Analysis

Collected data were checked for completeness and consistency, and coded. Data entry was made using Epi-Data Version 3.5.1 software, and transported to STATA 17 for cleaning and analysis. Descriptive statistics were used to compute frequencies and percentages. A Poisson regression model with a robust variance estimation was used to examine the association between active trachoma and selected variables. Variables with a p-value < 0.25 in the bivariable analysis were considered for multivariable analysis. Statistically, a significant association was declared at a p-value less than 0.05 with a 95% confidence interval. Akaike's Information Criterion (AIC) and Bayesian Information Criterion (BIC) methods were used for model selection. The fitness of the model was assessed using Hosmer–Lemeshow goodness-of-fit test. The presence of multicollinearity was checked using VIF before fitting to the model and the variables whose VIF < 10 were selected for the final model.

Ethical Consideration

The Institutional Health Research Ethics Review Committee of the College of Health and Medical Sciences, Haramaya University, granted its approval with the ethical clearance number IHRERC/16/ 05/2015. The college was then provided a letter of support to the relevant district health authorities. The district and town administrations were given us a letter so that the study could be carried out. Each family of the study participants received an explanation of the study's objective, benefits, and risks during the data collection. Then, written, signed consent that was informed, voluntary, and given before the start of the data collection. Names and other participant identifiers were not entered into the data gathering tools to maintain participant confidentiality. Children with a diagnosis of active trachoma were given free treatment, and those with complicated cases were referred to the local medical center for additional attention.

Results

Socio-Demographic Characteristics of Participants

A total of 760 children aged l-9 years participated in this study. The mean and standard deviation (SD) age of the children was 2.7± 0.72 years. Nearly one-third of 488(64.2%) of them were females. Four hundred sixty-eight (61.6%) of the participants were rural residents. Half 386(50.8%) of the fathers of children, attended

primary and above education while 408(53.7%) of them were farmers by their occupation (Table 1)

Table 1. Socio-demographic characteristics of children and parents (aged 1-9 years) assessed for active trachoma in the Haramaya District, Eastern Ethiopia, 2017 (n=760).

Variables	Category	Frequency	Percentage
Age, in years	1-5	668	87.9
	6-9	92	12.1
Sex	Male	272	35.8
	Female	488	64.2
Place of residence	Urban	292	38.4
	Rural	468	61.6
Father educational status	Illiterate	374	49.2
	Primary and above	386	50.8
Father occupation	Farmers	408	53.7
	Daily laborer	290	38.2
	*Others	62	8.1

**Others: merchant and government-employee*

Environmental Conditions of Households and Behavioral Characteristics

Most of the households 538(70.8%), had water in their compound, and 728(95.8%) of them got it from the protected areas. Majority 565(61.2%) of the households, had latrines. Five hundred thirty-eight (70.8%) of children shared a home with animals. According to a report from the parents/guardians, 470 (61.8%) children washed their faces once per day.

Two hundred (26.3%) of children reported squinting during twilight (Table 2).

Prevalence of Active Trachoma

The prevalence of active trachoma in children aged 1–9 years was 27% (95% CI: 23.9, 30.2). Among 668 children aged 1-5years, 187(28%) of them had active trachoma (Figure 1).

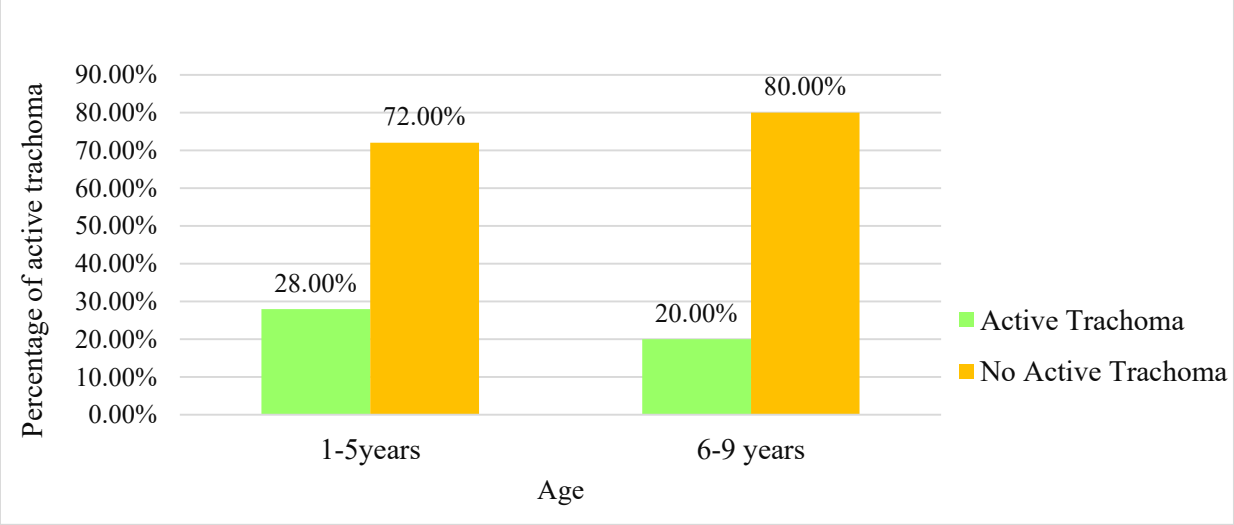

Figure.1. Prevalence of active trachoma among children (aged 1-9 years) in the Haramaya District, Eastern Ethiopia, 2017(n=760).

Table.2. Environmental conditions of households and behavioral characteristics of children (aged 1-9 years) assessed for active trachoma in the Haramaya District, Eastern Ethiopia, 2017 (n=760)

Variables	Category	Frequency	Percentage
Time required to fetch water	In compound	538	70.8
	5-30 min	135	17.8
	> 30 min	87	11.4
Source of water	Protected	728	95.8
	Unprotected	32	4.2
Accessibility of latrine	Yes	465	61.2
	No	295	38.8
Solid waste disposal system	Available	257	33.8
	Not available	503	66.2
Sharing a home with animals	Yes	538	70.8
	No	222	29.2
Trachoma prevention project in the area	Yes	474	62.4
	No	286	37.6
Frequency of face washing	Once per day	470	61.8
	Twice per day	260	34.2
	Occasionally	30	4.0
Cleanliness of the face	Clean	405	53.3
	Unclean	355	46.7
Flies on the face within 3 seconds	Yes	273	35.9
	No	487	64.1
Child squinting during twilight	Yes	200	26.3
	No	560	73.7

Predictors of Dietary Diversity Status

Bivariate Poisson regression analysis identified that fathers' education, the time required for fetching water, source of water, access to a latrine, solid waste disposal system, sharing the same home with animals, frequency of face washing, cleanliness of the face, presence of flies on the face within 3 seconds of observation, and child squinting during twilight were associated with active trachoma among children aged 1-9 years at p-value < 0.25. After adjusting for possible confounders, the prevalence ratio of active trachoma for those who traveled a walking distance of more than 30 min to fetch water was 1.53 times higher than those who got water in their compound (APR=1.53; 95% CI: 1.13, 2.06).

The prevalence of active trachoma was 22 % higher among children who lacked latrine facilities than those who did (APR=1.22; 95% CI: 1.01, 1.47). The prevalence ratio of active trachoma among children who shared the same home with animals was 4.20 times higher than those who did live in separate houses (APR=4.20; 95% CI: 3.18,5.56). The prevalence ratio of active trachoma among children with unclean faces during the observation was 4.11 times higher than those without (APR=4.11; 95% CI: 2.46, 6.87). In comparison to children with flies not noticed, the prevalence of active trachoma was 15% higher in those children with flies observed on their faces within 3 seconds of direct observation (APR=2.15; 95% CI: 1.46, 3.16) (Table 3).

Table 3. Factors associated with active trachoma among children (aged 1-9 years) in Haramaya District, Eastern Ethiopia, 2017 (n=760)

Variables	Active trachoma		CPR (95%CI)	APR (95%CI)
	Yes n (%)	No n (%)		
Father's educational level				
Illiterate	157(42)	217(58)	1	1
Primary and above	48(12.4)	338(87.6)	0.29(0.22,0.39)	1.21(0.80,1.83)
Time required to fetch water				
In compound	134(24.9)	404(75.1)	1	1
5-30 min	30(22.2)	105(77.8)	0.89(0.63,1.26)	1.36(0.99,1.85)
> 30 min	41(47.1)	46(52.9)	1.89(1.45,2.47)	1.53(1.13,2.06) *
Source of water				
Protected	191(26.2)	537(73.8)	1	1
Unprotected	14(43.8)	18(56.2)	1.67(1.10,2.52)	0.66(0.44,1.01)
Accessibility of latrine				
Yes	87(18.7)	378(81.3)	1	1
No	118(40)	177(60)	2.14(1.68,2.71)	1.22(1.01,1.47) *
Solid waste disposal system				
Available	56(21.8)	201(78.2)	1	1
Not available	149(29.6)	354(70.4)	1.36(1.04,1.78)	0.92(0.75,1.13)
Sharing a home with animals				
Yes	156(70.3)	66(29.7)	7.71(5.83,10.21)	4.20(3.18,5.56) *
No	49(9.1)	489(90.9)	1	1
Frequency of face washing				
Once per day	163(34.7)	307(65.3)	1	1
Twice per day	27(10.4)	233(89.6)	0.29(0.21,0.44)	0.73(0.53,1.01)
Occasionally	15(50)	15(50)	1.44(0.98,2.11)	1.11(0.88,1.39)
Cleanliness of the face				
Clean	17(4.8)	338(95.2)	1	1
Unclean	188(46.4)	217(53.6)	9.69(6.02,15.59)	4.11(2.46,6.87) *
Flies on the face within 3 seconds of observation	149(54.6)	124(45.4)	4.75(3.63,6.21)	2.15(1.46,3.16) *
Yes	56(11.5)	413(88.5)	1	1
No				
Child squinting during twilight				
Yes	88(44)	112(56)	2.11(1.68,2.64)	1.01(0.82,1.63)
No	117(20.9)	443(79.1)	1	1

Discussion

According to this study, the prevalence of active trachoma among children aged 1-9 years was 27%. The factors associated with active trachoma were a long time to fetch water (more than 30min), lack of latrine, living in the same house with animals, unclean face, and flies observed on the face within 3 seconds of inspection.

In this study, active trachoma was higher than the WHO trachoma elimination target (<5%). This implied that active trachoma remains a public health problem although Ethiopia signed the VISION 2020 initiative and developed its own 20 years' strategic plan to eliminate trachoma (Gedefaw *et al*., 2013), and it also highlights the urgent need for mass distribution of antibiotics to stop the spread of trachoma in the district. This finding was a bit higher than the findings studies conducted in the Afar, Dire Dawa, Benishangul-Gumuz, Tigray,Gambella, and Somali regions (21.4%) (Gebrie *et al.,* 2019), and Jimma Zone of Ethiopia (25.2%) (Ejigu *et al*., 2013).

The higher prevalence in our study could be attributed to inadequate integration of eye care, personal hygiene, and environmental sanitation into school-based health education programs and less antibiotic mass treatment coverage. However, it was lower than the studies done in the Wagehemra Zone (52.4%) (Anteneh and Getu, 2016), Wolaita Zone (37.9%) (Alambo *et al*., 2020) and Gamo Gofa Zone (36.7%), Ethiopia (Mengistu *et al*.,

2016). The variation might be due to higher latrine availability in the current study setting and disease endemicity, and poor implementation of health extension packages in health promotion, disease prevention, hygiene, and environmental sanitation.

Time is taken (greater than 30 minutes) to fetch water for household consumption was significantly associated with the development of active trachoma. This finding was congruent with previous studies carried out in Kersa district, South West, and Dambia district North West Ethiopia (Ejigu *et al*., 2013; Ferede *et al*., 2017). This could be because getting the water source in a shorter time/distance can facilitate keeping personal hygiene, thereby decreasing the risk of trachoma. On the other hand, the literature argues that more proximate water sources may serve as an indicator of an increased quantity of water, but is not a guarantee for improved water quality, and enhancement the practice of keeping personal hygiene (Stocks *et al*., 2014; Gudata *et al*., 2021). Moreover, the household's allocation of water for hygienic purposes could also be a stronger determinant of the prevalence of active trachoma than the amount of time it takes to fetch water.

Inaccessibility to latrines was a predictor of active trachoma which was consistent with the previous findings of the studies in Areka, Wolaita Zone, and Dera District, Ethiopia (Alemayehu *et al.,* 2015; Alambo *et al.,* 2020) and in Zamfara state, Nigeria (Muhammad *et al*., 2015). The reason might be that lack of access to latrines facilitates open-field defecation. *Musca Sorbens* flies were attracted to volatile odors from human faces, which promotes the growth of the flies spreading the C*hlamydia trachomatis* bacteria that is a primary cause active trachoma (Bristow *et al*., 2020; Abebe and Tucho, 2021). On the other hand, the access and proper use of latrine facilities enabled proper sanitation and disposal of fecal matter from the environment which minimizes fly breeding sites, thereby decreasing the risk of transmission (Gebrie *et al*., 2019). A longitudinal study indicated that more access to latrines declined the incidence of ocular chlamydia (Meron Haile, 2013).

This study found that sharing the same home with an animal was associated with active trachoma. Similar findings were reported from previously conducted studies in Gonji Kolella district, West Gojjam zone, Arba Minch and Mojo and Lume districts of Ethiopia (Yalew *et al*., 2012; Nigusie *et al*., 2015; Glagn Abdilwohab and Hailemariam Abebo, 2020). This might be because flies normally require food, moisture, and warm temperatures to survive and multiply, and the manure and urine of the animals serve as the ideal media for providing both necessities, which increases children's exposure to the flies. However, one study in Ethiopia reported that sharing the same home with the cattle was found to have a protective effect (Muluneh *et al*., 2016). Therefore, further investigation is recommended to ascertain it.

In this study, an unclean face showed an association with active trachoma. This finding was in line with previous studies done in Zala district, Gamo Gofa Zone, Baso Liben District of East Gojjam, Dera Woreda, Arba Minch Health, and Demographic Surveillance Site of Ethiopia (Ketema *et al*., 2012; Alemayehu *et al.,* 2015; Mengistu *et al*., 2016; Glagn Abdilwohab and Hailemariam Abebo, 2020).The reason might be that flies can be attracted by an unclean face or the presence of ocular discharge. Specifically, female flies play a crucial role in the mechanical transmission of trachoma while consuming human ocular and nasal secretions to obtain the nutrients necessary for egg production (Ramesh *et al*., 2016).

The study has certain limitations. The cross-sectional nature of the study design did not show the temporal relationship between trachoma and associated factors. Some factors like estimations of household time to fetch water merely relied on the participants' responses. Dacron swabs of the upper right tarsal conjunctiva were not evaluated with a PCR assay. Concordance or discordance among observers (optometrists) was not done.

Conclusion

The study revealed that about a quarter of children aged 1-9 years had active trachoma. Spending more than 30 minutes to fetch water, lack of a latrine facility, sharing a home with animals, the unclean face of children, and flies observed on the face during 3 minutes of inspection were associated with active trachoma. Designing an intervention that enhances personal and environmental hygiene in children through proper face washing, and proper disposal of human fecal matter is recommended to reduce the risk of active trachoma among children in the area. Similarly, community levels awareness creation activity needs to build a separate home for animals. Further strengthening the implementation of the SAFE strategy for the control and treatment of trachoma to end the infection cycle is vital.

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Competing Interests

The authors declare that they have no competing interests.

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This study was not funded by any organization.

Authors' Contributions

All authors made a substantial contribution to the conception, design, acquisition, and interpretation of data. All authors have revised the article critically for important intellectual content. All authors read and approved the final version of the manuscript.

List of Abbreviations

AOR; Adjusted Odds Ratio, CI: Confidence Interval, COR; Crude Odds Ratio, EDHS; Ethiopian Demographic and Health Survey.

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