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ABSTRACT

BACKGROUND: Approximately 1.9 million people worldwide are blind or visually impaired due to trachoma, and trachoma remains endemic in 44 countries. Amhara in Ethiopia has the highest burden of trachoma in the world. A key indicator of whether active trachoma requires public health intervention is the incidence of trachomatous inflammation-follicular in children aged 1 to 9 years. However, limited study has been conducted on the determinants in rural communities. This study therefore aimed to fill this gap by identifying determinants in the Gozamn district of northwestern Ethiopia.

METHODS: A community-based case-control study was carried out between March 15 and April 30, 2021. Five or more follicles on the epitaxial conjunctivae that are larger than 0.5 mm were considered a case. Controls were free of any sign of trachoma. A semi-structured questionnaire and an observational checklist were used to gather the data, and STATA version 14 was used for the analysis. Using a 95% confidence interval, both bivariable and multivariable conditional logistic regression was performed.

RESULTS: A total of 726 mothers/caregivers participated in this study, with a participation rate of 98.4%. Children from poor families (mAOR = 4.68; CI: 2.80-6.21), households where the water source is far from home (>30 minutes) (mAOR = 4.91; KI: 1.37-12.56), mean daily water consumption (<20 l/c/d) (mAOR = 4.42; CI:1.71-11.39), face washing frequency less than once a day (mAOR = 10.64; CI: 2.58-18.84), cloth washing frequency once a month or less (mAOR = 9.18; CI: 2.20-18.62), and mothers or caregivers with poor knowledge of active trachoma (mAOR = 3.88; CI: 1.47-10.22) were determinants of trachomatous inflammation-follicular.

CONCLUSIONS: We conclude that infrequent faces and clothes washing; unavailability of water, children in poor families, and poor knowledge of mothers/caregivers were risk factors. Health education initiatives about active trachoma, its prevention, and control methods focusing on personal hygiene are so required.

KEYWORDS: Trachomatous inflammation-follicular, children, matched, case-control study, determinant, rural area, Ethiopia

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Background

The most prevalent infectious cause of blindness in the world is trachoma. It is caused by Chlamydia trachomatis[1] and children are the main reservoir.[2] The following is world health organization (WHO) clinical grade for trachoma: active trachoma with follicles (TF) is defined as having at least 5 follicles, each measuring at least 0.5 mm in diameter, on the upper epitaxial conjunctiva. The appearance of considerable inflammatory thickening of the epitaxial conjunctiva, which covers half of the typical deep epitaxial vessels, is a sign of active trachoma intense (TI). The palpebral conjunctiva may have a type of scarring, trachomatous scar (TS). These scars are plainly apparent as white bands, sheets, or lines in the conjunctiva of the tarsal vessels. Trachomatous trichiasis (TT) is characterized by the presence of one or more eyelashes that rub against the eyeball or by signs of recently removed everted eyelashes. When viewed through the opacity, at least a portion of the pupil margin is obscured, which is known as corneal opacity (CO).[3,4] Since active trachoma is a family-based illness, it tends to cluster in homes and communities.[5]

Fourteen countries had reported accomplishing their elimination goals as of January 6, 2022.[6] Even though the prevalence of active trachoma has dramatically decreased in the last decades, the disease still exists, especially in underdeveloped areas, including large cities. Around 1.9 million people have been rendered blind or visually impaired throughout the worldwide[1] and it is still endemic in 44 countries.[7]

West Africa and the savannah parts of East and Central Africa have the highest prevalence of active trachoma and trichiasis, making Africa the worst-affected continent. Trachoma is hyper endemic (defined as TF prevalence in 1-9 years-olds of 30%) in a significant number of the investigated districts, including South Sudan (83%), Ethiopia (64%), Guinea (50%), Uganda (37%), Chad (38%), Cameroon (38%) and Tanzania (32%), among others.[8]

Trachoma is the third most common cause of impaired vision and the second most common cause of blindness in Ethiopia, where it is prevalent. Children aged 1 to 9 years old had a 40.1% prevalence of active trachoma.[9,10] Ethiopia, like some other African countries, has only consistently implemented the "antibiotics" component of SAFE strategy's,[11] while under-performance has been reported regarding the "F" and "E" components.[12]

Trachoma has historically been one of the most prevalent diseases in Amhara.[13] Impact surveys conducted in 2015 indicated that the average prevalence of active trachoma in this region was 25.9% (24.9%-26.9%).[14] Up to 90% of people had TF before the implementation of SAFE strategy.[15] Active trachoma was still prevalent in the Baso Liben District of the East Gojjam Zone at 24.1%. 54 (6.9%) of these were TI cases, while 137 (17.2%) were TF cases.[16]

Investigations about determinants of trachomatous inflammation-follicular are yet limited and unstudied in Gozamn district, but socio-demographic characteristics that contribute to crowded living situations, such as a high family size and the presence of children between the ages of 1 and 9, make active trachoma more contagious.[17] Environmental risk factors that are prevalent in underdeveloped nations assist the endemic character of active trachoma.[18,19] The SAFE strategy, which is being supported by WHO as a way of achieving Global Elimination of Trachoma (GET) by 2030, takes into account the significant impact that these environmental factors play in transmission. In addition to the poor quality evidence from peer-reviewed literature on the strength of the association between these risk factor variables and the prevalence of active trachoma, measures to increase face washing or enhance the environment have been neglected.[11]

A few institutional-based matched case-control studies have identified factors related to trachomatous trichiasis.[20,21] In contrast, most studies have focused on the prevalence and proven ambiguous on the independent predictors of TF in rural communities.[16,22] Therefore this study aims to identify determinants of trachomatous inflammation follicular among children 1 to 9 years old using a community-based matched case-control study approach by controlling confounders.

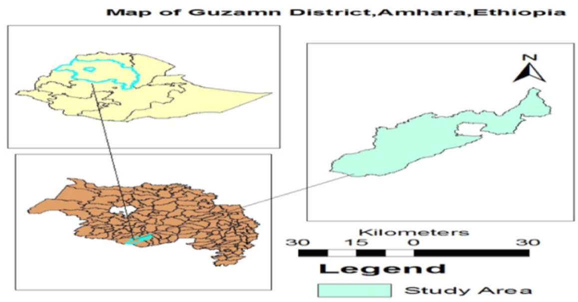

Figure 1. Map of Gozamn District, Amhara, Ethiopia, by Balew Adane, 2021.

Methods and Materials

Study area descriptions

The Gozamn district served as the study site (Figure 1). It is one of the 20 districts that make up Ethiopia's Eastern Gojjam Zone. The district has 30 kebeles (Ethiopia's smallest administrative division). A total of 153 151 people live in the district, of which 30 982 are women of childbearing age (15-49 years old). There are also 4769 infants and 20 747 children aged 1 to 9. Six health centers` and 26 health posts within the district provide community health services.[23] The district has 29 565 houses and 30 180 households with an average population of 4.4 persons per household.[24]

Study design and source populations

From 15 March to 30 April 2021, a community-based matched case-control study design was used. The study population consisted of children who were cases and matched controls and their mothers/caregivers in selected 6 *kebeles*. All children aged 1 to 9 years and their caregivers/mothers from rural *kebele* in Gozamn District were the source population.

Sample size determination

Pitman efficiency assumption of the matched pair sample size[25] was taken into consideration when estimating the sample size for the matched case-control study design.[26]

Using the following assumptions, a sample size of 738 participants was deemed adequate: (1) a likelihood of type I error of 5%; (2) a test's 80% power; (3) a probability of type II error of 10%; and (4) a ratio of 1 case to 2 controls, or 246 cases: 492 controls; (5) Based on the primary interest variables, the suitable exposure variables in controls were chosen from a variety of exposure variables which was based on a study done among children aged 1 to 9 in Baso Liben District, Amhara, Ethiopia (access to water source: 28.7%[16]; (6) anticipated odds; ratio is 1.75; (7) there is a 10% non-response rate; and (8) according to Pitman efficiency criterion, the control-to-case ratio (R) is 2.[25] Because case-control studies are analytical designs that do not require design effect and because the study's design did not permit the use of design effect, this study did not employ design

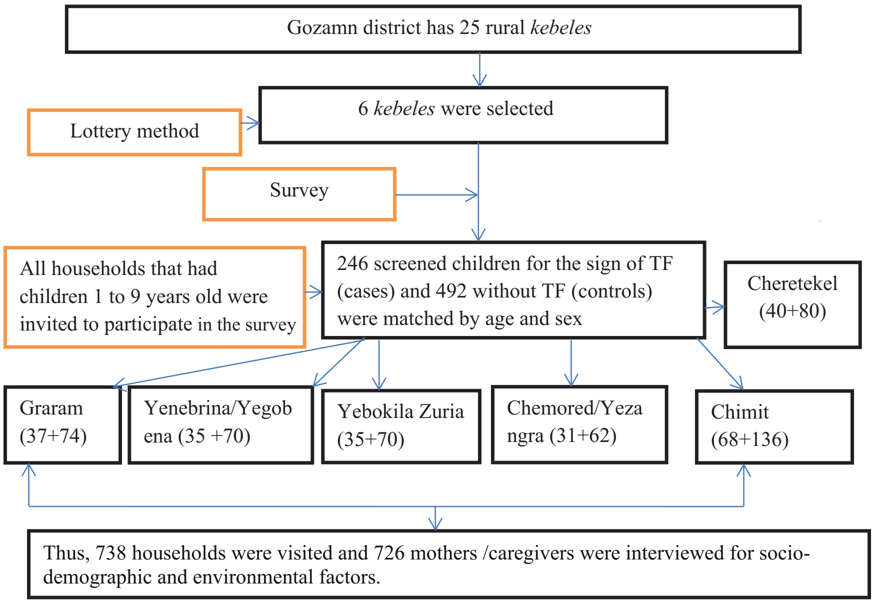

Figure 2. The schematic diagram of sampling procedures in selecting 1 to 9 years old case and matched control children in Gozamn District, northwest Ethiopia, from 15 March to 30 April, 2021.

effect. Thus, sample size calculation for number of cases using the above assumptions[26]:

$$n = (R+1)\,[Z_{a/2}(1+OR)+2Z_{\beta}\sqrt{OR}]^{2\div}$$
$$2R\,(OR^{2}\text{-}1)^{*}S\,(P, OR) \text{ where, } S\,(P, OR)=(OR\text{-}1)^{*}P\,(1\text{-}P)/(1\text{-}P)\;+P\,(OR),$$

where n = Initial sample size

P = .287, R = 2, OR = 1.75, $Z\alpha_{/2}$ = 1.96, $Z_{\beta-1}$ = 1.28. Therefore, the initial calculated sample size (n) becomes 221 cases. After considering 10% non-response rate, the sample size was estimated as; final sample size [N] $= \frac{n}{1-10\%}$ Then, sample size for cases, N = 221/1-10% = 246. Control sample size = case sample size*R. Hence, the paired controls were calculated by multiplying the case with R, which is 246 × 2 = 492.Total sample size for this study sample became 738.

Inclusion and exclusion criteria's

Mothers/caregiver of children aged 1 to 9 who were not permanent residents (who did not have a *kebeles* identity card) and mothers or caregiver who did not give verbal consent were not included in the study. If 2 cases and 2 controls lived in the same household, one was excluded by a lottery method due to equal exposure to environmental factors

Case and matched control selections

As TF is a family-based disease that clusters at the household and community level, there was no established sampling framework for case and control selections using a systematic sampling approach.[5] TF was identified in children aged 1 to 9 years using the WHO signs and symptoms of TF, defined as ⩾5 follicles on the epitaxial conjunctiva ⩾0.5 mm in diameter. The control group was children aged 1 to 9 who showed no signs of trachoma, lived in the same village, but did not belong to the same family. To increase the number of available controls, the age of controls was set at case age ±2 months. After identifying cases and controls, house-to-house data collection was conducted from mothers or caregivers (Figure 2).

Operational definitions

Trachoma inflammation, the follicle (TF): According to the definition of WHO, "a condition in which 5 or more follicles with a diameter of 0.5 mm or more are present in the central part of the epitaxial conjunctiva."[27]

Availability/accessibility of water: The principal water source is 30 minutes away from the home, and the daily water consumption in the home is 20 l/cap.[28]

Knowledge about trachoma: Mothers or caregivers were quizzed on the disease's signs and symptoms, modes of transmission, and methods of prevention, and their answers were graded as <50% = poor knowledge, 50% to 75% score = moderate knowledge, >75% score = good knowledge.[29]

Poor solid waste disposal: At the household level, generated trash was not disposed of in sacks, pits for solid waste disposal, or by composting.[30]

Poor liquid waste discharge: Septic tanks or soak pits were not used to dispose of generated liquid waste at the household level.[30]

Districts: Populations of 100 000 to 250 000 people.[31]

Rural areas: Rural areas are defined as territory, population, and housing units that the census bureau does not categorize as urban or those without a municipality.[32]

Variables and measurements

For TF, the outcome variable was a dichotomous measure, based on WHO simplified grading scale, for the absence/presence of trachomatous inflammation—follicular.[33]

Age of mothers/caregivers, marital status of mothers/caregivers, educational status of mothers/caregivers, educational status of fathers, occupation of the mothers/caregivers, family size, birth order of children were measured by asking mothers/caregivers of children 1 to 9 years old of both cases and controls. Using principal component analysis, indices of family wealth were determined using selected assets in rural areas.[34]

The type of water source, average water consumption (l/c/d), and distance of water source (round trip per time) were measured by asking mothers/caregivers of children. Solid waste disposal method, liquid waste discharge method, latrine availability, and locations of cattle house was measured by direct observations.

Frequency of children's face washing, children's clothes washing, and knowledge of mothers/caregivers about active trachoma were measured by asking mothers/caregivers of children 1 to 9 years old of both cases and controls.

Data collection procedures

With the aid of a semi-structured, pre-tested questionnaire, face-to-face interviews, and an observational checklist for socio-demographic behavioral and environmental variables were gathered. The questionnaire was initially written in English, translated into Amharic, and then returned to English with the aid of Google Translate. Ten health professionals were chosen to conduct eye examinations (six) and gather data (four). Three public health experts who were trained as integrated eye workers for an eye examination, and 3 diploma nursing assistants for eye examination have participated. Using a magnifying loupe (×2.5) and torchlight, the children`s eyelids were everted and individually checked for indications of TF on the superior epitaxial conjunctiva (flashlight). Examiners were observed to ensure that they cleaned their hands with alcohol after inspecting each subject in order to prevent cross-infection. Both the data collectors (4 environmental health professionals) and mothers or caregivers were blinded to cases and controls to prevent bias in the data collection phase.

Data quality assurance

In addition to properly designing and pre-testing the questionnaires, Cranach's alpha test was applied to test the consistency and validity of the questionnaires, which measured a score of 0.70, indicating the validity of the questionnaires was assured.

Five percent of the sample size had a pretest in neighboring Aneded District Daget/Yezeleka *kebeles* with comparable socio-demographic characteristics. The data collectors completed the pre-test to increase their capacity for data collection

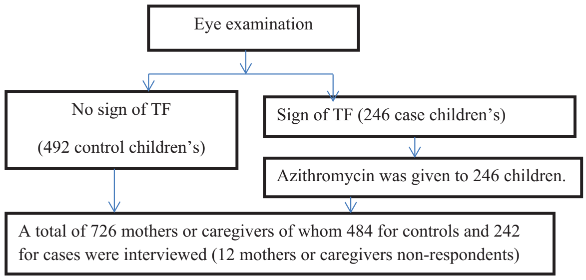

Figure 3. The schematic presentation of eye examination and result reporting procedure of TF in 1 to 9 years old case and matched control children in Gozamn District, northwest Ethiopia, from 15 March to 30 April 2021.

during the real data collection. The Carter Center trained public health professionals and assistants in the WHO trachoma grading system. The principal investigator trained data collectors for 1 day on the purpose of the study, the questionnaire's content, the data collection process, how to assist study participants, and various ethical issues before the pretest, and the pretest results were discussed to allay any worries. The investigator verified the accuracy and completeness of the collected data each day. The following morning, the data collectors received the appropriate feedback, and any missing data was re-gathered.

Data management and analysis

To check for consistency, completeness, and the presence of missed values, the data were cleansed. After that, Epi-Data version 4.6 was used to code and input the finished survey. A Multicollinearity test was also conducted using a variance inflation factor, and there is no correlation detected between variables. STATA version 14 was used to analyze the data. For cases and controls, descriptive statistics [n (%)] were performed, including means (standard deviations) for continuous variables. Then, a 95% confidence interval matched adjusted odds ratio (mAOR) and bivariable matched crude odds ratio (mCOR) conditional logistic regression analysis was run. All independent variables with a *P*-value of less than .25 in the bivariate analysis were included in the multivariate analysis. Then, in the multivariable analysis, factors with a *P* value less than .05 were taken into consideration determinants of TF.

Results

Socio- demographic and economic characteristics of study participants

Out of 738 (246 cases and 492 control) children`s mothers or caregivers in the study, 242 cases, and 484 controls children's mothers or caregivers participated, for a response rate of 98.4% (Figure 3).

The majority, 213 (88.0%) and 306 (63.2%) of the case and controls child mothers/caregivers were illiterate. Ninety-seven (40.1%) of case children belong to poor households compared

Table 1. Mothers/caregivers-related socio-economic and demographic determinants among 1 to 9 years old case and matched control children in a rural area of Gozamn District, Ethiopia, from 15 March to 30 April, 2021 (N = 726).

VARIABLES	TF CASES (N = 242) N, %	CONTROLS (N = 484) N, %	MCOR (95% CI)	*P*-VALUE
Age of mothers/ caregivers				
>49 years	58 (24.0)	86 (17.8)	1.46 (0.94-2.06)	.093
⩽49 years	184 (76.0)	398 (82.2)	Ref	
Marital status of mothers/caregivers				
Non married	60 (24.8)	93 (19.2)	1.39 (0.97-1.82)	.096
Married	182 (75.2)	391 (80.8)	Ref	
Educational status of mothers/ care givers				
Illiterate	213 (88.0)	306 (63.2)	4.27 (2.33-6.43)	<.001
Literate	29 (12.0)	178 (36.8)	Ref	
Educational status of fathers				
Illiterate	216 (89.3)	378 (78.1)	2.33 (1.20-3.55)	.012
Literate	26 (10.7)	106 (21.9)	Ref	
Occupation of caregivers				
Farmers	193 (79.8)	383 (79.1)	1.04 (0.37-1.78)	.633
House wife	49 (20.2)	101 (20.9)	Ref	
Household occupants /family size				
>5	143 (59.1)	144 (29.8)	3.41 (1.50-5.24)	<.001
⩽5	99 (40.9)	340 (70.2)	Ref	
Wealth index of the family				
Rich	92 (38.0)	355 (73.3)	Ref	.024
Medium	53 (21.9)	66 (13.7)	2.12 (2.59-6.56)	<.001
Poor	97 (40.1)	63 (13.0)	6.41 (5.16-8.71)	

Abbreviations: Ref, reference category; unadjusted mCOR, unadjusted matched crude odds ratio; CI, confidence interval.

to the control children which is 63 (13.0%) (Table 1). The mean age of mothers/caregivers among cases and controls was 43.8 (±8.9) and 38.1 (±7.8) years respectively. The mean current family size of the 2 groups was 6.2 (±1.7) and 5.1 (±1.5) for the cases and controls, respectively.

Environmental-related determinants

Out of the total 242 cases and 484 controls children mother or caregiver, 140 (57.8%) and 280 (57.8%) used water from unimproved sources respectively. One hundred fifty-five (64.0%) of cases and 99 (20.5%) of control children mothers or caregivers had to walk >30 minutes (round trip) to fetch water, most 214 (88.4%) of the cases and least 217 (44.8%) of the control children mothers or caregivers average water consumption were <20 l/c/d. Mostly 159 (65.7%) of case mothers or caregivers poorly discharge the liquid waste generated (Table 2).

Behavioral-related determinants

Among 242 and 484 mother/caregivers of cases and controls 90 (37.2%) of cases and 413 (85.3%) of controls mothers/caregivers washed their children's faces once or more times a day respectively. Eighty-two 82 (33.9%) of mothers/caregivers of cases and 345 (71.3%) of mothers/caregivers of controls washed their children's clothes 3 or more times a month (Table 3).

Determinants of trachomatous inflammation follicular

In multivariable conditional logistic regression, variables that exhibit a correlation with TF at a *P*-value of less than .25 from the bivariate analysis were included. Among children aged 1 to 9 years, a significant relationship between 6 factors and trachomatous inflammation-follicular was identified.

Table 2. Water and waste disposal related determinants among 1 to 9 years old case and matched control children in a rural area of Gozamn District, Ethiopia, from 15 March to 30 April 2021 (N = 726).

VARIABLES	TF CASES (N = 242) N, %	CONTROLS (N = 484) N, %	MCOR (95% CI)	*P*-VALUE
Type of water sources				
Unimproved	140 (57.8)	280 (57.8)	1.00 (0.51-1.92)	
Improved	102 (42.2)	204 (42.2)	Ref	
Distance of water sources				
>30 min	155 (64.0)	99 (20.5)	6.93 (3.50-10.37)	<.001
⩽30 min	87 (36.0)	385 (79.5)	Ref	
Average daily water consumption				
<20 l/c/d	214 (88.4)	217 (44.8)	9.40 (5.29-13.59)	<.001
⩾20 l/c/d	28 (11.6)	267 (55.2)	Ref	
Latrine facilities				
Latrine available	160 (66.2)	300 (62.0)	Ref	.46
No latrine	82 (33.8)	184 (38.0)	1.12 (0.12-4.27)	
Liquid waste discharge method				
Poor discharge	159 (65.7)	248 (51.2)	1.82 (1.53-2.41)	.033
Proper discharge	83 (34.3)	236 (48.8)	Ref	
Solid waste disposal method				
Poor disposal	143 (59.1)	187 (38.6)	2.29 (1.60-2.94)	.025
Proper disposal	99 (40.9)	297 (61.4)	Ref	
Location of cattle house				
Attached to the house	176 (72.7)	270 (55.8)	2.11 (1.66-3.15)	.028
Detached from the house	66 (27.3)	214 (44.2)	Ref	

Abbreviations: Ref, reference category; unadjusted mCOR, unadjusted matched crude odds ratio; CI, confidence interval.

Table 3. Behavioral-related determinants among 1 to 9 years old case and matched control children in rural areas of Gozamn district, northwester Ethiopia, from 15 March to 30 April, 2021.

VARIABLES	TF CASES (N = 242) N, %	CONTROLS (N = 484) N, %	mCOR (95% CI)	*P*-VALUE
Child face washing frequency				
Less than once a day	152 (62.8)	71 (14.7)	9.82 (6.21-13.42)	<.001
Once or more times a day	90 (37.2)	413 (85.3)	Ref	
Child cloth washing frequency				
Three or more times a month	82 (33.9)	345 (71.3)	Ref	
Twice a month	63 (26.0)	76 (15.7)	3.49 (2.59-5.36)	<.001
Once or less times a month	97 (40.1)	63 (13.0)	6.48 (3.06-9.91)	<.001
Knowledge of mothers/caregivers about TF				
Good knowledge	83 (34.3)	90 (18.6)	Ref	
Moderate knowledge	63 (26.0)	100 (20.7)	1.46 (1.31-2.13)	.036
Poor knowledge	96 (39.7)	294 (60.7)	2.82 (1.98-3.72)	<.001

Abbreviations: Ref, reference category; unadjusted mCOR, unadjusted matched crude odds ratio; CI, confidence interval.

The major results of this study showed that children who cleansed their faces less than once a day had 10.64 (mAOR: 10.64 CI: 2.58-18.84) times higher odds of acquiring TF than those who washed their faces once or more frequently during the day.

Children who had their clothes washed once a month or fewer had a 9.18 (mAOR: 9.18 CI: 2.20-18.62) times greater chance of having TF than those whose clothes were washed 3 or more times per month and 4.12 (mAOR: 4.12 CI: 2.59-6.56) times greater chance than those whose clothes were washed twice per month.

Children from low-income families had a 4.68 (mAOR: 4.68 CI: 2.80-6.21) higher risk of developing TF than those from wealthy families.

When compared to children of caregivers with good knowledge, children of caregivers with poor knowledge were 3.88 (mAOR: 3.88 CI: 1.47-10.22) times more likely to have TF.

Children aged 1 to 9 years from households with low water consumption (<20 l/c/d) were at increased risk of developing TF (mAOR: 4.42 CI: 1.71-11.39) than households using 20 l/c/d or more.

Children living in households without access to water within a 30-minute walk were more likely to develop TF (mAOR: 4.91 CI: 1.37-12.56) than children who could access water within 30 minutes or less on foot (Table 4).

Table 4. Multivariable conditional logistic regression analysis of socio-demographic environmental and behavioral factors of trachomatous inflammation follicular among 1 to 9 years old case and matched control children in a rural area of Gozamn District, Ethiopia, 2021 (N = 726).

VARIABLES	mAOR (95% CI)	*P*-VALUE
Wealth index of the family		
Rich	Ref	
Medium	1.08 (0.85-3.62)	.630
Poor	4.68 (2.80-6.21)	.008
Average daily water consumption		
<20lc/d	4.42 (1.71-11.39)	.002
⩾20 l/c/d	Ref	
Distance of water source		
>30 min	4.91 (2.47-12.56)	.001
⩽30 min	Ref	
Child face washing frequency		
Less than once a day	10.64 (2.58-18.84)	<.001
Once or more times a day	Ref	
Child cloth washing frequency		
Three times a month and more	Ref	
Two times a month	2.78 (0.65-6.77)	.164
One times a month or less	9.18 (2.20-18.62)	<.001
Knowledge of mothers/care givers about TF		
Good knowledge	Ref	
Moderate knowledge	1.16 (0.05-2.43)	.282
Poor knowledge	3.88 (1.87-10.22)	.006

Abbreviations: Ref, reference category; mAOR, adjusted matched odds ratio; CI, confidence interval.

Discussions

The aim of this study was to identify the cause of TF in children aged 1 to 9 years living in the rural Gozamn district between 15 March and 30 April 2021. The presence of TF was determined by poverty, distance to water source >30 minutes (round trip), mean daily water consumption <20 l/c/day, frequency of washing children's faces and clothes, and poor knowledge of TF the mothers and caregivers.

A poor household's economic situation is significantly associated with the development of TF as opposed to a wealthy one. This might be because wealthy people can afford to buy sanitizer and soap to maintain personal and environmental hygiene and limit the entry of *Musca sorbens* flies. According to a study done in the Southern region's Leku town, the prevalence of active trachoma is highly correlated with the poor economic level of the household.[35] According to a study on the prevalence and correlations of active trachoma in rural preschool children in Wadla region, northern Ethiopia, the lowest economic position has been substantially correlated with the frequency of active trachoma.[36,37]

In our study, consistent with previous studies children aged 1 to 9 years from households using less than 20 l of water per cap/day were more likely to have TF than those using 20 l per day or more. Active trachoma rates were higher in children from families with an average daily water intake of 2 to 4 l/capita than those drinking more than 8 liters/capita, according to a study conducted in the Baso Liben District, which shares a border with the study area.[16] Water scarcity contributes to the prevalence of trachoma, as households do not have enough water to wash their faces, wash dirty clothes, wash their hands after using the toilet, and do other personal hygiene practices.[38]

The study also found that more children with TF were identified in families where walking to the water required more than 30 minutes as opposed to households where walking to the water required 30 minutes or less. In agreement with this study, a related investigation revealed that children from households with water access more than 30 minutes away from their homes were more likely to have active trachoma than children from households with water access no more than 30 feet away.[16] The prevalence of TF in children and the distance to a water source have both been linked in other research. More than

30 minutes of walking in Malawi[39] and more than 2 hours in Tanzania.[40]

It was also observed that children who washed their faces less than once a day were more likely to develop TF than those who washed their faces more than once a day. This finding is supported by another study, which shows that children with dirty faces are more likely to have active trachoma than those with clean faces.[16] Numerous other studies found that clean faces and frequent face-washing practices are associated with reduced prevalence of active trachoma.[41-43] This suggests that improvement in face-washing behavior can significantly reduce a children's risk of acquiring or transmitting the trachoma. Additionally, children whose clothes were washed one time a month or less were more likely to have TF than children whose clothes were washed 3 times a month or more. We were less likely to find evidence that supports this finding.

Children of mothers or caregivers who had poor knowledge about TF were more likely to have TF than those children of mothers or caregivers who had good knowledge. This finding is consistent with other studies in Ethiopia that reported a 4% to 12% reduction in trachoma overall after providing health education to the community.[44-46]

Strengths and Limitations of the Study

By addressing confounders, the matched case-control design of this study made it more successful than unmatched case-control and cross-sectional studies in identifying the determinant of TF. A study limitation is the lack of utilization of the Dacron swab for the Chlamydia RNA (Ribonucleic Acid) polymerase chain reaction test to confirm ocular chlamydia infection. Some results may be exaggerated or understated because some of the data were gathered through self-reporting in answer to interviewer questions (eg,: methods used to estimate average daily water consumption, distance of water source). Finally here may be bias in recall because individuals were questioned after the fact regarding risk factors.

Conclusions

We can conclude that having poor knowledge mothers and caregivers, washing the children's faces less than once a day, washing the children's clothes once a month or less, living more than 30 minutes from water sources, using less than 20 l of water per cap/day on average, and children who belongs to poor families are all determinants for the prevalence of TF.

In order to raise mothers` and caregivers' knowledge of TF and to promote face and clothing washing healthcare professionals must put in a lot of effort in community meetings and schools. Additionally, non-governmental organizations (NGOs) and government stakeholders had to increase water accessibility by constricting additional water standpipes in the village. Last but not least, collaborative work is critical among the communities, government organizations, and NGOs like carter center to implement a SAFE strategy focusing on facial cleanliness and environmental improvement to prevent and control TF in a rural area of Gozamn district Ethiopia.

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Authors' Contributions

BA, MA, AA, and AM: Initiated the research, wrote the research proposal, conducted the research, BS, BA, MM, MG, LW, TT, AM and LK participate in data entry and analysis. BA, YB, MA, GY and AA wrote and edited the manuscript. All authors read and approved the final manuscript.

Availability of Data and Materials

The datasets collected and/or analyzed during the current study are available from the corresponding author on reasonable request.

Consent for Publication

Not applicable.

Ethics Approval and Consent to Participate

The Declaration of Helsinki's ethical principles were adhered to in all study techniques.[47] Wollo University College of Medicine and Health Sciences Ethical Review Committee (ERC) gave its approval (Protocol number: 594/13/13). From the Gozamn District Health Office, the East Gojjam Zonal Health Department, and six chosen *kebeles*, a letter of permission was obtained. Informed consent was obtained from mothers or caregivers of the sampled case and matched control children. The respondents were made fully aware of their ability to reject to participate in the process at any moment and to do so at any time. Those who were identified as having TF were given azithromycin.

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