



RESEARCH ARTICLE

PREVALENCE AND RISK FACTORS FOR TRACHOMA AMONG PRIMARY SCHOOL CHILDREN IN SANA'A CITY, YEMEN

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Abstract

Background: Trachoma is a contagious infection caused by *Chlamydia trachomatis*. The disease causes roughness of the inner surface of the eyelids which in turn leads to eye pain, collapse of the outer surface and scratching of the cornea, and ultimately blindness.

Objectives: This study was designed to determine Trachoma prevalence and associated risk factors among primary school children in Sana'a city, Yemen.

Methods: A cross-sectional study was performed on 991 schoolchildren aged 6-12 years that were chosen from sixteen primary public schools and ten private ones, that are located in five districts in Sana'a city and represent nearly 10% of total number of schools in Sana'a. Child's eye examination was done by trained 12 students of Medicine, according to WHO grading system for trachoma. Data on risk factors and health characteristics of a child were collected using a structured questionnaire and statistical analysis was performed using Epi-Inf version 6.

Results: The gender distribution of study contributors was male 41.7 % and female was 58.3%. The results of independent associated odds ratio analysis discovered that risk factors of contracting Trachoma from the upper to the lower are: Absent of latrine in the house of child (OR=10.6, $p<0.001$), orphan of mother (OR=4.7, $p<0.001$), absent of water in the house of child (OR=3.9, $p<0.001$), flies in the face (OR=1.9, $p=0.005$), No education of the mother (OR=1.7, $p=0.01$), No education of the father (OR=1.6, $p=0.04$), No face washing with soap per day (OR=3.1, $p=0.001$), keeping animals in living house (OR=1.6, $p=0.03$), and house overcrowding (OR=2.5, $p=0.002$).

Conclusions: Area was identified where, at the time of the survey among 10-12 children, as defined by WHO trachoma was a public health problem. As for the loss of the child to his parents, especially the loss of the mother, it is a disaster for the child, so the treatment of causes such as war and poverty for this problem should be a priority in Yemen

Keywords: Prevalence, risk factors, trachoma, school children, Sana'a city, Yemen.

INTRODUCTION

Trachoma is a contagious illness that caused by *Chlamydia trachomatis*^{1,2}. The trachoma causes roughness of the inner surface of the eyelids which lead to eye pain, collapse of the outer surface or cornea of the eye, and ultimately blindness. Recurrent, untreated trachoma can lead to a manner of permanent blindness after the eyelids revolve inward². The *C. trachomatis* can be spread by contact indirectly and directly with an

infected person's nose or eyes discharge. The flies play an important role in transmission the trachoma disease. The children are more exposed to trachoma infection than adults. Crowded living conditions, poor sanitation, lack of clean water and absence of toilets increase the spread of the trachoma^{1,2}. One of the ways to prevent trachoma is, first, to facilitate and improve the conditions for access to clean water, and secondly, to treat with antibiotics, which leads to reducing the number of people infected with bacteria. The two steps

can work simultaneously as the population is treated in the entire disease area³. Researchers have found that washing the face alone is not sufficient to prevent disease in endemic areas but may be beneficial in combination with other measures such as mass-treatment^{4,5}. The doxycycline or erythromycin antibiotics are prescribed by Physicians to eliminate genital infections in adults. While the trachoma infection among eyes of newborns are initially treated with erythromycin cream and then with oral erythromycin for 14 days. Surgical correction of eyelid deformities may prevent the scratching, scarring, and blindness that typically result from eye infections¹.

Globally, active trachoma has been reported in about 80 million, and in some regions, trachoma infection may appear in up to 60-90% of children². Among adults, the disease has an effect on women more commonly than men probable owing to their close contact with children. Reports have found that this disease is responsible about 2.2 million of visual impairment among people and 1.2 million of them have been completely blind. Trachoma is a public health problem in 44 countries across Africa, Asia, and Central and South America, with 136.9 million people at risk. It leads to economic losses of \$8 billion annually². It belongs to a group of diseases known as neglected tropical diseases⁴. In Yemen, studies in the field of eye diseases are still limited, and recently there is a good start in this important field, as many studies have recently been conducted on the comparison between the Limbal and Pars Plana approaches using vitrectomy to remove congenital cataracts with primary intraocular lens implantation, and bacterial causes and pattern of antimicrobial sensitivity of external ocular infection, and adult bacterial conjunctivitis^{1,6-8}.

Infectious disease data are available in Yemen for the prevalence of infectious diseases including viral infections such as hepatitis B virus, CMV, bacterial infections such as tuberculosis, leptospirosis, cholera, protozoa infections, and yeast infections⁹⁻¹⁶. Whereas trachoma has been neglected as only two survey studies have been conducted in the past five years^{1,17}. A study by Thabet *et al.*,¹⁷ determined the trachoma prevalence among children living in the nine governorates and found that the prevalence of trachoma in children aged 1-9 years was $\geq 10\%$, and being male, living in a household with higher numbers of children, and living in a household that reported the use of open defecation, were each independently associated with higher odds of trachoma. Recently, Al-Shamahi *et al.*,¹ among primary school children in Bajil District, Al Hudaydah observed that the trachoma prevalence was 10.9%, and the independent associated odds ratio analysis were: 7-9 years children, < 2 time frequency of face washing per day, flies, no education of the father and mother, absent of the water for face and body wash and absent of latrine in the house of child. The data about the prevalence of trachoma disease in Sana'a city are limited. Therefore, the aim of this study was to determine the prevalence and risk factors for active trachoma among primary school children living in Sana'a city, Yemen.

SUBJECTS AND METHODS

Study Design: A cross sectional study was conducted.

Study Population: The targets in this study were students of both sexes, aged between 6 and 12 years, selected from public and private primary schools located in the five districts of Sana'a. All children matched the study inclusion criteria: 6 to 12 years, whom provided informed consent from their parents on the day of examination. Exclusion criteria included non-Yemeni children and medically compromised.

Sample size: Using EPI software version 7 the sample size was calculated based on the following assumptions: a). The total number of students in the five Sana'a city directorates is 101,590 according to the Ministry of Education. b). The recurrence of previous trachoma is estimated to be around 10%^{1,17}, with a confidence level of 95% and a margin of error of 1.86^{1,17}. From the previous assumptions, it was found that 991 participants are needed to give significant results from the total population of school children in Sana'a city.

Study area and sampling type: The multi-stage sampling method recommended by the World Health Organization was chosen, the first stage was from the ten regions, the five regions were randomly selected: the south of Al-Sabeen, from the north of Al-Thawra, from the west, Azal and Al-Wahda and from the middle the old Sana'a district. As for the second stage: in each region, we considered that all private and public schools are included in the study, then we randomly chose sixteen public schools and ten private schools, representing approximately 10% of the total number of schools according to the statistics of the Ministry of Education, 2018. As for the third stage: in all schools that were randomly selected, we considered that all categories of students aged 6 to 12 years were included in the study. Then we randomly choose one category from each level. Finally, selection from the selected classes was systemically random; in order to be able to reach the target sample size, which was estimated at 991 children.

Data collection: A questionnaire was filled out for each child with the child's personal and clinical data and risk factors. This included age, gender, and clinical information related to eye infections. Also risk factors for conjunctivitis.

Clinical examination: The general medical students were trained to examine the eye for trachoma and then they performed clinical examinations of the children under supervision of experienced examiners. When a disease case was diagnosed, the cases were photographed and referred to Prof. Dr. Essam Al-Shamahi and Prof. Dr. Sameha Al-Eryani to confirm the diagnosis. The child's eye examination was performed according to the WHO classification system for trachoma. The response variable for this study was the presence of a sign of active trachoma (TF/TI) in either of the child's eyes which could be scored as: The independent variables or risk factors for this study were: sex of the child, age of the child. Frequency of washing the face per day, using soap when washing the face facial hygiene, noting the presence of flies on the

child's face, the child's parental education level, family size, availability of water in the house, availability of latrines, keeping animals in the living house, the history of the children's eye discharge, the child's family members eye discharge, as well as the parental status of the child, i.e. is he/she an orphan, the mother or the father, or both²⁰.

Ethical consideration: The study was approved by the Research Ethics Committee of the Faculty of Medicine and Health Sciences, Department of Medical Microbiology, Sana'a University.

Statistical analysis

Clinical, personal, and risk factor data as well as clinical outcomes entered into the questionnaire were analyzed by Epi Info, version 7. All children with signs of active trachoma (TF/TI) in either of the child's eyes were considered to have trachoma. Differences in categorical variables were evaluated using Fisher's exact tests as appropriate. Ninety-five percent confidence intervals (CIs) were calculated for odds ratios (ORs) according to the cornfield limits, and 95% confidence intervals (CIs) were calculated for simple

ORs using an exact binomial method. The significance of the difference in ratio and odds ratio was analyzed, and a chi-square (χ^2) greater than 3.84 and a *p*-value less than 0.05 were considered statistically significant.

RESULTS

A total of 991 schoolchildren aged 6-12 years were participated in this study observed the females were the higher participants at 58.3% when compared to males at 41.7%. Also, most of the children were in the age group of 6-9 years with 89% while the children aged 10-12 years made up only 11% of the total (Table 1). Table 2 shows the basic characteristics of 991 school children who participated in the study of trachoma in 2021. About 69.3% of children wash their faces at least twice a day. Only 22.2% of the children used soap to wash their faces and 831 (83.8%) of the children had a clean face during the interview. Total 18% of fathers are uneducated and 36% of mothers are uneducated. Only 37.1% of children have water in their homes while 5.9% have no water at all in their homes.

Table 1: The distribution of participated school children according to gender and age.

Age group (in years)	Gender		Total No. (%)
	Female No. (%)	Male No. (%)	
6- 9 years	511 (88.4)	371 (89.8)	882 (89)
10-12 years	67 (11.6)	42 (10.2)	109 (11)
Total	578 (58.3)	413 (41.7)	991 (100)

Table 2: Prevalence of trachoma among different ages and gender.

Ages	Prevalence of trachoma (n=90)				Total	
	6 - 9 years old		10 -12 years old		N	%
Gender	N	%	N	%	N	%
Males	30/371	8.1	8/42	19	38/413	9.2
Females	47/511	9.2	5/67	7.4	52/578	9
Total	77/882	8.7	13/109	11.9	90/991	9.1

*significance level less than 0.05 (*p*).

About 98.8% of children's families have toilets and 1.2% do not have toilets at home. 23.4% of children who take care of animals in their homes, 41.8% of children's households have a family size greater than 6 (41.8%) and 65.4% have crowded homes. There were 7.6% of the children with glasses, 15.6% of the children had a history of recent eye discharge, 16.4% had a history of eye discharge from family members, 7.6% of the children were mother orphans, 9% were fatherless, and 3.9 % is an orphan from both parents. This study revealed that the overall prevalence of trachoma was 9.1% recorded in Sana'a, 9.2% for males and 9% for females. Regarding age, the prevalence of trachoma was 8.7% found among the age group of 6-9 years and 11.9% among the age group of 10-12 years (Table 3). The results of independent associated odds ratio analysis revealed that risk factors of contracting Trachoma from the upper to the lower are: Absent of latrine in the house of child ($OR=10.6$, $p<0.001$), orphan of mother ($OR=4.7$, $p<0.001$), absent of water in the house of child ($OR=3.9$, $p<0.001$), flies in the face ($OR=1.9$, $p=0.005$), no education of the mother ($OR=1.7$, $p=0.01$), no education of the father ($OR=1.6$,

$p=0.04$), No face washing with soap per day ($OR=3.1$, $p=0.001$), keeping animals in living house ($OR=1.6$, $p=0.03$), and house overcrowding ($OR=2.5$, $p=0.002$) (Table 4).

DISCUSSION

The prevalence of active trachoma (TF) was 9.1% in this study, which is slightly similar compared to Al-Shamahi *et al.*, study in Bajjal (Hodeidah) (10.93%) in 2020 as well as by Thabet *et al.*, in Al-Dhalea, Al-Hodeidah, Al-Jawf, Hadhramaut, Hajjah, Ibb, Lahj, Marib and Taiz) (9%). The result of this study illustrated that children aged 6-9 years had a rate equal to 8.7% and it was slightly lower than the rate of 10-12 years (11.9%). This result differs from that of several other studies,^{1,21-24} in that there is typically a TF burden in younger children than in older children. Whereas, the younger age group shows to harbor the largest portion of the ocular *C. trachomatis* reservoir in environments^{25,26}. A change in trachoma load to upper age groups is observed in areas wherever the prevalence of trachoma is usually lower, most probably

for the reason that transmission intensity (and age of first exposure) is lower in these areas. Though, it has been suggested that clinical signs of active trachoma and *C. trachomatis* infection are separate at lower prevalence²⁷. Face washing is encouraged by the World Health Organization's Global Trachoma Elimination

Program as part of the "SAFE" strategy²⁸. The SAFE strategy involves of surgery to treat trichiasis, antibiotics for infectious trachoma, facial hygiene to decrease transmission of infection; and environmental developments (domestic sanitation, clean water provision etc.).

Table 3: The background characteristics of 991 school children participate in the trachoma study in 2021.

Variables	Number	Percentage
Frequency of face washing		
< 2	304	30.7
≥ 2	687	69.3
Washing face with soap		
Yes	220	22.2
No	771	77.8
Face conditions (*No nasal or eye discharge)		
Clean*	831	83.8
Unclean	160	16.2
Present of flies on face during investigation		
Yes	555	56
No	436	44
Education level of Father		
No education	178	18
Primary school above	813	82
Education level of mother		
No education	357	36
Primary school above	634	64
Availability of water in the living house for face and body wash use		
Always	368	37.1
Often	470	47.4
Rarely	95	9.6
Absent	58	5.9
Latrine availability in the house		
Yes	979	98.8
No	12	1.2
Keeping animals in living house		
Yes	232	23.4
No	759	76.6
Family size		
<4	336	31.9
4-6	278	26.4
>6	440	41.8
House overcrowding		
Yes	648	65.4
No	343	34.6
Has eye glasses		
Yes	75	7.6
No	916	92.4
History of recent eye discharge		
History of recent eye discharge	155	15.6
History of family member eye discharge		
History of family member eye discharge	163	16.4
Orphan of mother		
Orphan of mother	75	7.6
Orphan of father		
Orphan of father	89	9
Orphan of both parents		
Orphan of both parents	35	3.5

The current study demonstrated a potentially valuable result of soap-cleaning faces in dipping the odds of developing active trachoma (TI/TF) where washing the face with soap at least once per day had an effect on both TF/or TI ($OR=0.3$, 95% $CI=0.15- 0.8$, $X^2=10.1$, $p=0.001$). It also showed that other exposures related to hygiene affect active trachoma (TI/TF), such as availability of clean water etc. This result was similar to that reported by Stocks *et al.*, showing a potentially valuable result of facial cleaning in decreasing the odds of developing active trachoma (TI/TF). They included non-randomized studies reporting data presentation that washing the face at least once per day had an effect on

equally TF and TI ($OR=0.76$, 95% $CI=0.57$ to 0.96). It also illustrated that extra hygiene-related exposures have an effect on active trachoma (TI/TF), such as: absence of eye secretions, absence of nasal secretions, use of soap, bathing at least once daily and use of towels²⁹. These outcomes can be clarified by the significance of the face-washing constituent of the SAFE strategy intended at preserving clean faces in the community with the purpose of decrease eye-seeking flies and person-to-person transmission of *C. trachomatis*. The promotion of face washing as a community intervention can be jointed with mass therapy for people on antibiotics in areas where

trachoma is common. Mass treatment with antibiotics aims to decrease the stock of *C. trachomatis* in the community, whilst face washing plans to disrupt the cycle of infection and re-infection in the long term^{3,30}. This is due to the fact that using soap in washing the face, the hygiene of the child's face improves. This reduces the chance of a child developing trachoma and this finding was consistent with previous studies^{31,32}. The presence of flies on the children's face was one more significant risk factor for increasing active

trachoma in this study ($OR=1.9$, $95\% CI=1.2-3.1$, $p=0.005$). Children who did not have flies on their faces were less possible to get trachoma this is due to the reality that flies perform as a spreading agent of trachoma, transmitting *C. trachomatis* from the eyes of infected children to the eyes of uninfected children. This outcome was in harmony with previous studies^{1,30} which illustrated that the occurrence of flies on the face increases the opportunity of a child developing trachoma.

Table 4: Table 4: Risk factors associated with trachoma prevalent among participated school children.

Variables	No	%	Positive trachoma		OR	95%CI	X ²	p
			No	%				
Sex								
Male	413	41.7	38	9.2	1.0	0.6-1.5	0.008	0.92
Female	578	58.3	52	9	0.9	0.6-1.5	0.008	0.92
Age groups								
6-9 years	882	89	77	8.7	0.7	0.3-1.3	1.2	0.27
10-12 years	109	11	13	11.9	1.4	0.7-2.6	1.2	0.27
Frequency of face washing								
< 2	304	30.7	29	9.5	1.0	0.68-1.7	0.1	0.73
≥ 2	687	69.3	61	8.9	0.9	0.58-1.4	0.1	0.73
Washing face with soap								
Yes	220	22.2	8	3.6	0.3	0.15-0.8	10.1	0.001
No	771	77.8	82	10.6	3.1	1.5-6.6	10.1	0.001
Face conditions (*No nasal or eye discharge)								
Clean*	831	83.8	67	8.1	0.5	0.3-0.8	6.4	0.01
Unclean	160	16.2	23	14.4	1.5	1-2.5	2.8	0.09
Present of flies on face during investigation								
Yes	555	56	63	11.4	1.9	1.2-3.1	7.7	0.005
no	436	44	27	6.2	0.5	0.3-0.8	7.7	0.005
Education level of Father								
No education	178	18	23	12.9	1.6	0.9-2.7	3.9	0.04
Primary school above	813	82	67	8.2	0.6	0.3-1	3.9	0.04
Education level of mother								
No education	357	36	43	12	1.7	1.1-2.6	6	0.01
Primary school above	634	64	47	7.4	0.5	0.3-0.9	5.9	0.01
Availability of water in the living house for face and body wash use								
Always	368	37.1	25	6.8	0.7	0.45-1.19	1.5	0.2
Often	470	47.4	34	7.2	0.5	0.35-0.8	7.1	0.006
Rarely	95	9.6	16	16.8	2.3	1.2-4	7	0.005
Absent	58	5.9	15	25.4	3.9	2.1-7.5	21	<0.001
Latrine availability in the house								
Yes	979	98.8	84	8.6	0.09	0.02-0.29	24	<0.001
No	12	1.2	6	50	10.6	3.3-33	24	<0.001
Keeping animals in living house								
Yes	232	23.4	29	12.5	1.6	1.0-2.6	4.2	0.03
No	759	76.6	61	8	0.6	0.39-0.9	4.2	0.03
Family size								
<4	336	31.9	21	6.3	0.5	0.3-0.9	4.9	0.026
4-6	278	26.4	25	9	0.9	0.6-1.5	0.02	0.95
>6	440	41.8	44	10	1.2	0.7-1.0	0.8	0.36
House overcrowding								
Yes	648	65.4	72	11.1	2.5	1.3-3.8	9.3	0.002
No	343	34.6	18	5.2	0.4	0.2-0.7	9.3	0.002
Has eye glasses								
Yes	75	7.6	14	18.6	2.5	1.3-4.7	9.0	0.002
No	916	92.4	76	8.3	0.39	0.2-0.7	9	0.002
History of recent eye discharge								
	155	15.6	35	22.6	4.1	2.6-6.5	40	<0.001
History of family member eye discharge								
	163	16.4	30	18.4	2.9	1.7-3.4	43	<0.001
Orphan of mother								
	75	7.6	21	28	4.7	2.7-8.3	35	<0.001
Orphan of father								
	89	9	10	11.2	1.3	0.6-2.6	0.54	0.45
Orphan of both parents								
	35	3.5	10	28.6	4.3	2.0-9.4	16.6	<0.001

In current data, the reported absence of a toilet in the child's home (open defecation) was associated with higher odds of active trachoma in children ($OR=10.6$, 95% $CI=3.3-33$, $p<0.001$), as also seen previously^{1,21,22}. This is consideration to be related to the fact that *Musca* sp. flies lay their eggs on exposed surface human faeces^{34,35}. It has been recommended that the specification of enhanced latrines could decrease the fertility of these flies³³ and thus reduce transmission of ocular *C. trachomatis* in areas where flies are significant vector. This disease continues in a lot of parts of the developing world, in communities that lack access to adequate water and sanitation²⁹. This study discovered that children with home water absenteeism were 3.9 times ($OR=3.9$, 95% $CI=2.1-7.5$, $p<0.001$) more likely to have active trachoma matched up to with home children with constant availability of water in their complex. This may be owing to the value of water for facial and personal hygiene. Facial hygiene is one component of the SAFE strategy. To employ this policy, the availability of water is critical to reduce the transmission of trachoma. This result was consistent with other studies^{1,31,36,37}. Wars, epidemics (such as AIDS), and poverty³⁸ have resulted in many children becoming orphans. In Yemen the significant causes of orphans are war and poverty³⁹. The catastrophic consequences of war in Yemen causes the loss of a female parent, a male parent, or both. This study revealed that children of a missing mother were 4.7 times ($OR=4.7$, 95% $CI=2.7-8.3$, $p<0.001$) more likely to have active trachoma compared with children with a father (mother). This might be due to the importance of mother in caring children on matter of hygiene, nutrition's and psychological care. To implement this strategy, availability of health care and nutritional personal in primary schools in Sana'a city are crucial to reduce the transmission of trachoma. This association was not mentioned before in other studies^{1,31,36,37}.

CONCLUSIONS

The outcomes of this study illustrated that the risk factors: lack of a toilet in the child's house, orphan mother, lack of water in the child's house, flies in the face, non-educated mother, non-educated father, not washing the face with soap daily, and keeping animals in house and overcrowded homes. Accordingly, the study recommended that the authorities concerned with the control and prevention of trachoma among primary school children living in Sana'a must pay special awareness to these factors. The WHO-approved SAFE strategy for effective prevention and control of trachoma was recommended in the study area due to the prevalence of active trachoma, being 11.9% in older children above the WHO-recommended thresholds (prevalence>10%). Evidence from this study intimates that washing the face with soap and possibly supplemented with tetracycline eye drops can be effective in increasing facial hygiene and in reducing severe trachoma.

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AUTHOR'S CONTRIBUTION

This research work is part of a project of the Faculty of Medicine and Health Sciences. **Al-Eryani SA:** study design, writing original draft. **Alshamahi EYA:** literature survey, clinical work. **Al-Shamahy HA:** critical review, supervision. **Al-Moyed KAA:** methodology, formal analysis. **Al Shawkany ARM:** visualization, editing. **Al-Ankoshy AAM:** data interpretation.

DATA AVAILABILITY

The data supporting the findings of this study are not currently available in a public repository but can be made available upon request to the corresponding author.

CONFLICT OF INTEREST

None to declare.

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