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).

Conclusion: Area was identified to identify 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 trachomatis1-2. 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 inward3. 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 trachoma1-2. 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 area. 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. 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 infections.

Globally, active trachoma has been reported in about 80 million, and in some regions, trachoma infection may appear in up to 60-90% of children. 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 annually. It belongs to a group of diseases known as neglected tropical diseases. 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.

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 infections. Whereas trachoma has been neglected as only two survey studies have been conducted in the past five years. A study by Thabet et al. 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 ≥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. 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%. With a confidence level of 95% and a margin of error of 1.86. 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 systematically 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/TT) in either of the child's eyes which could be scored as: The independent variables or risk factors for this study

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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 both.20

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.

Data 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/TT) 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 ($\chi^2$) 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 1: The distribution of participated school children according to gender and age.

| Age group (in years) | Female No. (%) | Male No. (%) | Total 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            | 6 - 9 years old | 10-12 years old | Total |
|-----------------|-----------------|-----------------|-------|
| 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-Shamahy 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, 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 prevalence\(^{27}\). Face washing is encouraged by the World Health Organization's Global Trachoma Elimination Program as part of the "SAFE" strategy\(^{28}\). The SAFE strategy involves 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                |        |            |
| Yes                                            | 155    | 15.6       |
| No                                             | 163    | 16.4       |
| History of family member eye discharge         |        |            |
| Orphan of mother                               | 75     | 7.6        |
| Orphan of father                               | 89     | 9          |
| 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 towels\(^{29}\). 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 (\(OR=1.9, 95\% CI=1.2-3.1, p=0.005\)).

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

| Variables                          | No | %   | Positive trachoma | OR    | 95%CI | X\(^2\) | p       |
|------------------------------------|----|-----|--------------------|-------|-------|---------|---------|
|                                   | No | %   | OR 95%CI           |       |       |         |         |
| Sex                                |    |     |                    |       |       |         |         |
| Male                               | 413| 41.7| 38.92              | 0.61.5| 0.008 | 0.92    |         |
| Female                             | 578| 58.3| 52.9              | 0.61.5| 0.008 | 0.92    |         |
| Age groups                         |    |     |                    |       |       |         |         |
| 6-9 years                          | 882| 89  | 77.87              | 0.31.3| 1.2   | 0.27    |         |
| 10-12 years                        | 109| 11  | 13.11.9            | 0.72.6| 1.2   | 0.27    |         |
| Frequency of face washing          |    |     |                    |       |       |         |         |
| < 2                                | 304| 30.7| 29.95              | 0.61.7| 0.1   | 0.73    |         |
| ≥ 2                                | 687| 69.3| 61.89              | 0.51.4| 0.1   | 0.73    |         |
| Washing face with soap             |    |     |                    |       |       |         |         |
| Yes                                | 220| 22.2| 83.6              | 0.150.8| 10.1  | 0.001   |         |
| No                                 | 771| 77.8| 82.10.6           | 1.56.6| 10.1  | 0.001   |         |
| Face conditions (\(^*\)No nasal or eye discharge) |    |     |                    |       |       |         |         |
| Clean                              | 831| 83.8| 67.81              | 0.30.8| 6.4   | 0.01    |         |
| Unclean                            | 160| 16.2| 23.14.4            | 1.25.2| 2.8   | 0.09    |         |
| Present of flies on face during investigation |  555| 56 | 63.11.4 | 1.23.1 | 7.7 | 0.005 |
| Yes                                | 436| 44  | 27.62              | 0.30.8| 7.7   | 0.005   |         |
| Education level of Father          |    |     |                    |       |       |         |         |
| No education                       | 178| 18  | 23.12.9            | 0.92.7| 3.9   | 0.04    |         |
| Primary school above               | 813| 82  | 67.82              | 0.3   | 3.9   | 0.04    |         |
| Education level of mother          |    |     |                    |       |       |         |         |
| No education                       | 357| 36  | 43.12              | 1.12.6| 6    | 0.01    |         |
| Primary school above               | 634| 64  | 47.74              | 0.30.9| 5.9   | 0.01    |         |
| Availability of water in the living house for face and body wash use |    |     |                    |       |       |         |         |
| Always                             | 368| 37.1| 25.68              | 0.451.9| 1.5  | 0.2     |         |
| Often                              | 470| 47.4| 34.72              | 0.350.8| 7.1  | 0.006   |         |
| Rarely                             | 95 | 9.6 | 16.16.8            | 1.2   | 7    | 0.005   |         |
| Absent                             | 58 | 5.9 | 15.25.4            | 2.17.5| 21   | <0.001  |         |
| Latrine availability in the house  |    |     |                    |       |       |         |         |
| Yes                                | 979| 98.8| 84.86              | 0.020.29 | 24 | <0.001  |         |
| No                                 | 12 | 1.2 | 6.50               | 3.333 | 24  | <0.001  |         |
| Keeping animals in living house    |    |     |                    |       |       |         |         |
| Yes                                | 232| 23.4| 2912.5             | 1.02.6| 4.2   | 0.03    |         |
| No                                 | 759| 76.6| 61.8               | 0.390.9| 4.2  | 0.03    |         |
| Family size                        |    |     |                    |       |       |         |         |
| <4                                 | 336| 31.9| 21.63              | 0.30.9| 4.9   | 0.026   |         |
| 4-6                                | 278| 26.4| 25.9               | 0.61.5| 0.02  | 0.95    |         |
| >6                                 | 440| 41.8| 4410               | 0.77.0| 0.8   | 0.36    |         |
| House overcrowding                 |    |     |                    |       |       |         |         |
| Yes                                | 648| 65.4| 72.11.1            | 1.33.8| 9.3   | 0.002   |         |
| No                                 | 343| 34.6| 185.2             | 0.20.7| 9.3   | 0.002   |         |
| Has eye glasses                    |    |     |                    |       |       |         |         |
| Yes                                | 75 | 7.6 | 1418.6            | 1.34.7| 9.0  | 0.002   |         |
| No                                 | 916| 92.4 | 76.83             | 0.20.7 | 9   | 0.002   |         |
| History of recent eye discharge    | 155| 15.6| 3522.6            | 2.66.5| 40   | <0.001  |         |
| History of family member eye       |    |     |                    |       |       |         |         |
| discharge                          | 163| 16.4| 3018.4            | 1.73.4| 43   | <0.001  |         |
| Orphan of mother                   | 75 | 7.6 | 2128              | 2.78.3| 35   | <0.001  |         |
| Orphan of father                   | 89 | 9   | 1011.2           | 0.62.6| 0.54  | 0.45    |         |
| Orphan of both parents             | 35 | 3.5 | 1028.6          | 2.09.4| 16.6 | <0.001  |         |
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 which illustrated that the occurrence of flies on the face increases the opportunity of a child developing trachoma. 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. This is considered to be related to the fact that Musca sp. flies lay their eggs on exposed surface human faces. It has been recommended that the specification of enhanced latrines could decrease the fertility of these flies 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 sanitation. 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. Wars, epidemics (such as AIDS), and poverty have resulted in many children becoming orphans. In Yemen the significant causes of orphans are war and poverty. 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.

CONCLUSION

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 city 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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CONFICT OF INTEREST

No conflict of interest associated with this work.

AUTHOR'S CONTRIBUTION

This research work is part of a project of the Faculty of Medicine and Health Sciences. The first and second authors trained the survey team and supervised clinical work, while the other authors reviewed and edited the research.

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