Chlamydia trachomatis infections among Yemeni school pupils in relation to environmental conditions

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ABSTRACT

Objectives: This study is aimed at establishing the prevalence of *Chlamydia trachomatis* infections among school pupils in Sana`a, Republic of Yemen, and to explore the association of infection with environmental and social factors.

Methods: A total of 787 school children, 529 boys and 258 girls, were randomly selected for enrollment in this study. Four hundred and twenty-nine were from 4 schools in Sana`a city, and 358 from 3 rural schools around Sana`a, Republic of Yemen. Questionnaire forms were filled in for each child to investigate environmental and social factors. Sera were tested for anti *Chlamydia trachomatis* IgG antibodies using enzyme-linked immunosorbent assay CTM-IgG®.

Results: An overall rate of infection of 45.9% was determined. The rate of infection among rural pupils (73.2%) was higher (P<0.0001) than that among urbanones (23.1%).

The rate of infection was found significantly (P<0.001) inversely correlated with age of the pupils. Environmental factors which were found to influence the infection rate were; rural residence, unplastered walls, mud floor, lack of stand pipe water, lack of latrine and presence of animals within dwelling with odds ratio of 9.1, 6.3, 6.1, 5.2, 3.7, 3.5 and 1.7. Also, the male sex and illiteracy of the parents has been found to be risk factors for infection.

Conclusion: Prevalence of *Chlamydia trachomatis* infection was found to be high. The prevalence correlates inversely with age. Rural residence, environmental conditions and social factors were risk factors for infections. Yemen could be identified as a trachoma endemic area, which should be targeted by the control programs.

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*C*hlamydia trachomatis is a small gram negative coccoid obligate intracelluar bacterium. It involves a number of serotypes causing a variety of infections. Serotypes A, B, Ba and C are the cause of trachoma. Serotypes D to K are responsible for cervicitis, urethritis, proctitis, conjunctivitis and neonatal pneumonia whereas L1 L2 and L3 are the etiological agents of lymphogranuloma venerum. It is estimated that 15% of the world blindness is caused by *Chlamydia*

trachomatis.[1] Active trachoma has been found to affect 150 million people and 5.5 million are blind as a consequence of the disease.[2] Trachoma is reported to be endemic in several Eastern Mediterranean countries such as the Kingdom of Saudi Arabia,[2] Egypt[3] Sudan[4] and Oman.[5] A study, conducted in Egypt, revealed a prevalence of active trachoma of 36.5% among preschool children and rural children were found to be more commonly infected than urban children.[6] In

Turkey, a prevalence of active trachoma and its residual effect of 3.2% was found in individuals less than 30 years whereas those aged over 30 years showed a prevalence of 1.9%.[7] In North India, clinical trachoma was found in 8.5% of 1-10-years- old children with higher prevalence among males and the prevalence was found to increase with age[8] although age as a risk factor of infection is controversial.[7-9] The risk factors that predispose to infection are mostly environmental and hygienic practices. The major risk factors are overcrowding, absence of latrine,[3] a home of wood and earth[10] and poor personal hygiene.[11] Specific risk behaviors remain to be identified and validated as independent risk predictors in different settings and cultures.[12] Sexually transmitted infections, including *Chlamydia trachomatis* infection, are not listed with the common diseases in Yemen.[13] Fifty-one percent of Yemeni households have safe water supply, latrines are available in 37% of houses and illiteracy in Yemen is 50%.[14]

The aim of this study was to establish the prevalence of *Chlamydia trachomatis* infections among schoolchildren in urban and rural Sana`a and to correlate the infection rate with environmental, hygiene and cultural factors.

Methods. Over the period between May and December 2001, a total of 787 school children, 529 boys and 258 girls were randomly selected for enrolment in this cross-sectional study. Of these, 429 were from 4 schools in Sana`a city, Yemen and 358 from 3 rural schools around Sana`a city, Yemen. Elementary school age in some areas in Yemen exceeds the age of 18-years-old. Thus, this study involves subjects of up to 20 years of age. Questionnaire forms were filled in for each child to investigate the role of cultural, demographic and environmental factors in transmission of *Chlamydia trachomatis*. These were, age, sex and parent's literacy, urban or rural residence, pucca or mud house floors, plastered or unplastered house walls, availability of latrine within the dwelling, presence of stand pipe water within the house, and attainment of animals within the house.

Sera were collected and kept frozen at –20 until they were tested. *Chlamydia trachomatis* IgG antibodies levels were measured using enzyme-linked immunosorbent assay (ELISA) CTM-IgG®. The test is designed to quantify the *Chlamydia trachomatis* IgG antibodiest the concentrations of which are measured proportionally to the color intensity. The test procedures were performed, and results were calculated according to the manufacturer instructions. Chi[2] test was used to assess the trend of infection in relation to age

Results. The mean age of children was 13.98 ± 3.48 years. Male pupils constituted of 67.2% while female pupils were 32.8%. An overall rate of infection with *Chlamydia trachomatis* was found to be 45.9%. The rate of infection among the rural pupils (73.2%) was higher (P<0.0001) than that among the urban ones (23.1%). The infection rate was found to inversely correlate with age **(Table 1)**. The environmental factors, which were found to influence the infection rate were; rural residence, unplastered house walls, mud house floors, lack of stand pip water lack of latrine and presence of animals within the dwelling. Odd ratios of 9.1, 6.3, 5.2, 6.1, 3.7, and 3.5 **(Table 2)**. The male sex and illiteracy of the parents are also risk factors for infection under bivariate analysis. **(Table 3)**

Discussion. The ELISA used in this study detects antibodies to the all *Chlamydia trachomatis* seroptypes. The most likely serotypes of *Chlamydia trachomatis* responsible for infection in our study group are those which cause trachoma (serotypes A, B, Ba and C). Sexually transmitted serotypes are unlikely to cause infection in our study group who are mainly children and young adults who are culturally considered as sexually not active. In addition, the pattern of infection seems to follow that for diseases associated with a low standard of hygiene which is a risk factor for trachoma.

Our findings revealed an overall prevalence of *Chlamydia trachomatis* infection among schoolchildren of 45.9%. This is higher than trachoma prevalence reported from Egypt,[6] Indian children[8] and Turkish subjects below 30 years.[7] The reason for this difference could be attributed to the approach of diagnosis followed in these studies. In our study the diagnosis was based on detection of high IgG level to *Chlamydia trachomatis*. This diagnostic approach detects

Table 1 - Infection rate of *Chlamydia trachomatis* in school pupils in rural and urban Sana'a according to age.

Age group in years	n of subjects	Positive n (%)
5-6	31	28 (90.3)
7-8	52	42 (80.8)
9-10	45	29 (64.4)
11-12	89	48 (53.9)
13-14	166	70 (42.2)
15-16	216	79 (36.6)
17-18	144	51 (35.4)
19-20	36	12 (33.3)
21-25	8	2 (25)
Total	**787**	**361 (45.9)**
Chi[2] - 77.21, P<0.01		

Table 2 - Infection rate of *Chlamydia trachomatis* in school pupils of rural and urban Sana'a in relation to environmental factors.

Environmental factors	Negative n (%)	Positive n (%)	OR (CI)	Chi square	p value
Place of residence					
Urban	330 (77.5)	99 (27.4)	9.1	197.3	<0.0001
Rural	96 (22.5)	262 (72.6)	(6.6-12.6)		
Plastered house walls					
Yes	367 (86.1)	181 (50.1)	6.3	119.8	<0.0001
No	59 (13.8)	180 (49.9)	(4.4-8.7)		
Pucca house floors					
Yes	354 (83.1)	175 (48.5)	6.1	138.8	<0.0001
No	72 (16.97)	186 (51.5)	(4.4-8.3)		
Availability of standpipe water					
Yes	322 (75.6)	122 (33.8)	5.2	106.3	<0.0001
No	104 (24.4)	239 (66.2)	(3.8-7.2)		
Availability of latrine					
Yes	408 (95.8)	310 (85.9)	3.7	24	<0.0001
No	18 (4.2)	51 (14.1)	(2.1-6.5)		
Animals within the dwellings					
Yes	279 (68.7)	127 (32.5)	3.5	71.9	<0.0001
No	147 (38.6)	234 (64.8)	(2.6-4.7)		
OR - odds ratio, CI - confidence interval					

Table 3 - Infection rate of *Chlamydia trachomatis* in school pupils of rural and urban Sana'a in relation to socioeconomic status.

Socioeconomic factors	Negative n (%)	Positive n (%)	OR (CI)	Chi square	p value
Education of mother					
Yes	107 (25.1)	32 (8.9)	3.5	35.5	<0.0001
No	319 (74.9)	329 (91.1)	(2.3-5.3)		
Education of father					
Yes	325 (76.3)	203 (56.2)	2.5	35.6	0.0001
No	101 (23.7)	158 (43.8)	(1.8-3.4)		
Sex					
Female	163 (38.3)	95 (26.3)	1.7	12.7	<0.0001
Male	263 (61.7)	266 (73.7)	(1.3-2.4)		
OR - odds ratio, CI - confidence interval					

symptomatic and asymptomatic *Chlamydia trachomatis* infections whereas diagnosis in other studies was based on the clinical features of the disease. Diagnosis based on clinical features of trachoma may results in sub-clinical cases being missed out. This high rate of infection could be a good reason for recognition of Yemen as a likely trachoma endemic area and thus, inclusion of Yemen in trachoma control program.

Our findings showed that the highest infection rate (90.3%) was among children between 5 and 6 years followed by age group of 15-16 years (36.6%). The age group between 19 and 25 years showed the lowest rate (33.3%). This could be attributed to the difference in personal hygiene, which expectedly improves with increasing age. High trachoma prevalence (36.5%) was reported in Egypt among preschool children[6] and in Senegal among 5-15 years old children.[15] Association of high prevalence of *Chlamydia trachomatis* infections with early age has been reported in Turkey as a prevalence of active trachoma and its residual effect of 3.2% has been found among individuals aged under 30 years whereas a prevalence of 1.9% was found among those aged over 30 years.[7] This is in agreement with our findings although the age groups in this study were

different. An inverted pattern has been reported from North India as trachoma was found in 8.5% of 1-10 years old children with prevalence increasing with age.[8] The disagreement of this study with our findings could be attributed to cultural habits such as several daily face washing which is expected among Muslims over 10 years old. Poor personal hygiene has been reported as a risk factor for *Chlamydia trachomatis* infection.[9]

Our findings showed that the likelihood of infection among rural children is 9 times greater than that among urban children. This difference has also been reported elsewhere.[6] Environmental factors such as unplastered houses walls, lack of standpipe water within the dwelling, mud floors, lack of latrines and presence of animals have also shown a role in infections among our subjects. This is consistent with findings of other investigators.[1] Lack of education of parents was found to be a risk factor for infection as a higher prevalence of infection was found among children with illiterate parents. Low socioeconomic status may be a reason of illiteracy, which contribute to low standard of hygiene. Also, the higher overall infection rate among males compared to that among females despite the same socioeconomic status suggests a male sex as a risk factor.

To conclude, a high prevalence of *Chlamydia trachomatis* infection was found among school children. The prevalence inversely correlated with age. The likelihood of infection among rural children is 9 times greater than that among urban children. Environmental and social factors were found to be risk factors for infections. Further, studies should look into the role in infection of factors such as parent occupation the family size, number of infected children within the family, medical history of subjects, weather conditions and level of enviromental pollution. Also, further studies are required to determine the circulating *Chlamydia trachomatis* serotypes in Yemen.

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