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Prevalence and Risk Factors of *Ascaris lumbricoides* Infection: Experience from Some Rural Communities of Assam

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INTRODUCTION

The nematode *Ascaris lumbricoides* has a worldwide distribution (WHO, 1987; Warren and Mahmoud, 1984) and causes up to a million cases of disease annually (Hall et al., 1992). Ascariasis is an important public health problem in developing countries and is particularly prevalent is Asia (Pawlowski, 1984). Children are the most vulnerable to ascariasis affecting their nutritional and immune status (WHO, 1981). Heavy infection of *Ascaris lumbricoides* can cause intestinal obstruction especially in children. Serious surgical emergencies may result due to migrating adult worm in extra-intestinal sites such as bile and pancreatic ducts, respiratory passages and peritoneum (WHO, 1987).

Ascaris lumbricoides has been reported to be endemic in Assam (Mahanta et al., 1996) however, no information is available on the socio-environmental predictors relevant to *Ascaris* infection in rural communities. Whilst geohelminthic infections *per se* is an inevitable consequence of poor personal hygiene and household sanitation (Hidayah et al., 1997) the importance of specific factors in the epidemiology of *Ascaris* infection have not been formally investigated. Consequently, there is a need for study of risk factors associated with *Ascaris lumbricoides* infection in order to understand the local ways of transmission so that appropriate measures for public health interventions can be formulated. We performed a cross-sectional study to investigate some socio-economic and behavioural risk factors for ascariasis in some rural communities of Assam.

MATERIAL AND METHODS

Study area and Population

This study was conducted during 1996-1998 in Dibrugarh district of upper Assam with a population of about 1.04 million people. The study population consisted of 244 children (age 15 years & below) and 336 adults selected from three villages *viz.*, Soraipung, Japihosia and Babesia in Dibrugarh district of upper Assam. The population of these villages ranged from 500 to 1000 individuals and all the villagers are indigenous people who are mainly subsistence rice farmers. Most houses are 1-2 room bamboo houses with mud flooring and are widely scattered in the area.

Parasitological Examination of Stool

Two sequential stool samples were collected in plastic containers in 10% (v/v) formalin in saline (0.9%w/v NaCl) from each of 580 individuals selected from 144 randomly selected households. Formol-ether concentration technique was used for detection of *Ascaris lumbricoides* eggs microscopically (Allen and Ridley, 1970).

Collection of Data

Data concerning possible risk factors was collected by administering a questionnaire to the principal member of each household and by observational methods. The information was collected on age, sex, type of flooring of the house (cement or earth flooring), source of drinking water (tube well or kaccha-well), the site of defaecation of the subjects (sanitary latrines, pit latrines or in wilderness), income (regular or irregular), family size, and number of children in the household.

Statistical Analysis

Contingency tables with Chi square tests were used to find the association between putative risk factors and *Ascaris lumbricoides* infection. The prevalence rate ratio (PRR) (= relative risk) and 95% confidence interval (CI) were calculated for univariate analysis (Woolson, 1987). PRR provides an unbiased estimate of relative risk regardless of disease prevalence (Greenland et al., 1986). Z- test for equality of proportion of two independent samples was also used when appropriate (WHO, 1992). For multivariate analysis we used Cox's proportional hazards regression assuming constant risk period (Lee, 1994; Breslow, 1974). As pointed out by Lee (1994), in agreement with others (Greenland, 1987; Hughes, 1995), application of multiple logistic regression analysis (which yields odds ratio as effect measure) is not considered appropriate for cross-sectional data. It has been shown that by assuming constant risk period the Cox's proportional hazards regression model, originally developed for estimation of conditional hazards ratio and survival functions based on longitudinal data, can be adapted to estimate PRR which is more desirable measure than odds ratio for cross sectional-data (Lee, 1994). Initially all the independent variables were included in the multivariate model. However, in the final model non significant variables (cutoff p = 0.01) were removed by backward elimination technique.

RESULTS

Prevalence of *Ascaris lumbricoides* Infection

Two hundred and sixty eight of 580 subjects (46.2%) were found infected with *Ascaris lumbricoides*. No significant difference in the prevalence of infection between male and female subjects was found (z-test: p=0.835). There was also no significant trend in the frequency of *A. lumbricoides* infection in different age groups in males (χ^2 for linear trend = 4.13; p =0.659). However, in females there was a significant decrease in infection with increasing age (χ^2 for linear trend = 16.48; p = 0.011). The relationship between age and prevalence of *A. lumbricoides* in both male and female subjects is shown in figure 1.

In males, peak prevalence (51.0%) occurred in the 21 to 30 age group. However, this prevalence was not greater when compared to other younger and older age classes (p>0.05 for each comparison). In females, peak prevalence (67.3%) was found in age group (6-10 years) and minimum prevalence (32.1%) in 0 to 5 age class. This difference in prevalence of *A. lumbricoides* in females in two age groups is statistically significant (z-test: p<0.001).

Factors Associated with *Ascaris lumbricoides* Infection

Out of 580 subjects, 41.7% individuals were found to defecate in open and 52.2% persons had pit latrines. Only 6% of people have sanitary latrines. Safe drinking water was not accessible to 34.3% persons who used kaccha-well water as a source of drinking water. These wells are not covered and are easily contaminated by surface run off and seepage water during rainy season. Only 65.7% persons used tube-well water as a source of drinking water. Majority of houses had earth floors (86.9%) and the rest had cemented floors in their houses.

Table 1 shows potential risk factors of *Ascaris lumbricoides* along with prevalence rate ratio (relative risk), 95% CI and statistical significance based on univariate analysis. Two factors were found associated with the increased risk of being infected with *Ascaris lumbricoides* (p<0.05). Persons who used to defaecate indiscriminately have 1.3 times higher risk of *Ascaris* infection than those who use pit or sanitary latrines (PRR = 1.3; 95% CI=1.09-1.54). Children in the age group 6-10 years and adults in 21-30 years of age were at higher risk of *Ascaris* infection (PRR = 1.62; 95% CI=1.18-2.23 and PRR=1.48;95% CI=1.07 to 2.05, respectively). Independent effect of multiple risk factors on *Ascaris lumbricoides* infection was assessed by adjusting for confounding factors in the Cox's proportional hazards regression analysis. In the overall model only open field defaecation was found independently associated with *Ascaris* infection (PRR=1.30, 95% CI= 1.02-1.65, p=0.032).

Figure 2 shows differences in prevalence of *Ascaris* infection in different sub-population based on relation between defaecating habits of people and source of their drinking water and type of flooring. The prevalence of *Ascaris* infection was less (37.1%; n=35) in persons using sanitary latrines as compared to persons defecating in open (53.3% n= 242). However, this difference in the prevalence of *Ascaris* infection was not statistically significant probably because the number of persons using sanitary latrines was less.

DISCUSSION

The results of this study show that *Ascaris*

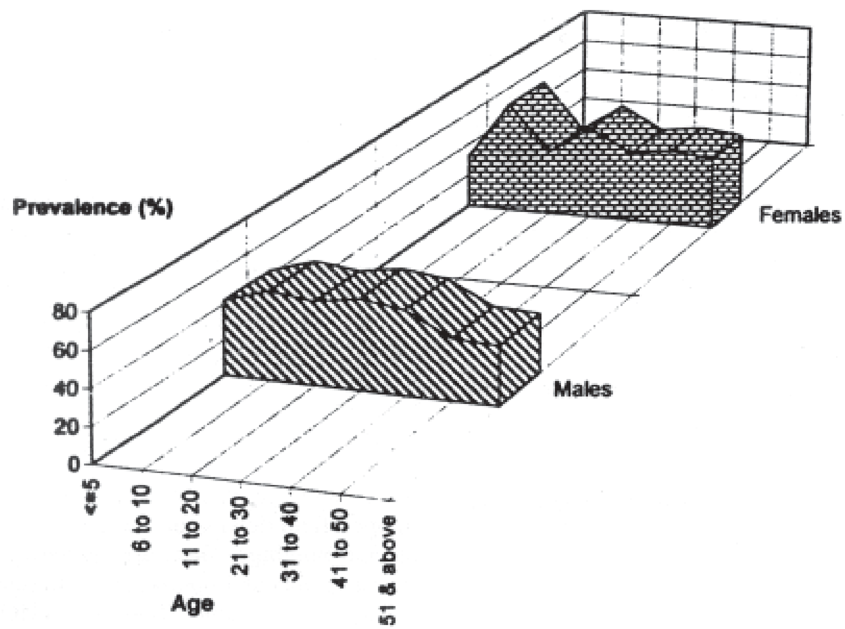

Fig. 1. Changes in prevalence of *Ascaris lumbricoides* infection with age in male and female subjects

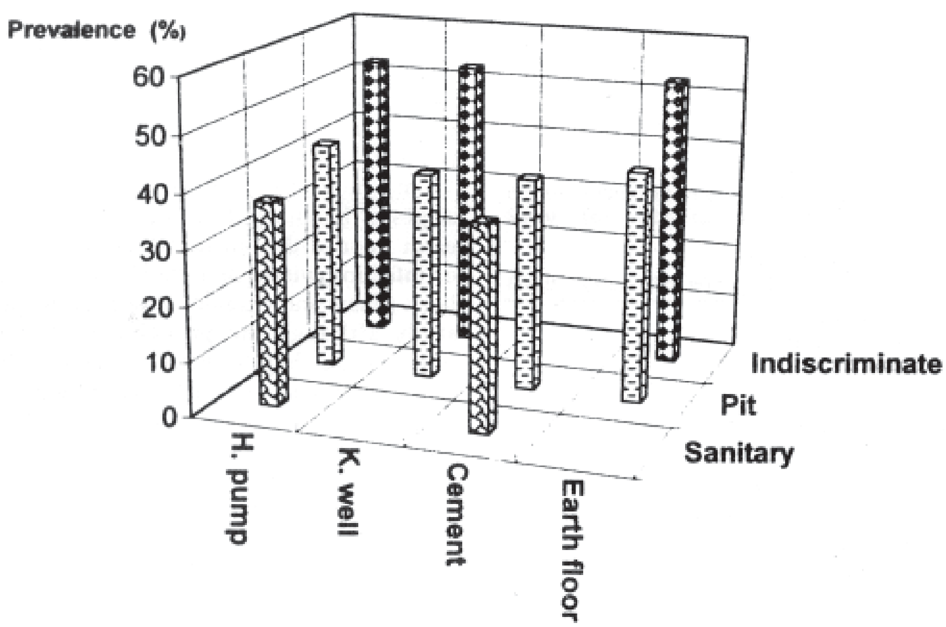

Fig. 2. Prevalence of *Ascaris lumbricoides* according to defaecating habits of people (indiscriminate, use of pit or sanitary latrines) versus their source of drinking water (kaccha- well water or tube -well water) and type of flooring in the house (earth or cemented). (Note persons having sanitary latrines did not have earth flooring or kaccha-wells and persons who lived in houses with cemented flooring did not defecate in the open fields).

Table 1: Proportion of individuals infected with *Ascaris lumbricoides* according to potential risk factors. Prevalence rate ratio (PRR) along with 95% confidence interval (CI) are also given

Risk factor		*No. infected (%)*	*PRR (95% CI)*	*P-value*
Age	<or=5	33/91 (36.3)	1*	
	6to10	57/97 (58.8)	1.62 (1.18-2.23)	0.003**
	11to20	45/105 (44.8)	1.18 (2.83-1.68)	0.427
	21to30	57/106 (53.8)	1.48 (1.07-2.05)	0.02**
	31to40	35/77 (45.5)	1.25 (0.87-1.81)	0.293
	41to50	23/57 (40.4)	1.11 (0.73-1.69)	0.745
	51 and above	18/47 (38.3)	1.06 (0.67-1.66)	0.961
Sex	Male	126/279 (45.2)	1	
	Female	142/301 (47.2)	1.04 (0.88-1.25)	0.687
Source of drinking water				
	Tube well	-167/381 (43.8)	1	
	Kaccha-well	101/199 (50.8)	1.16 (0.97-1.38)	0.134
Site of defaecation				
	Sanitary/ Pit	139/338 (41.1)	1	
	Open field	129/242 (53.3)	1.3 (1.09-1.54)	0.005**
Type of flooring				
	Cement	29/76 (38.2)	1	
	Earth	239/504 (47.4)	1.24 (0.92-1.68)	0.166
Family size				
	1to4	41/107 (38.3)	1	
	5&above	227/473 (48.0)	1.25 (0.97-1.62)	0.088
No. of children in household				
	0	119/260 (45.8)	1	
	1to2	74/185 (40.0)	0.87 (0.7-1.09)	0.266
	3&above	75/135 (55.6)	1.21 (0.99-1.48)	0.082
Family income				
	Regular	94/215 (43.7)	1	
	Irregular	174/365 (47.7)	1.09 (0.91-1.31)	0.403

*= Reference category
**= Significant at $p < 0.05$

infection is endemic in rural communities of Assam. Even in children of the age group 5 years and below the prevalence of infection was 36.3%. Although there was no gender specific difference in the overall prevalence of *Ascaris* infection however in females the prevalence of infection showed significant decline with age in contrast to males. Slight decline in prevalence of *Ascaris* with increasing age has also been reported by earlier workers (Bundy et al., 1992). The reason for this decline in prevalence may possibly be due to development of immunity with age or behavioural changes in adults resulting in reduced exposure in adults (WHO, 1987). In girls prevalence of infection in age group 6-10 years is higher (67.3%, n=49) as compared to boys in the same age group (prevalence of *Ascaris* infection =50%, n=48), however, this difference was not statistically significant.

Open field defaecation, after adjusting for confounding factors, was the most important behavioural factor responsible for about 30% increase in the risk of *Ascaris* infection in both males and females. In this study persons having sanitary latrines and access to safe drinking water the prevalence of *Ascaris* infection was 37.1%. This shows that the protective effect of use of sanitary latrines is less in an community where other members of the community indulge in open field defecation thereby contaminating the surroundings. There are evidences that dust may also play an important role in transmission of ascariasis in some regions (WHO, 1981). Therefore, the transmission of ascariasis in a community will be influenced by the extent of contamination of the surroundings by open field defecation. In other words, the extent of transmission of ascariasis in a community will be related to the proportion of persons defecating in open. Thus, not only individual but also the participation of the whole community will be an important factor in the control of ascariasis.

In a slum community in Colombia, infective stages of helminths have been detected on the earth floor of the houses where the possibility of infection within household was also speculated (Faust and Giraldo, 1960). In the present study although the prevalence of *Ascaris* infection was high in persons living in houses with earth flooring (47.4%) as compared to persons living in houses with cemented floors (38.2%) however, this difference was not statistically significant. Similarly, persons who used kaccha-well as a source of drinking water have slightly higher prevalence of *Ascaris* infection (50.8%) as compared to persons using tube-well water (*Ascaris* prevalence =43.8%) though this difference is not statistically significant.

In conclusion, the results of this study indicate that, in these rural communities, major risk factors of *Ascaris lumbricoides* occurs due to open field defaecation. Therefore, keeping in view the available resources for control of geohelminths in these communities cost effective approaches for intervention are required. Even installation of pit latrines (if not sanitary latrines) together with providing safe source of drinking water would probably reduce the transmission of *Ascaris lumbricoides* in the long run, although mass chemotherapy can help in reducing community prevalence effectively.

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KEY WORDS *Ascaris lumbricoides*. Risk Factors. Rural Communities. Assam.

ABSTRACT This study describes the prevalence and socio-environmental predictors of *Ascaris lumbricoides* infection in rural communities in Assam, India. Two sequential stool samples from 580 residents selected from three rural areas were examined for intestinal parasites. Information on many potential risk factors for infection was obtained by questionnaire from a respondent in each household studied. To control for confounding factors Cox's proportional hazards analysis (assuming constant risk period) was used. In the overall multivariate model, open field defaecation was the only factor found independently associated with *Ascaris* infection. There was no gender specific difference in overall prevalence of *Ascaris* infection, however, there was statistically significant declining trend in prevalence with increasing age in females. Implication of these results for the epidemiology and control of *Ascaris* infection are briefly discussed.

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