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Declining prevalence of pulmonary paragonimiasis following treatment & community education in a remote tribal population of Arunachal Pradesh, India

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***Background & objectives*: In India, human pulmonary paragonimiasis is an important public health problem in the northeastern (NE) region. In 2005 we reported a hyperendemic focus of paragonimiasis in a remote tribal village in the hills of Changlang district in Arunachal Pradesh. The community was made aware of the disease and all active cases were treated. This study was aimed to assess the decline in the prevelance of paragonimiasis in the same area after a re-survey done in 2011 after a gap of six years.**

***Methods*: Re-surveys were carried to determine the reduction in the prevalence of paragonimiasis. Community education was given to the villagers to raise their awareness about paragonimiasis. A total of 624 individuals including 301 children (age ≤ 15 yr) were included in the study. Sputum and stool samples were examined for eggs of lung flukes. Serum samples were screened for IgG antibodies against lung fluke antigen by ELISA.**

***Results*: A significant (P<0.001) decline in the prevalence of paragonimiasis was found. There was decline in both ELISA positivity and egg positivity. Antibody positivity against excretory-secretary (ES) antigen in children (age ≤ 15 yr) fell down from earlier 51.7 to 15.9 per cent and in individuals 16 - 30 yr of age the serological prevalence fell down from 22.4 to 8.2 per cent and in individuals aged ≥ 31 yr, the decline in prevalence was from 15.3 to 3.7 per cent. Gender-wise analysis revealed that the decline in ELISA positivity was similar in both genders and fell down from 33.9 to 11.5 per cent in males and from 29.8 to 10.7 per cent in females. Similarly, there was a significant decline rate in egg positivity also.**

***Interpretation & conclusions*: The strategy of hotspot targeted active paragonimiasis case detection and treatment of infected cases together with community education appears to be feasible methods to achieve control of paragonimiasis in this region.**

Key words Community education - paragonimiasis - prevalence - treatment - tribal

Paragonimiasis is an important neglected tropical disease. Among food-borne trematodes, the lung fluke infection costs more in terms of disability adjusted life years (DALYs) than opisthorchiasis, fascioliasis, and intestinal diastome infection combined[1]. An estimated 293 million people are at risk of paragonimiasis worldwide[2] and it has been reported that about 23 million people in 48 countries are infected[3,4]. In India, human pulmonary paragonimiasis is emerging as an important public health disease in northeastern (NE) region[5-11]. The parasite is zoonotic, cycling through wild carnivorous mammals, freshwater snails, crabs or crayfish. Interest in paragonimiasis has increased partly because the symptoms closely mimic those of tuberculosis, frequently leading to inappropriate treatment being administered to smear negative suspected TB cases. Failure of patients to respond to treatment may lead to inflated estimates of the prevalence of multi-drug resistant tuberculosis and may have other far-reaching health implications[12-14]. The distribution of paragonimiasis is highly heterogeneous and a few hotspots of transmission foci can be recognised in NE region. Earlier we reported a hyper-endemic focus of paragonimiasis in a remote tribal area in the hills of Changlang district of Arunachal Pradesh[7]. During that active survey carried out in 2005 in the community all the infected patients were treated with praziquantel. The villagers were also given awareness about paragonimiasis and various preventive measures. Subsequently, we carried out a re-survey in 2011 with an aim to determine whether household screening and treatment of infected individuals together with imparting community education could decrease the prevalence of paragonimiasis in this highly endemic focus of paragonimiasis after an interval of six years.

Material & Methods

Study area: This study was conducted by the Regional Medical Research Centre (RMRC), Dibrugarh, Assam jointly with community health centre (CHC), Miao, in the five villages of Changlang district of Arunachal Pradesh where paragonimiasis was found to be highly endemic based on cross-sectional surveys conducted earlier by us[7]. The study area is economically underdeveloped and predominantly hilly with extensive forests and is located at an elevation of 200-4500 m above sea level. Furthermore, these villages are located in remote areas without proper roads and communication. The nearest community health centre is at Miao and can only be approached by foot from the selected study villages. The inhabitants of these villages are predominantly tribal and their primary occupation is subsistence farming.

Sample size and sampling methodology: The re-surveys were carried out during 2011 in the five villages, of Changlang district following the same strategy as used earlier[7]. The two study samples were independent. We assumed a null hypothesis of no change in the prevalence of paragonimiasis as assessed in earlier cross-sectional survey[7]. In order to detect at least 10 per cent decline in the seroprevalence (from 50 to 40%) at 5% level of significance and 90% power, the required sample size was 515 subjects. However, we included a total of 624 individuals including 301 children (age $\leq$ 15 yr). The households were randomly selected and all individuals in the selected households were included. Information on age, sex, history of cough, crab eating habits was recorded. Written informed consent was obtained from all the persons or their guardians in case of children. The study protocol was approved by the ethics committee of RMRC, Dibrugarh. Blood and stool samples were collected from all the individuals and those with cough also provided the sputum samples. The sputum and stool samples were collected in duplicate and examined for characteristic operculated eggs of lung flukes under light microscope. In addition, the sputum samples were examined for acid fast bacilli (AFB) using Ziehl–Neelsen (Z-N) staining to exclude tuberculosis. IgG antibodies against excretory-secretory (ES) antigen of adult lung flukes were detected using enzyme-linked immunosorbent assay (ELISA) as previously described[7,15]. Known positive and negative reference serum samples were included in each ELISA test to monitor quality control. A sample was considered positive if the OD was 0.49 or more.

Statistical Package for Social Sciences (SPSS) version 17 (SPSS Inc., Chicago, Illinois, USA) was used for data entry and analysis. Chi square test was used to compare the prevalence of infection in different age groups and gender.

*Community education: C*ommunity education was given to the villagers to make them understand the mode of transmission of paragonimiasis. Information regarding the risky food habits which could facilitate transmission of paragonimiasis was also given to the inhabitants of the study villages. Focus group discussions and in-depth interviews were carried out in the study villages during earlier surveys. The participants included the village headman, adult community members (both men and women) and also children. People were also educated about maintaining

proper hygiene. Charts and photographs were shown to the villagers to make them understand the life cycle of the lung flukes. The people were also advised to seek medical attention at community health centre (CHC), Miao, if they had persistent cough for more than two weeks with or without haemoptysis.

Clinicians and health care providers of the community health centre of Changlang district at Miao were also informed about the existence of a highly endemic focus of paragonimiasis in their catchment area. All the infected subjects who were sputum or stool egg positive for paragonimiasis were given praziquantel treatment (25mg /kg body weight given orally three times per day for 2 consecutive days)[16] at CHC, Miao. All treated subjects were re-examined and their sputum or stool samples were re-tested after 15 days to one month of treatment for confirming the success of treatment.

Results

The results of this study showed that there was a significant (P<0.001) decline in the prevalence of paragonimiasis as revealed by the decline in both ELISA positivity (Fig. 1) and egg positivity (Fig. 2). Antibody positivity against ES antigen in children fell down from earlier 51.7 (n=263) to 15.9 per cent (n=305) and in individuals 16-30 yr of age the serological prevalence fell down from 22.4 (n=196) to 8.2 per cent (n=185) and in individuals aged 31 yr and above, the decline in prevalence was from 15.3 (n=216) to 3.7 per cent (n=134). Gender-wise analysis revealed that the decline in ELISA positivity was similar in both genders and fell down from 33.9 (n=292) to 11.5 per cent (n=275) in males and from 29.8 (n=383) to 10.7 per cent (n=349) in females. In children (age ≤ 15 yr) egg positivity fell down from 20.9 to 3.6 per cent and from 7.1 to 1.6 per cent in individuals 16-30 yr of age. However, there was statistically no difference in the prevalence of egg positivity in individuals 31 yr and above (1.5 vs 2.2%). Gender-wise analysis revealed that there was significant reduction rate in the egg positivity in both male and female subjects (from 10.3 to 3.1% in males and from 11.0 to 2.01% in females). Sputum smear examination revealed that sputum samples from two of the 170 cases examined, were positive for AFB. These cases were referred to the CHC for pulmonary TB treatment.

Discussion

The present study revealed a significantly different picture of paragonimiasis in Changlang district of Arunachal Pradesh than the one appeared in 2007[7]. The prevalence of paragonimiasis both in terms of seropositivity and egg positivity has declined substantially. The results of this study should be a reason for cautious optimism that pro-active case detection and treatment of paragonimiasis cases together with community education can significantly reduce this food-borne disease in highly endemic and difficult to access

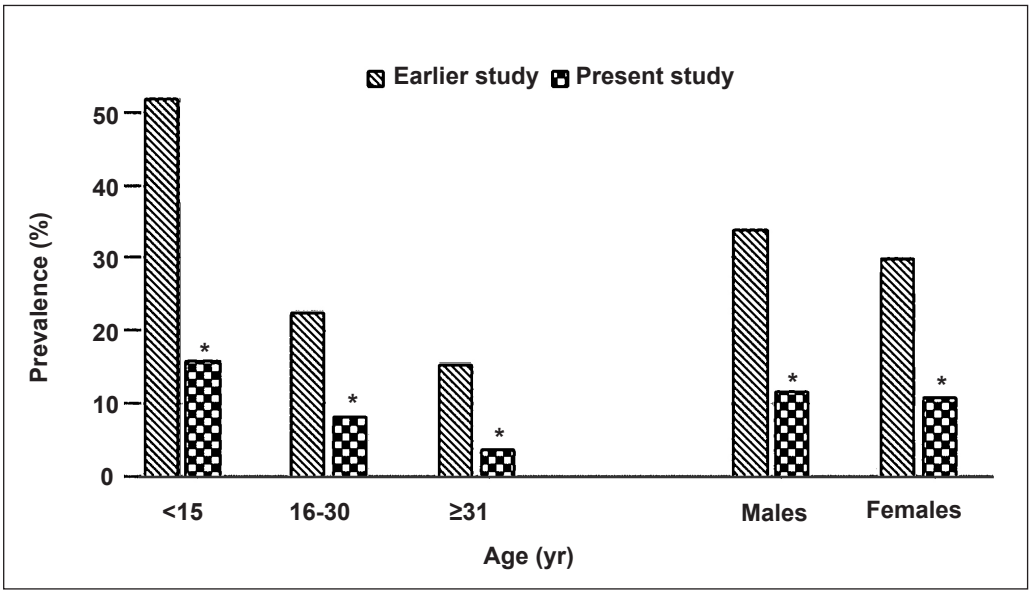

Fig. 1. Bar diagram showing decline in the prevalence of paragonimiasis based on ELISA positivity (age-group and gender-wise comparison of pre- and post-intervention data). (*Souce for pre-intervention data*: Ref. 7). *P<0.001 compared with earlier study.

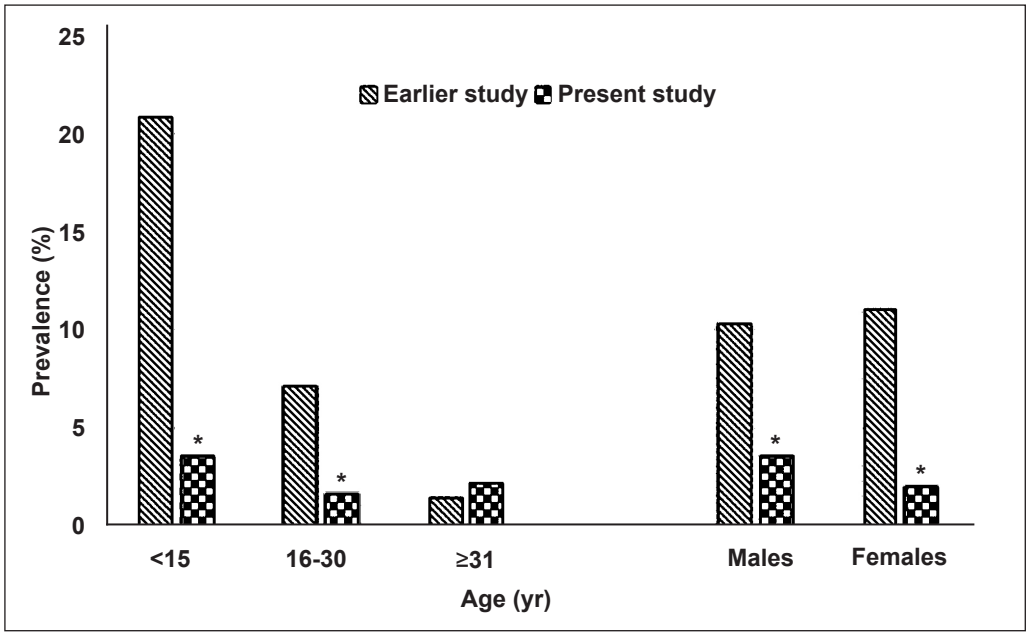

Fig. 2. Bar diagram showing decline in the prevalence of paragonimiasis based on sputum egg positivity (age-group and gender-wise comparison of pre and post-intervention data). (*Souce for pre-intervention data*: Ref. 7). *P<0.001 compared with earlier study.

foci and ultimately may contribute to the elimination of paragonimiasis in NE region. This strategy of hotspot targeted active case detection and treatment of infected cases together with community education for raising the awareness about paragonimiasis appears to be a feasible method for controlling paragonimiasis in remote and difficult to access foci.

In northeastern India paragonimiasis mostly affects communities who have very limited economic development and reside in the remote hilly and forested areas with poor access to health care facilities[6,7,13]. Although paragonimiasis is clinically important[17], yet it is a neglected food-borne trematode infection in NE region of India. Various factors like lack of education, poverty, remoteness of health care facilities are responsible for high prevalence of lung fluke infections in the endemic areas of Arunachal Pradesh.

Control initiatives from other countries where paragonimiasis is endemic, have revealed that lung fluke infection can be controlled effectively by active detection and treatment of cases and imparting education in a culturally sensitive manner by encouraging good sanitary practices, discouraging risky food habits like consumption of raw or partially cooked crabs or crayfishes[17]. In countries like China, Korea and Japan paragonimiasis control initiatives have considerably reduced the prevalence of the lung fluke infections[1]. In South Korea more than one million people were infected in 1950s[18-20]. However, sustained control efforts have dramatically reduced the prevalence of paragonimiasis which ranged earlier from 7.4 to 52.8 per cent[1] in different regions to almost negligible levels. In China where paragonimiasis is highly endemic, the surveillance and control measures are actively carried out to reduce prevalence of this disease[21-24]. Japan has a national programme for controlling paragonimiasis which has resulted in a significant decrease in prevalence of paragonimiasis[1]. Similarly, paragonimiasis control initiatives have been undertaken in other endemic Western Pacific countries[21].

In 2012, the WHO provided a roadmap for combating neglected tropical diseases including paragonimiasis[25]. It was suggested that by 2015 preventive chemotherapy and morbidity control should also be considered for combatting paragonimiasis and other food-borne trematode (FBT) infections wherever feasible. It was also suggested that by 2020, 75 per cent of population at the risk of FBT should be reached by chemotherapy. However, usefulness of preventive chemotherapy for control of paragonimiasis is yet to be evaluated[1, 26]. Studies conducted earlier[6, 13], including the present study have shown that TB and paragonimiasis are overlapping public health issues in NE region. At present, there is no national level

intervention programme targeted towards control of paragonimiasis in India. Integration of paragonimiasis control with the national TB control programme will be an important step towards paragonimiasis elimination in the NE region.

In conclusion, our results showed that active case detection and treatment of infected cases together with community education and awareness programme could be a method to achieve control of paragonimiasis in the endemic areas of NE region of India.

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