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Hookworm Infection: A Cross-Sectional Study of a Rural Community in a Subtropical, High-Rainfall Area of Meghalaya, India

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An intensive survey for hookworm infection was carried out in a village in Meghalaya state, North-East India. The study population was a village community (Nongkya, Umsning), comprising 489 individuals. Only 425 subjects could be examined. Stool examinations were using the Kato-Katz smear technique and modified Harada-Mori test-tube cultivation methods. Of the tested subjects 58.5% harboured single- or multiple-species infections involving hookworm, *Ascaris* and *Trichuris*. The prevalence of hookworm infection occurring as a single-species infection was 7.29%. The study identified the high-risk age group for this infection as 5-9 years, since the prevalence was higher in this age group (13.9%) in comparison to the age groups 0-4 years (3.48%). 10-14 years (10.4%), 15-19 years (9.52%) and 20+ years (3%). Between the two sexes the prevalence was slightly higher among females. The hookworm infection was found largely restricted to the subjects who work in the field. The influence of ambient climatic factors on the hatching of eggs and viability of infected larvae is being assessed.

Key words: Hookworm, Infection, Prevalence, Human population, Meghalaya, India.

Infection with intestinal parasites is a widespread problem in the developing world, accounting for approximately one quarter of the global population infected with these parasites (WHO, 1987, 1992; World Bank Report, 1993). The prevalence and severity of infection is especially high in the developing countries where health and sanitation facilities are unable to cope with the needs of increasing population (Crompton and Savioli, 1993). Intestinal nematodes with direct life cycle are amongst the most prevalent of all infectious disease agents of man. Recent estimates suggest that approximately 1.4 billion, 1.2 billion and 1 billion persons are currently infested with *Ascaris*, hookworms and *Trichuris*, respectively (WHO, 1994), all three of which are major soil-transmitted helminths and constitute a formidable public health problem with chronic morbidity and long lasting adverse effect on physical and mental development of young subjects (Stephenson *et al.*, 1990; Nokes *et al.*, 1992; Savioli *et al.*, 1992). The results compared for the prevalence of such infections estimate in 1947 and in 1997 suggest that the prevalence of hookworm and *Trichuris trichura* have changed very little over this period in developing countries, whereas that of *Ascaris lumbricoides* has decreased variably in both Africa and Asia. This can be explained as most of the anthelmintic drugs used in the past 50 years are more effective against *A. lumbricoides* than against other worm species (Chan, 1997).

Of hookworms, two species, namely, *Necator americanus* and *Ancylostoma duodenale* emerge to be the commonly occurring infections in the tropical and subtropical regions with the latter species being responsible for most of the infections and usually more abundant in rural as opposed to urban communities (Gilles, 1985; WHO, 1994). Several studies carried out in the 1920s to 1940s provided a wealth of quantitative information on the pattern of hookworm infection in different tropical and subtropical regions and these studies usually emphasized on changes in intensity and prevalence of infection in different sexes, age, social behaviour and ethnic groups within a community (Cort, 1922; Stoll, 1923; Sawyer, 1925; Chandler, 1925; Hill, 1926; Augustine, 1926; Chang, 1949). In context of India, extensive investigation carried out on similar lines by Chandler (1926-1928) and covering almost all provinces of erstwhile British India, provided immense information on the prevalence and epidemiology of hookworm infection in relation to the prevailing geographical, climatic and sociocultural conditions. Chandler reported that while the entire north-western and Deccan part of India was entirely free from hookworm infection, a high incidence of it occurred in Bihar, Orissa and some parts of (erstwhile) Assam states. In the hills of Assam (e.g. in the Khasi hills) the degree of infection was low and the intensity, light.

Recent studies in Assam, carried out after a gap of nearly six decades, still show a high prevalence of hookworm infection in human populations, particularly those in tea gardens (Regional Medical Research Centre, Assam, 1993). Reports from the various medical agencies in Meghalaya state (which now includes the 'hills' of the British Assam) also suggest a considerable prevalence of hookworm infection in the region. The present study was, therefore, undertaken with a view to investigating the status of hookworm infection in human population of Meghalaya. We report herein the prevalence and intensity of infection in a selected community of a village which represents a subtropical, high-rainfall montane area.

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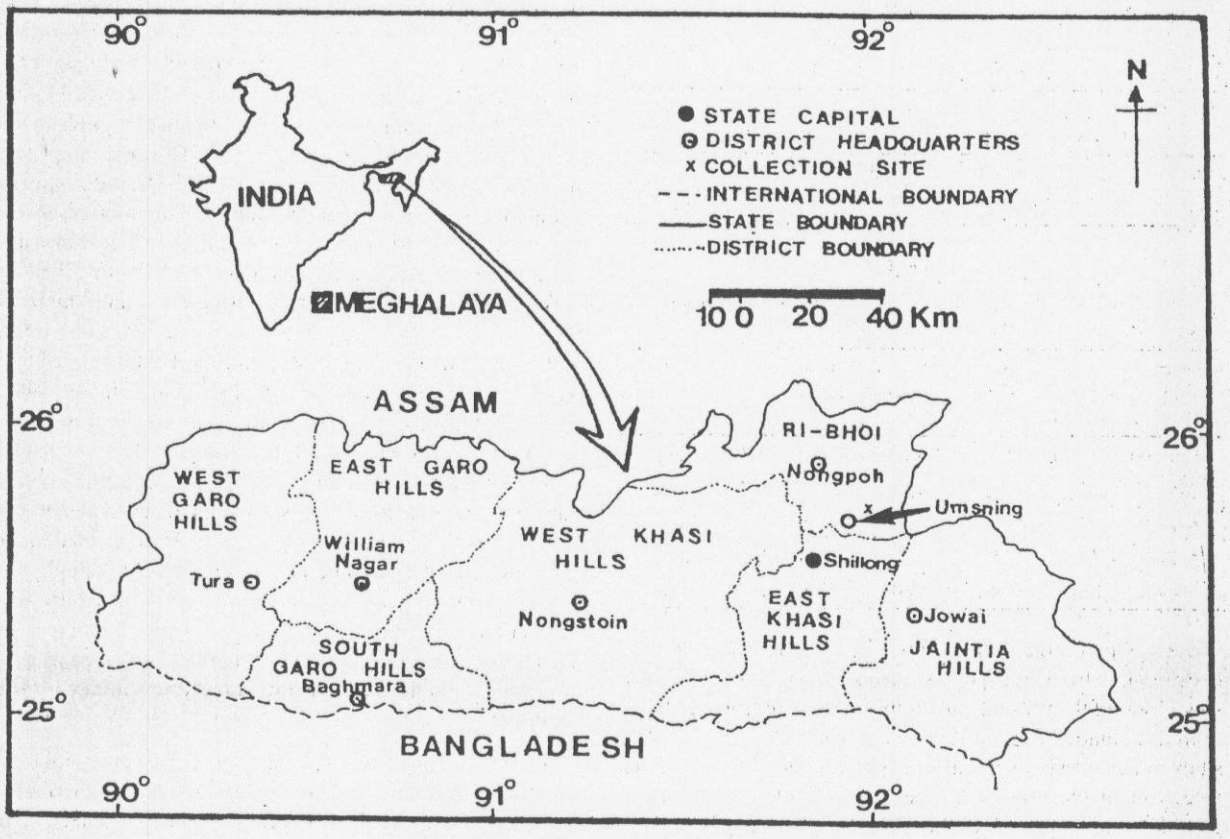

Fig. 1. Map of Meghalaya, showing the study site.

MATERIALS AND METHODS

The study was undertaken in a rural community of the village Nongkya (Umsning), which is situated about 33 km north of the state capital Shillong (Fig. 1). The area represents a warm and humid climate, experiencing rainfall almost throughout the year (averaging 277.6 mm, range 2.9-742.5 mm during the decade 1988-1997) except for a short period of dry season usually during winter (November to February) when the rainfall is very less (average 28 mm, range nil-266.6 mm). The mean minimum and maximum monthly temperatures in the area vary between 8.5°C and 17.9°C, respectively during winter and 15.4°C and 22.8°C, respectively during the monsoon period while the mean daily relative humidity ranges between 67-91%. The ecosystem basis of the area is rice field and the people are mostly agricultural workers. The level of hygiene and health education is by and large very poor. People mostly defecate in the open fields owing to the lack of sanitary lavatories in the area and use paper, not water, for self ablution as a common practice.

The population of the village comprised 489 individuals. However, only 425 subjects could be examined as the others declined to participate in the study. The infection was determined by examining the stool using the Kato-Katz smear technique (Martin and Beaver, 1968) and modified Harada-Mori filter-paper-strip cultivation method (Kosin *et al.*, 1973). The intensity of infection was assessed by counting the number of eggs per gram (EPG) of faecal sample, following Stoll's dilution counting method (WHO, 1963) and infections were classified according to individual egg counts as heavy, moderate, or light, following WHO recommendations (WHO, 1987; Renganathan *et al.*, 1995).

RESULTS

In the present study out of the 425 subjects examined, 249 (58.5%) were found infected with single-or multiple-species

Table I

Prevalence of helminthic infection in Nongkya village, Meghalaya (number examined = 425)

Parasite	No. infected	Prevalence (%)
Ascaris	162	38.1
Hookworm	31	7.29
Trichuris	4	0.34
Ascaris + Hookworm	44	10.3
Ascaris + Trichuris + Hookworm	8	1.9
Hookworm + Trichuris	nil	nil
Total	249	58.5

Table II

Sex-wise prevalence and intensity of hookworm infection in Nongkya village, Meghalaya

Host	No. examined	No. infected	Prevalence (%)	Mean EPG	S.D.
Male	219	14	6.39	712.57	±236.6
Female	206	17	8.25	678.23	±177.1

Table III

Age-wise prevalence and intensity of hookworm infection in Nongkya village, Meghalaya

Age group	No. of subjects examined	No. of subjects infected	Prevalence (%)	Mean EPG	S.D.	Intensity
0-4	86	3	3.48	600.0	±57.15	light
5-9	86	12	13.9	780.8	±212.28	light
10-14	67	7	10.4	742.8	±129.36	light
15-19	53	5	9.52	660.0	±159.37	light
20+above	133	4	3.0	457.5	±184.44	light

infections involving hookworms, *Ascaris* and *Trichuris* spp. (Table I). The prevalence of hookworms occurring as a single site of the present study represents a subtropical, high-rainfall climatic zone of Meghalaya, North-East India. The study indicated a high prevalence of multiple-helminth species infection in the area, the infected subjects harbouring a combination of geohelminthic nematodes, namely, *Ascaris*, *Trichuris* and hookworm. Intestinal parasitoses involving multiple species infections of these nematodes are of common occurrence in South East Asia (Carrol and Walker, 1990; Bakta *et al.*, 1993), as well as in the rain forest region of Ranomafana, Madagascar (Kightlinger *et al.*, 1995) in Pemba Island in Zanzibar (Renganathan, 1995). With regard to the hookworm infections, the prevalence was noted to be slightly higher in females than in male subjects. This may be related to the profession of the subjects, as in the study area as per the social set up the women folk work more in the fields and, therefore, are prone to more exposure to infection as compared to the males (Chandler, 1928). The present study identified the high risk age group for the infection as 5-9 years. This may be related to the status of personal hygiene practised in the said age group and also to more frequent exposure to the places such as house yards, school yards, play grounds and public places which are contaminated with hookworm eggs/larvae. In an earlier study made elsewhere in the state, Yadav and Tandon (1989) reported a high prevalence of hookworm eggs/larvae in places frequently exposed to children. In contrast to the present finding, other studies suggest a different pattern in which both prevalence and intensity of hookworm infection show a rise with age (Bundy *et al.*, 1992) and the worms tend to be more aggregated among adults than among children (Bundy *et al.*, 1987; Bundy, 1988; Bradley *et al.*, 1992). Whereas among the urban populations the prevalence of infection is high in the 20-30 year age group (Udonsi, 1983), in the rural communities the highest prevalence reportedly occurs in 5-15 year age group (Onubogo, 1978; Nwosu and Anya, 1980; Nwosu, 1981). All the positive cases of hookworm infection showed light infection, though no sex-related trend for intensity was evident. This low intensity of infection in the subjects may be due to inter-species competition, as majority of the subjects had multiple-species infection. The estimation of worm burden which is based on EPG count may have several sources of variation which can make the inference of intensity status for individuals imprecise (Bundy *et al.*, 1992); egg counts also vary from day to day within individuals (Hall, 1982) and the fecundity of female worms is also dependent on worm density (Anderson, 1986). A high prevalence of *Ascaris* infection compared to that of hookworm in the study area is perhaps reflective of their different transmission modes, e.g. passive ingestive mode of transmission of the former versus inoculative skin penetration of the infective larvae of the latter. Besides, inadequate structure of pit latrines and lack of regular water supply may cause drying up of exposed faeces and interfere with cumulative acquisition of hookworm infection, whereas the *Ascaris* infective stage (i.e., egg containing L_2 larvae) which is more resistant to desiccation overcomes unfavourable condition.

Even though the prevalence and degree of hookworm infection have emerged as low in the study area, nevertheless the infection may not be ignored as of no significance. The degree of infection required to produce measurable injury depends on many factors such as nourishment, and physical, physiological and immunological status of the host individual. Even without clinically demonstrated morbidity infections of <40 worms may have severe consequences, particularly in chronically malnourished populations in Sub-Saharan Africa, Asia and Latin America (WHO, 1994). The low index of infection in the rural community, studied herein, seems important epidemiologically. Further investigations into the transmission dynamics of hookworm infection among rural communities of the state, therefore, seems desirable.

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