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Original Research Article

Effect of Climatic Factors on the Prevalence of Soil Transmitted Helminthes from Koshi Region of North Bihar, India

Lakshmi Choudhary*

L. N. Mithila University, Darbhanga-846008, India
**Corresponding author*

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A B S T R A C T

Prevalence of soil transmitted helminthes infections in apparently healthy school children of 5-15 years and other people of different districts of Koshi regions of North Bihar during July 2009 to June 2010 were evaluated. The climatic factors are responsible for soil transmitted helminthes which are temperature, rainfall and relative humidity. *Ascariasis*, *Trichuriasis* and *Ancyclostomiasis* (Hookworm infection) are found to be endemic in this region. The incidence of *Ascaris lumbricoides* was highest in the month of August (18.64%). The month of September was 15.25% followed by that of July (14.4%) and October with 10.16%. Also the incidence of hookworm registered the highest incidence in the month of June 19.27% and lowest in the month of December (4.82%) during the study period.

Introduction

Intestinal parasitic infections are endemic worldwide and have been described as constituting the greatest single worldwide cause of illness and disease. Poverty, illiteracy, poor hygiene, lack of access to portable water and hot and humid tropical climate are the factors associated with intestinal parasitic infections. The study aimed to estimate prevalence and identify factors associated with soil transmitted helminthes infections in Koshi region of North Bihar.

STH infections are endemic worldwide and a major public health problem in developing countries (20). Many studies have been carried out in Pakistan (1), India (18) and elsewhere in the world regarding intestinal helminthiasis.

Soil transmitted helminthes are multi cellular pathogens that infect vast number of human and animal hosts causing wide spread chronic disease and morbidity.

Poor people in developing countries endure the burden of disease caused by four common species of soil transmitted nematodes that inhabit the gastrointestinal tract namely *Ascaris lumbricoides*, *Trichuris trichiura*, *Ancylostoma duodenale* and *Necator americanus* (10). Children and pregnant women are the main sufferers from these parasitic infections (27).The parasites are more common in rural areas in the developing countries of Asia, Africa and Central America and are often linked to poverty and other social problems such as poor sanitation and lack of clean water (25).

Soil transmitted helminthes (STH) infections are among the most prevalent of chronic human infection with an estimated 2 billion individuals infected world- wide (3). These infections are more common and prevalent in tropical and subtropical regions of the developing world where adequate water supply and sanitation are significance and economic impact of this groups of pathogens is hard to quantify, although the WHO has estimated that more than 1000 million people worldwide are infected with one or more of the major pathogenic species of human: *Ascaris lumbricoides, Trichuris trichiura,* Hookworm and that 39 million disability adjusted life years are attributed to these four Nematodes (8, 2 and 26).

Materials and Methods

Koshi region is situated at longitudinal 86.3-86.7 ^{0}E and latitude 25.88-26.7^{0}N. The climatic factors are responsible for soil transmitted helminthes which are temperature, rainfall and relative humidity. The maximum and minimum temperature in summer (44^{0}-35^{0}C), winter (25^{0}C-12^{0}C).It comes under wet and economically backward region of Bihar state having annual rainfall of 1142 mm. Temperature 17^{0}-44^{0}C and humidity 33%(May) to 94%(July- August).

The survey was conducted during July 2009 to June 2010. The stool samples were collected from 528 male and female of the people of different age groups of the Koshi region.

Collection and Examination of Faecal Samples

The pupils were educated on the causes of STH infections among school aged children and they were convinced that everyone ought to be free from such infections, thus the necessity of participating in the research work was appreciated by them. Thereafter wide mouth corked sterile bottles were given to the pupils for the collection of their stool samples at home.

The stool samples were properly labeled and were carried in a cold box filled with ice packs and transported to the laboratory for analysis. The samples that could not be analyzed immediately were preserved using 10% formalin until they were examined (9). Stool analysis was performed using kato-katz technique (27).

Stool Examination

Fresh morning stool samples were collected in nylon containers containing 10% formaldehyde. The containers were labeled and immediately transported to the pathology laboratory for further processing. The stool specimens were processed.

Results and Discussion

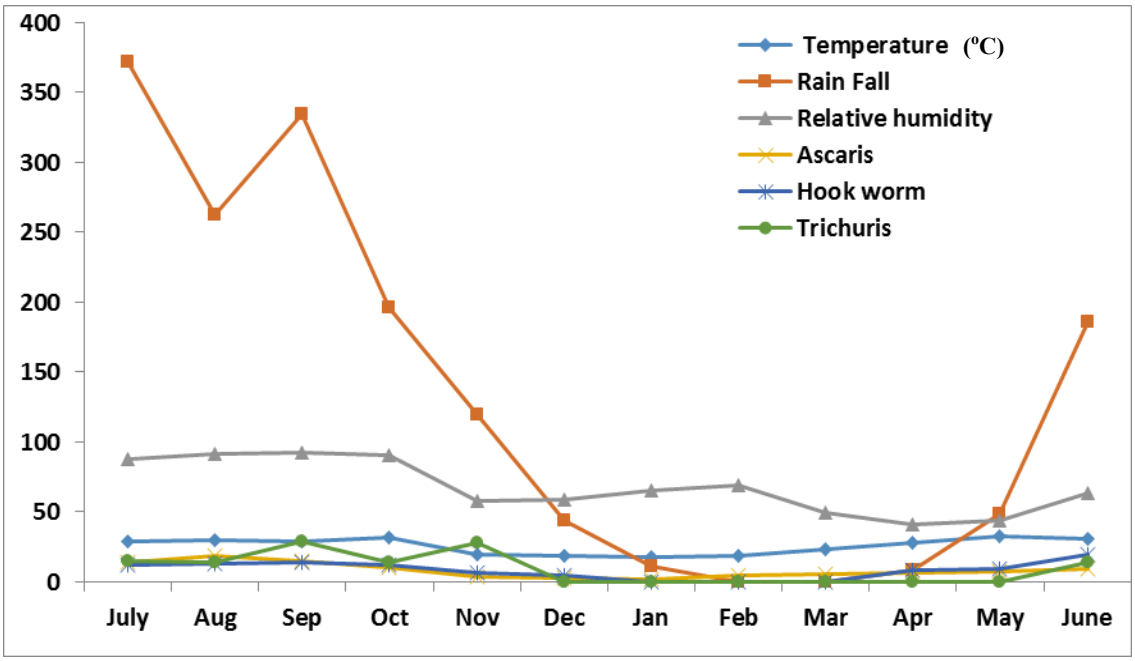
The temperature may rise to 44 degree Celsius and above in summer. The average rainfall is 1142 mm. Most of the precipitation is in the rainy season only. The cases studied here were drawn from; the districts of Koshi region (population 5,624,298*) Ascariasis, Trichuriasis and Ancyclostomiasis* (hookworm infestation) are found to be endemic in this region.

The month wise incidence of *Ascaris, Trichuris and Ancylostoma* during July 2009 to June 2010 was correlated with climatic factors like air temperature, rainfall and relative humidity. During the study period the incidence of *Ascaris lumbricoides* was highest in the month of August 18.64%. In the month of September it was 15.25% followed by that of July and October with 14.4% and 10.16%.

Table.1 Metrological conditions of Koshi region July 2009- June 2010

Month	temperature (^{0}C)	Rain Fall	Relative humidity	Ascaris	Hook worm	Trichuris
July	29 ± 0.25	372.2 ± 10.45	88.00 ± 3.75	14.4	12.5	14.8
Aug	29.7 ± 0.29	262.8 ± 30.78	91.56 ± 5.19	18.64	13.25	14.28
Sep	29 ± 0.18	334.8 ± 18.44	92.12 ± 4.49	15.25	14.46	28.57
Oct	31.5 ± 0.24	196.4 ± 25.58	91.00 ± 4.45	10.16	12.5	14.00
Nov	19.2 ± 0.17	120.0 ± 13.36	58.06 ± 9.41	3.39	6.2	28.00
Dec	18.6 ± 0.21	44.0 ± 0.74	58.98 ± 4.55	2.54	4.82	0
Jan	17.5 ± 0.13	11.5 ± 0.00	65.08 ± 3.41	1.69	0	0
Feb	19 ± 0.14	0 ± 0.00	69.06 ± 4.58	4.24	0	0
Mar	23 ± 0.24	0 ± 0.00	49.87 ± 5.22	5.9	0	0
Apr	28 ± 0.22	8.0 ± 0.00	41.14 ± 17.05	6.8	8.43	0
May	33 ± 0.11	48.5 ± 0.00	44.06 ± 25.44	7.63	9.64	0
June	31 ± 0.28	185.7 ± 3.89	64.00 ± 8.34	9.32	19.27	14.28

Fig.1 The prevalence of *Ascaris lumbricoides*, Hook worm and *Trichuris* in relation to Air temperature, rainfall and relative humidity recorded during July 2009 – June 2010



A gradual fall in the incidence of *Ascariasis* was also found in all other months of the year as shown in the table No.1 and fig.

Hookworm registered the highest incidence in the month of June 19.27%and lowest in the month of December 4.82%. A gradual fall in the incidence of Ancylostomiasis was also found in the other month as shown in the table and fig. During the study period the incidence of *Trichuris trichiura* was highest in September 28.57% and lowest in the month of October. Its occurrence in the people of study area was negligible (shown in the table).

The average rainfall in these months relative humidity observed was also high with mean

percentage values ranging from 95.08 ±3.27 to 111.02±18.99 mm. The relative humidity observed was also high with mean percentage value ranging for the study period.

Comparatively low incidence was observed during the cold months of December, January, February and March. Average incidence of these STH was noted in months of April May and June during the study period. The STH infection in the Koshi region was highly found in the rainy season, followed by the summer season and low in the winter season.

An important outcome of our investigation is the observation that STH were not independent of one another and that some species co-occurred more frequently than might have been expected if their occurrence were by chance. Though the pattern of interaction, especially the co-occurrence of *Ascaris lumbricoides* and *Trichiuris trichiura* have been described previously (5, 6, 12, 13, 14 and 15).

Regarding the other helminth species, similar associations have been found previously, such as in Brazil (11) and (13). In both studies, co-infection of Schistosomes and intestinal nematodes were very common. In Brazil, significant associations between hookworm infection and intestinal schistomiasis and of hookworm infection and ascariasis were found, intensity of hookworm infection increased with multiplicity of infections (11).

Maximum survival rates of hookworm larvae, as indicated by proportion of larvae surviving occur at 20-30 ^{0} C. Experimental studies suggest that maximum development rates of free living infective stage occur at temperatures between 28 – 32^{0} C, with development of *Ascaris lumbricoides* and *Trichuris trichiura* arresting below 5^{0}Cand above38 ^{0} C (4, 19) and development of hookworm larvae ceasing at 40 ^{0} C (23, 21). It is suggested that *Ascaris lumbricoides* are more resistant to extreme temperature than *Trichuris trichiura* eggs (7).

Soil moisture and relative atmospheric humidity are also known to influence the development and survival of ova and larvae. Higher humidity is associated with faster development of ova; and at low humidity (below 50%) the ova of *Ascaris lumbricoides* and *Trichuris trichiura* does not embryonate (17, 22). Field studies show that the abundance of hookworm larvae is released to atmospheric humidity (16, 24).

These differing rates of development and survival will influence parasite establishment in the human host and hence the infection levels. Thus a climate induced increase in the rate of establishment while holding parasites mortality constant causes the parasites equilibrium to rise (7).Although seasonal dynamics in transmission may occur, such fluctuations may be of little significance to the overall parasites equilibrium within communities. For all these reasons, spatial variability in long term synoptic environmental factors will have a greater influence on transmission, success and pattern of STH infection than seasonal variability in location.

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