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EPIDEMIOLOGY, ECOLOGY AND PREVALENCE OF SOIL TRANSMITTED HELMINTHS FROM KOSHI REGION OF NORTH BIHAR.

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ABSTRACT

Prevalence of soil transmitted helminthes infections in apparently healthy school going children and other 528 people of different districts of Koshi regions of North Bihar were evaluated. Over all incidences of STHs infection was 39.39% during study. High incidence of STH was seen in the rainy season *i.e.,* in the month of July and August, September, significantly higher (P<0.05) .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. However prevalence of *Trichuris trichiura* was negligible and it was almost nil in the most of the months but was highest in month of September with 28.57% and lowest in October with 14.00% 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.

Figures : 03 References : 34 Tables : 03
KEY WORDS : Climatic factors, Ecology, Epidemiology, Koshi region, Prevalence, Soil-transmitted helminths

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 infection. Soil transmitted helminthes also known as geohelminths, are major public health problem in developing countries[14]. Many studies have been carried out in the world regarding intestinal helminthiasis[24].

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 *Stongyloides stercoralis*[10]. Children and pregnant women are the main sufferers from these parasitic infections[34].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[32].

Soil transmitted helminthes (STH) infections are among the most prevalent of chronic human infection with an estimated 2 billion individuals infected world-wide[2]. The prevalence of STH infections was assessed among school children in south eastern Nigeria and found 16.9% of infection; stunted growth by 1.6m and 0.04 kg weight loss were recorded among infected children[13]. 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[1,11,33]. Occurrence of intestinal geohelminthic infections namely *Ascaris lumbricoides, Ancylostoma duodenale, Trichuris trichiura* and *Strongyloides stercoralis* were noticed in rural preschool children of administrative blocks of Khunti district , Jharkhand(India).Use of hand pump water and open air defecation ,household crowding , uneducated and cattle ownership were mainly responsible for the prevalence of

TABLE-1: Metrological conditions of Koshi region July 2009- June 2010 and prevalence of *Ascaris*

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

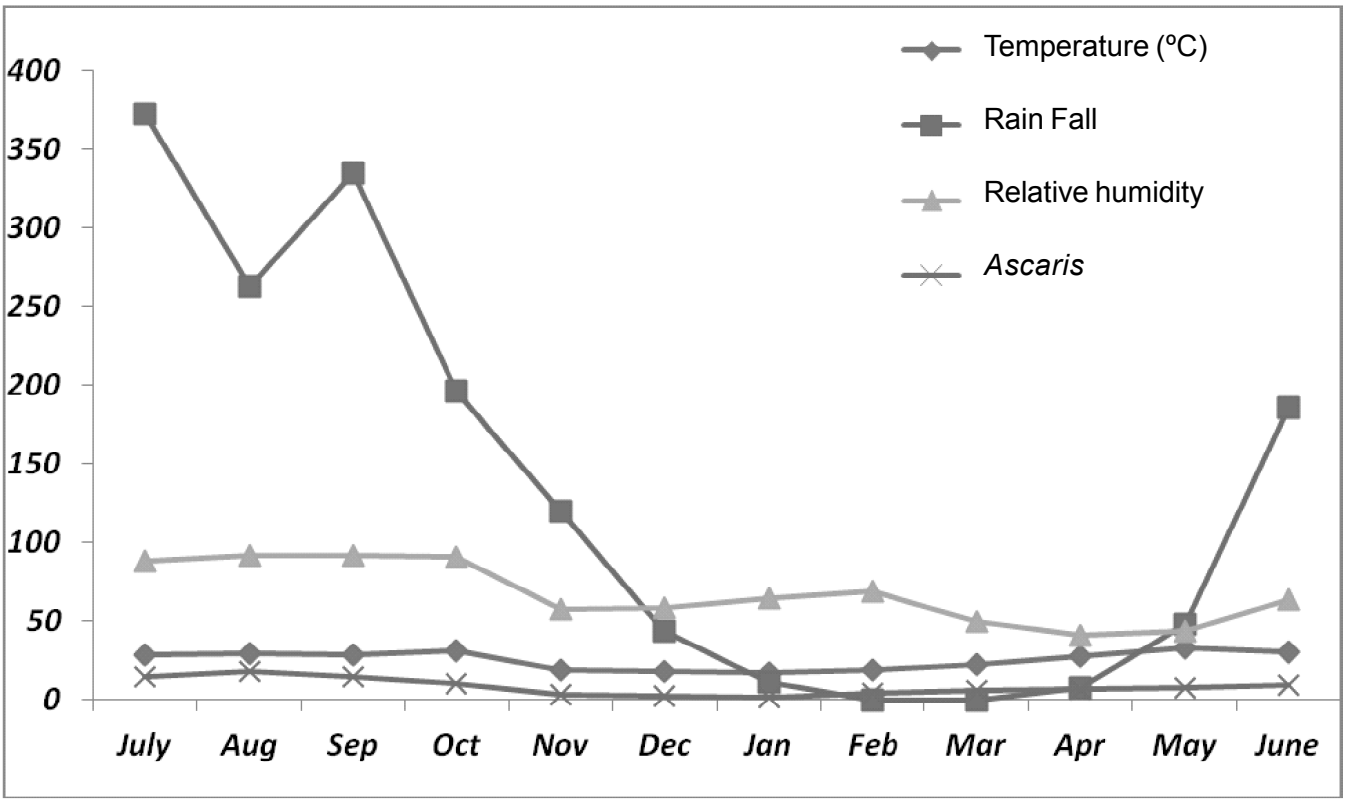

Fig. 1: The prevalence of *Ascaris lumbricoides* in relation to Air, temperature, rainfall and Relative humidity recorded during July 2009 – June 2010

TABLE-2: :Meteorological conditions of Koshi region July 2009- June 2010 and prevalence of *Trichuris*

Month	Temperature (°C)	Rain Fall	Relative humidity	Trichuris
July	29 ± 0.25	372.2 ± 10.45	88.00 ± 8.34	14.8
Aug	29.7 ± 0.29	262.8 ± 30.78	91.56 ± 3.75	14.28
Sep	29 ± 0.18	334.8 ± 18.44	92.12 ± 5.19	28.57
Oct	31.5 ±0.24	196.4 ± 25.58	91.00 ± 4.49	14.00
Nov	19.2 ± 0.17	120.0 ± 13.36	58.06 ± 4.45	28.00
Dec	18.6 ± 0.21	44.0 ± 0.74	58.98 ± 9.41	0
Jan	17.5 ± 0.13	11.5 ± 0.00	65.08 ± 4.55	0
Feb	19 ± 0.14	0 ± 0.00	69.06 ± 3.41	0
Mar	23 ± 0.24	0 ± 0.00	49.87 ± 4.58	0
Apr	28 ± 0.22	8.0 ± 0.00	41.14 ± 5.22	0
May	33 ± 0.11	48.5 ± 0.00	44.06 ± 17.05	0
June	31 ± 0.28	185.7 ± 3.89	64.00 ± 25.44	14.28

helminthiasis[3]. In India, 241 million children are estimated to need deworming to avert the negative consequences that STH infections can have on child health and development. In April 2011, 17 million children in Bihar state were dewormed during a government led school based deworming campaign.

In koshi region no study has been done to access the environmental risk due to the presence of helminthic eggs in the soil. The study aimed determining the prevalence and to identify the factors associated with STHs parasites infecting humans and identify the best practices to be adopted for control of STH infections in koshi region of North Bihar.

Materials and Methods

Koshi region is situated at longitudinal 86.3-86.7ºE and latitude 25.88-26.7ºN. The climatic factors are responsible for soil transmitted helminthes which are temperature, rainfall and relative humidity. The maximum and minimum temperature in summer was 44º-35ºC, winter 25ºC-12ºC.It comes under wet and economically backward region of Bihar state having annual rainfall of 1142 mm, temperature 17°- 44°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 every one 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[12]. Stool analysis was performed using kato-katz technique[34].

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.

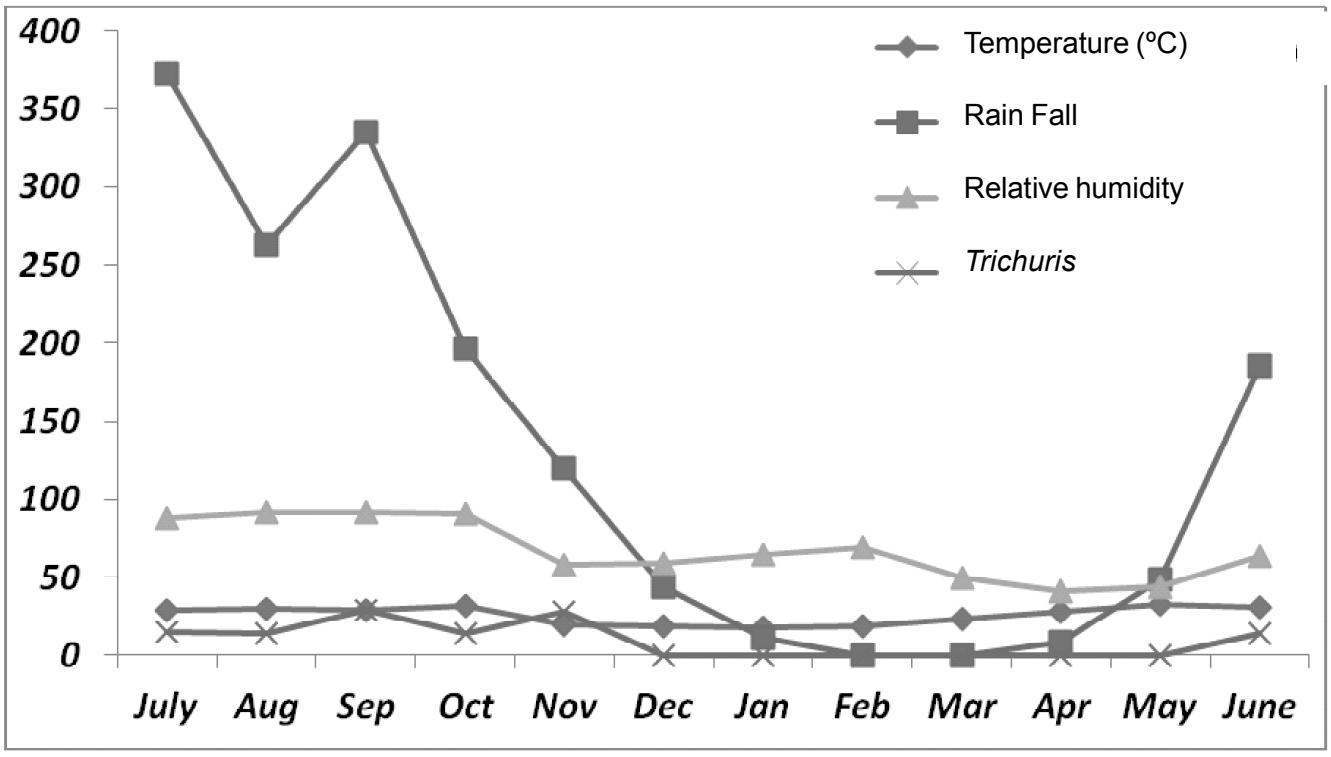

Fig. 2 : The prevalence of *Trichuris* in relation to Air, temperature, rainfall and Relative humidity recorded during July 2009 – June 2010.

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[14].

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%. 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.1.

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-3 and fig.3.

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 2 and fig. 2).

The average rainfall was 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[5,6,16, 19,21,22]. Regarding the other helminth species, similar associations have been found previously , such as in Brazil[15].

An environmental and climatic factor has most conclusive or decisive effect on the prevalence of STH. In particular our analysis confirms that warm and humid

TABLE – 3 : Meteorological conditions of Koshi region July 2009- June 2010 and prevalence of Hookworm

Month	Temperature (°C)	Rain Fall	Relative humidity	Hook worm
July	29 ± 0.25	372.2 ± 10.45	88.00 ± 3.75	12.5
Aug	29.7 ± 0.29	262.8 ± 30.78	91.56 ± 5.19	13.25
Sep	29 ± 0.18	334.8 ± 18.44	92.12 ± 4.49	14.46
Oct	31.5 ± 0.24	196.4 ± 25.58	91.00 ± 4.45	12.5
Nov	19.2 ± 0.17	120.0 ± 13.36	58.06 ± 9.41	6.2
Dec	18.6 ± 0.21	44.0 ± 0.74	58.98 ± 4.55	4.82
Jan	17.5 ± 0.13	11.5 ± 0.00	65.08 ± 3.41	0
Feb	19 ± 0.14	0 ± 0.00	69.06 ± 4.58	0
Mar	23 ± 0.24	0 ± 0.00	49.87 ± 5.22	0
Apr	28 ± 0.22	8.0 ± 0.00	41.14 ± 17.05	8.43
May	33 ± 0.11	48.5 ± 0.00	44.06 ± 25.44	9.64
June	31 ± 0.28	185.7 ± 3.89	64.00 ± 8.34	19.27

conditions are suitable for STH egg and larval development[7,29].

Extreme weather conditions could adversary effect development and survival of helminthes free living stages. Positive association precipitations were observed for the three STH species and temperature were an important risk factor for hookworm. The eggs of this species don't develop in temperature below 15°C and the larvae prefer shady, moist areas with temperature at or above 30°C above 45°C[3].

Temperature also plays an important role in speed of hatching and rate of development for ±5 days. Indeed larvae optimally hatch within certain temperature limits[8]. Maximum survival rates of hookworm larvae, as indicated by proportion of larvae surviving occurs at 20-30ºC. Experimental studies suggest that maximum development rates of free living infective stage occur at temperatures between 28ºC-32ºC with development of *Ascaris lumbricoides* and *Trichuris trichiura* arresting below 5ºC and above 38ºC[4,25] and development of Hookworm larvae ceasing at 40ºC[26,27,31]. It is suggested that eggs of *Ascaris* are more resistant to extreme temperature than *Trichuris trichiura* eggs[9]. Besides temperature, 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[23,29]. Field studies show that the abundance of hookworm larvae is released to atmospheric humidity[31].

The result revealed that variable temperature, moderate rainfall and high humidity are important for prevalence of STH infection. It increases as the temperature rises and decreases as the temperature gets slightly cooler. This indicates the importance of summer conditions in the transmission of STH infection in koshi region and suggests that transmission may be seasonal.

During the study period the incidence of STH was highest in August and lowest in the month of January. In January temperature of area remain 17ºC highest and in May it exceeds to average 33ºC.The average rainfall of area remains nearly 1135 mm and relative humidity is also high with mean percentage value ranging 64% to 94% for the study period. Comparatively high incidence of STH was seen in the rainy season *i.e.,* in the month of July and August, September, significantly higher ($P<0.05$) helminthes infection was observed in monsoon (when compared to post monsoon, winter and summer). Higher rainfall during monsoon provides suitable morality of salts

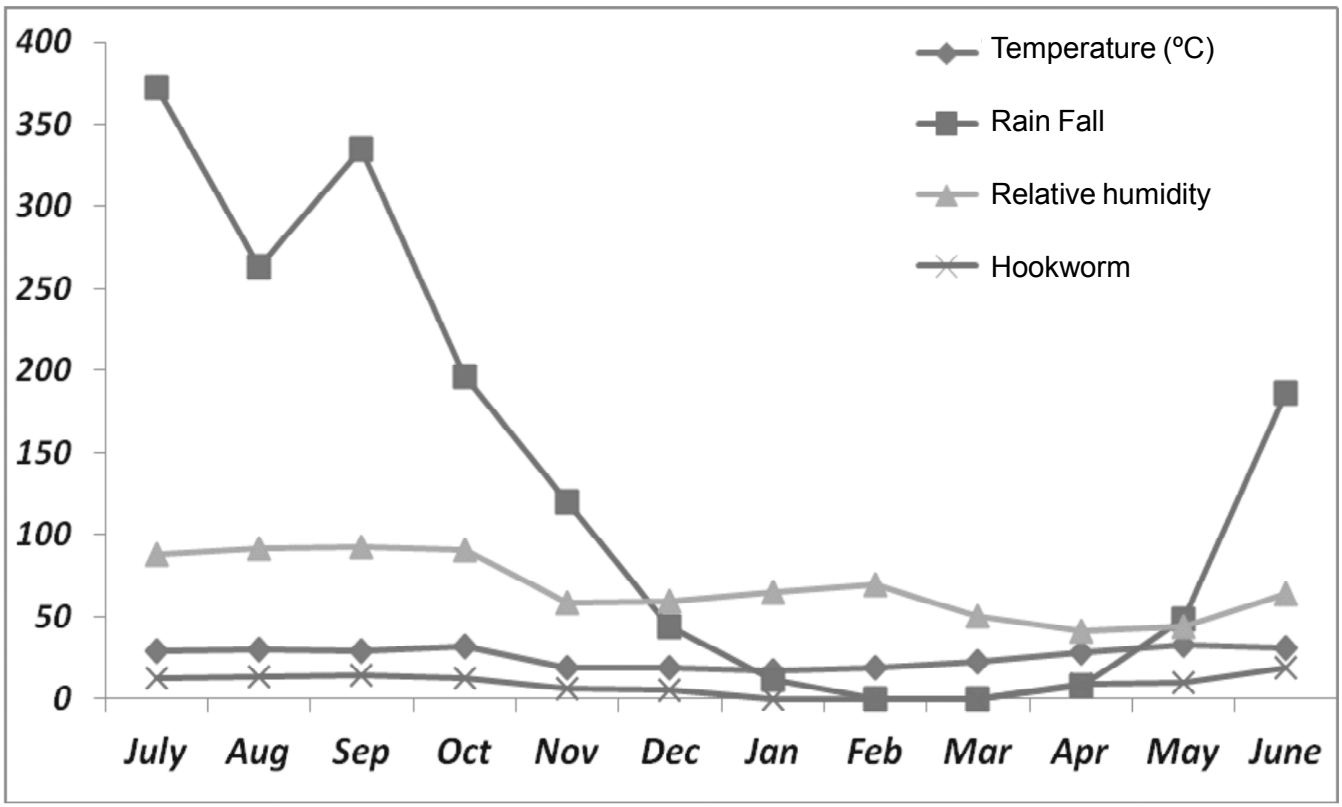

Fig. 3: The prevalence of hookworm in relation to air, temperature, rainfall and relative humidity recorded during July 2009- June 2010.

in soil, which is an important factor for ecdysis[28]. It also helps in larval dispersal and increases the chances of contact between host and infective larvae[20]. Higher temperature and rainfall causes stress to the host which lower its immunity and predisposes it to heavy infection[17].

During winter the prevalence of STH infection was very low. This could be due to adverse climatic condition in winter months which help in arrested development in host and environment[18]. In addition short photoperiod in winter reduces the outdoor activities and helps in reducing the chances of contact between the host and parasites. As the temperature increases from the month of March, the over wintered larvae start mounting and become infective and when host comes in contact infectivity leading to high prevalence during the month of April and May is seen.

These differing rates of development and survival will influence parasite establishment in the human host and hence the infection levels. Thus a climate and ecology induced increase in the rate of establishment while holding parasites mortality constant causes the parasites equilibrium to rise[9].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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