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Brief Communication

Intestinal Parasitic Infestations in Populations Inhabiting Similar and Contrasting Ecological Zones

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While intestinal parasitic infestations of both helminthic and protozoal types are endemic in most parts of West Bengal, and variations in their frequencies between (a) the southern coastal and (b) the northern sub-Himalayan ecological zones are generally recognized, microlevel studies are few. Studies undertaken on these two zones suggest that, considering four broad classes of infection, the differences between the two zones, as also within the sub-Himalayan zone, are significant. Possible explanations of such differences in terms of physical and cultural environmental factors are suggested.

KEY WORDS: intestinal parasites; environmental variation; physical environment; cultural environment; West Bengal.

INTRODUCTION

The state of West Bengal in eastern India is known for a wide diversity of environmental features, physical (altitude, temperature, rainfall, humidity, soil type, etc.) as well as cultural (settlement pattern, habitation type, degree of urbanization, dress, food preferences and taboos, etc.), matched by the diversity of its ethnic composition. Recent studies have sought to

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determine to what extent diversity clusters into two ecozones—southern coastal and northern sub-Himalayan—to evaluate the differences between and within these zones with respect to such biomedical traits as fertility mortality, adult body dimensions, child growth, and disease prevalences, and their determinants (Basu *et al.*, 1979; Bhattacharya, 1980; Gupta, 1980a,b; Gupta and Basu, 1980).

The study area chosen in the coastal zone was Geonkhali, at the confluence of the Hooghly, Rupnarayan, and Haldi rivers, in Tamluk subdivision, Midnapore district, and that in the sub-Himalayan zone was the medium-altitude area (3,000-7,000 feet) of the Kalimpong and Garubathan Police Station jurisdictions in Kalimpong subdivision, Darjeeling district (henceforth referred to simply as Kalimpong). The study areas and villages are shown in Fig. 1, and their physical environmental characteristics in Table I.

Two study villages, Mirpur and Gopalchak, were chosen in Geonkhali. The inhabitants of Mirpur claim descent from 12 Portuguese gunners brought in by the local ruler in the mid- to late 1700s to protect her estates from Maratha raiders from western India, the gunners having subsequently married local women and settled down. The majority of Mirpurians are agriculturists, cultivating their own land or working as agricultural laborers on others' land. Several adult males have clerical or semitechnical jobs in Calcutta city and visit home on weekends, while others are employed as sailors, and are away from home for long periods. The Mirpurians profess Christianity and (presumably) under missionary influence reflect a degree of urbanization including education, private, if primitive, toilets, Western dress, and shoes. While they have no religious food taboos, they suffer from malnutrition (Basu *et al.*, 1980), with a mainly cereal-based diet.

The indigenous Mahishya population of Gopalchak are traditionally an agricultural caste, working their own land or others', and are less urbanized than the Mirpurians. Being Hindu, they consider both beef and pork taboo. They also eat a mainly cereal-based diet and suffer from malnutrition.

At least three study villages were chosen in Kalimpong: the Sherpa villages of Upper Echhay near Kalimpong town, the Dhapgaon labor colony within the West Bengal Government Medicinal Plantation at Rango, and the Lepcha villages of Bong and Sindebong, also near Kalimpong town. The Sherpas are indigenous high-altitude people, who immigrated from the Tibetan plateau to northeastern Nepal about 450 years ago (Haimendorf, 1964; Oppitz, 1974) and thence to the Kalimpong town about 200 years ago (Gupta, 1980a). The Sherpas of Echhay are mainly agriculturists, cultivating their own or others' land, but some are engaged in services away from home, and a few in foreign countries. They also raise vegetables in their kitchen gardens and rear cattle, pigs, and chickens. The houses are scattered on the slopes of hills, and generally have pit toilets. Nearness to the town of

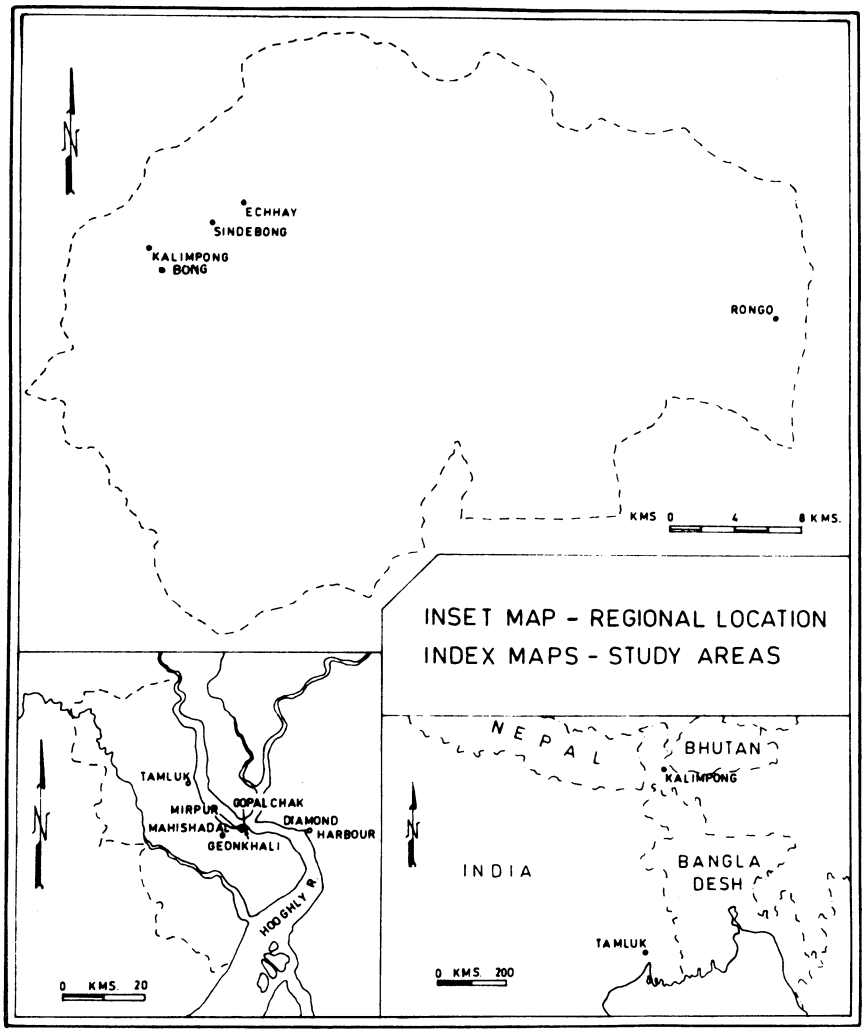

Figure 1. Map.

Kalimpong has resulted in a degree of urbanization, which is reflected in their level of education, urban contact, dress, and general way of life. As Buddhists, they have no food taboos and their diet is adequate in cereals, meat and milk products, and vegetables.

The Sherpas of Dhapgaon live off their meager weekly plantation labor wages with relatively few engaged in raising vegetables and rearing

Table I. Physical Environmental Characteristics of the Coastal and Sub-Himalayan Zones

	Meteorological characteristics (range of monthly avg.[a])				
Zone 1 region	Max. temp., °C	Min. temp., °C	Relative humidity, %	Rainfall, mm	Soil type[c]
Coastal Geonkhali[b]	25.0-32.0	15.8-27.4	65-86	8.3-410.0	Deltaic alluvial
Sub-Himalayan Kalimpong	15.5-24.4	7.8-19.3	69-92	4.9-635.0	Hilly

[a]From *Climatological Tables of Observatories in India (1931-1960)* (n.d.).
[b]Because no meteorological data are available from Geonkhali region, those from a neighboring coastal zone are given.
[c]Raychaudhuri (1969).

cattle, pigs, or chickens. The houses are huddled together with relatively poor sanitation, water supply, and general living conditions. While they also generally use Western dress, including shoes, the remote location of the plantation, far inside a forest range with poor transport facilities, puts a limitation on urbanization. As Buddhists, they have no food taboos, but with the only grocer's store in Dhapgaon and the others elsewhere in the plantation being poorly stocked their diet is monotonously cereal-based and inadequate.

The Lepchas are generally considered to be indigenous to the medium altitudes of Kalimpong, and probably a much wider region (Das, 1978). The Lepchas of Bong and Sindebong have been treated as a unit in this study because of the proximity of the two villages and close social intercourse among their inhabitants. They are mainly agriculturists, cultivating their own or others' land, but some work outside the village and a few outside the country. They also raise vegetables and rear cattle, pigs, and chickens. The houses are located on the slopes of hills and have toilets, and many residents use Western dress. The degree of urbanization is comparable to that in Echhay. The Lepchas have no food taboos and their dietary status is between those of Echhay and Dhapgaon.

In view of the different frequencies of the various helminthic infestations in West Bengal already known, i.e., high frequencies of hookworm (*Ancylostoma doudenale/Necator americana*) and whipworm (*Trichuris trichiura*) in the sub-Himalayan zone, and of roundworm (*Ascaris lumbricoides*) in the coastal zone (Chandler, 1926a,b), and those of protozoal infestations relatively less known, the purposes of the present report are the following:

(a) to present our data on differential intestinal parasitic infestation frequencies in the two zones, and in populations within each of them; and

(b) to suggest possible causes of such different frequencies.

The community/caste/tribal designations are used in this report in order to relate the sociocultural characteristics associated with each to the different parasite frequencies occurring among them.

MATERIALS AND METHODS

Feces specimens were collected from the five villages mentioned above and examined for helminthic and protozoal infestations. The total population of each village and the number of feces specimens examined from each are given in Table II. While no statistical sampling of households or individuals was attempted because of difficulties involved in such selection in the field, efforts were made to extend the sample to both sexes and all ages. This effort met with varying degrees of success in different villages, the differential proportions of the total village populations included in the samples being partially determined by the degree of rapport we were able to establish in each. In most villages the samples covered large proportions of the total populations, and represent them reasonably well.

RESULTS

Table III shows that the frequency of subjects with "nothing abnormal detected" (NAD) is lower, i.e., the overall prevalence is higher, in the sub-Himalayan than in the coastal zone, and that this higher frequency is mainly accounted for by the considerably higher hookworm prevalence in the former. Considering four broad classes, i.e., NAD, "protozoa only," "helminths only," and "multiple protozoa and helminths," the difference between the two zones is statistically significant (Table IV). Within the coastal zone the NAD frequency is lower, i.e., the overall frequency of parasites is higher, in Mirpur than in Gopalchak, in large part due to the higher helminths-only prevalence in the latter (Table III), but the difference is not statistically significant (Table IV). Within the sub-Himalayan zone,

Table II. Total Populations of the Villages Studied and Sample Sizes, by Zone, Village, and Community

	Coastal		Sub-Himalayan		
	Mirpur (mixed Portuguese and Bengali)	Gopalchak (Mahishya)	Echhay (Sherpa)	Dhapgaon (Sherpa)	Bong-Sindebong (Lepcha)
Population	320	649	206	308	281
Sample size	169	171	107	76	147

Table III. Prevalences of Intestinal Parasitic Infestations, by Zone and Village

Absence/presence and, if present, type(s) of infestation	Coastal						Sub-Himalayan							
	Mirpur (mixed Port. and Beng.)		Gopalchak (Mahishya)		Total		Echhay (Sherpa)		Dhapgaon (Sherpa)		Bong and Sinde-bong (Lepcha)		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Nothing abnormal detected (NAD)	19	11.24	34	19.88	53	15.59	10	9.35	1	1.31	9	6.12	20	6.06
Helminths only														
Ascaris only	25	14.80	36	21.05	61	17.94	4	3.74	8	10.53	1	0.68	13	3.94
Trichuris only	18	10.65	1	0.58	19	5.59	–	–	–	–	4	2.72	4	1.21
Hookworm only	6	3.55	20	11.70	26	7.65	43	40.19	16	21.05	53	36.05	112	33.94
Oxyuris only	–	–	1	0.58	1	0.29	–	–	–	–	–	–	–	–
Hymenolepis only	2	1.18	–	–	2	0.59	–	–	–	–	–	–	–	–
Multiple helminths	37	21.89	16	9.36	53	15.59	11	10.28	20	26.32	29	19.73	60	18.18
Subtotal	88	52.07	74	43.27	162	47.65	58	54.21	44	57.90	87	59.18	189	57.27
Protozoa only														
Giardia only	9	5.33	9	5.26	18	5.29	4	3.74	–	–	4	2.72	8	2.42
E. coli only	2	1.18	5	2.92	7	2.06	7	6.54	–	–	5	3.40	12	3.64
E. hist. only	1	0.59	4	2.34	5	1.47	2	1.87	–	–	1	0.68	3	0.91
Multiple protozoa	–	–	1	0.58	1	0.29	–	–	–	–	1	0.68	1	0.30
Subtotal	12	7.10	19	11.10	31	9.12	13	12.15	–	–	11	7.48	24	7.27
Multiple protozoa and helminths														
Giardia and helminth(s)	14	8.28	7	4.09	21	6.18	5	4.67	15	19.74	13	8.84	33	10.00
E. coli and helminth(s)	25	14.79	26	15.20	51	15.00	17	15.89	10	13.16	18	12.24	45	13.64
E. hist. and helminth(s)	11	6.51	11	6.43	22	6.47	4	3.74	5	6.58	9	6.12	18	5.45
Giardia, E. hist., and helminth(s)	–	–	–	–			–	–	1	1.31	–	–	1	0.30
Subtotal	50	29.58	44	25.72	94	27.65	26	24.30	31	40.79	40	27.21	97	29.39
Total	169	99.99	171	99.97	340	100.01	107	100.00	76	100.00	147	99.99	330	99.99

Table IV. Significance of Differences Within and Between Zones[a]

Zone and village	χ^2	d.f.	p
Coastal			
Mirpur and Gopalchak	7.44	3	> .05
Sub-Himalayan			
Echhay, Bong-Sindebong, and Dhapgaon	18.60	6	< .05
Echhay and Bong-Sindebong	2.79	3	> .05
Echhay and Dhapgaon	18.00	3	< .05
Bong-Sindebong Dhapgaon	11.18	3	< .05
Pooled coastal and pooled sub-Himalayan	17.68	3	< .05

[a]Analysis based on four broad classes: NAD, helminths only, protozoa only, multiple protozoa and helminths.

Dhapgaon stands out from both Echhay and Bong-Sindebong with the lowest frequency of NAD, complete absence of the protozoa-only class, and the highest frequency of multiple-protozoa-and-helminths (Table III).

The same data were analyzed to find the frequencies of the major helminthic and protozoal infestations, singly or in association with others (Table V). It appears that the incidence of *Ascaris* is considerably higher in the coastal zone and that of hookworm in the sub-Himalayan zone, with *Trichuris* and the three protozoal infestations about equally prevalent in both. Within the coastal zone *Trichuris* is much more, and hookworm much less, prevalent in Mirpur than in Gopalchak; *Taenia* occurs only in Mirpur; and the differences are smaller in the case of protozoal infestations. Within the sub-Himalayan zone, Dhapgaon shows considerably higher frequencies of *Ascaris* and *Giardia* than both Echhay and Bong-Sindebong, which, between themselves, differ markedly only with respect to *Trichuris* incidence.

DISCUSSION

While we lack sufficient data on all possible environmental features affecting the intestinal parasitic infestation frequencies, we suggest that the hilly soil and the cool climate of Kalimpong (Table I) are favorable to the delicate hookworm ova/larvae, and the alluvial soil and hot climate of Geonkhali (Table I) are relatively unfavorable to them and/or favorable to

Table V. Prevalences of Individual Helminthic and Protozoal Infestations, by Zone and Village

Zone and village	No. examined		No. and percent affected								
			Helminths						Protozoa		
			Ascaris[a]	*Trichuris*[a]	Hookworm[a]	HN[a]	T[a]	OV[a]	*Giardia*[a]	*E. coli*[a]	*E. hist.*[a]
Coastal											
Mirpur	169	No.	85	76	33	2	4	1	23	27	12
		%	50.3	45.0	19.5	1.2	3.0	0.6	13.6	16.0	7.1
Golpalchak	171	No.	83	1	63	1	–	5	16	32	17
		%	48.5	0.6	36.8	0.6	–	2.9	9.4	18.7	9.9
Total	340	No.	168	77	96	3	4	6	39	59	29
		%	49.4	22.6	28.2	0.9	1.2	1.8	11.5	17.4	8.5
Sub-Himalayan											
Echhay	147	No.	22	46	117	–	–	–	18	24	10
		%	15.0	31.3	79.6	–	–	–	12.2	16.3	6.8
Dhapgaon	76	No.	37	11	61	–	–	–	16	10	6
		%	48.7	14.5	80.3	–	–	3	21.1	13.2	7.9
Bong-Sindebong	107	No.	19	4	79	–	–	3.9	9	24	6
		%	17.8	3.7	73.8	–	–	–	8.4	22.4	5.6
Total	330	No.	78	61	257	–	–	3	43	58	22
		%	23.6	18.5	77.9	–	–	0.9	13.0	17.6	6.7

[a]Single or multiple infecton(s) involving this one.

the sturdier *Ascaris* ova/larvae. This possibility was already suggested by Bhattacharya (1980) on the basis of the characteristics of soil-transmitted helminths described by Beaver (1961).

Since within-zone differences cannot be explained in terms of soil type or climate, explanations must be sought in terms of cultural environmental factors (cf. Hasan, 1979; Picot and Benoist, 1975). We lack complete data on these factors from our study areas, but within the coastal zone the lower prevalence of hookworm infestation in Mirpur compared to Gopalchak is a function of the former's relatively greater urbanization (particularly through missionary influence) and the consequently greater use of toilets and footwear. The *Taenia* infestation in Mirpur, however infrequent, contrasted with its total absence in Gopalchak, is due to the habit among the Christian Mirpurians of eating beef and pork (poorly processed) and the religious taboo on these food items among the Hindu Mahishyas of Gopalchak. Within the sub-Himalayan zone the relatively greater similarity between Echhay and Bong-Sindebong is probably due to their proximity and/or similar degrees of access to the medical facilities available in the nearby town of Kalimpong. The ethnically related cultural differences between the Sherpas and the Lepchas have not been able to make their mark, except, probably, in the case of *Trichuris*. The reasons that the Dhapgaon Sherpas have the highest incidence of *Ascaris* and *Giardia* may lie in the fact that they live in a remote area, in congested labor colonies with insufficient water supply and sanitation, and are served only by a poorly stocked and poorly staffed dispensary.

CONCLUSIONS

The marked difference in frequencies of several infestations between the Sherpas of Echhay and Dhapgaon, with a common ethnic origin but widely different access to urban facilities, and the smaller differences between the Sherpas of Echhay and Lepchas of Bong-Sindebong, with different ethnic origin but similar access to urban facilities available in Kalimpong town, suggest that contagious diseases, at least those due to intestinal parasitic infestations, are controlled largely by environmental factors rather than genetic (ethnic) origin.

More detailed investigations of the physical and cultural environmental determinants of contagious diseases are being planned in both ecological zones.

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