

A Survey on Human Parasite Infections in Nepal

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Introduction

In Nepal, reports on sanitary conditions are quite scarce. Detailed surveys on the prevalence of human parasite infections are also very few. In February and March 1975, we accompanied the Okayama University Nepal Himarayan Expedition and conducted a survey on the prevalence of human parasite infections in several zones; Bagmati, Gandaki, Dhaulagiri, Lumbini and Sagarmata.

Materials and Methods

The prevalence of parasitic infections in Nepalese people was studied in 11 areas of the above-mentioned zones (Fig. 1): Damauli, Pokhara, Kusma, Syangja (Gandaki zone), Baglung, Beni, Darbang (Dhaulagiri zone), Tansen, Butwal, Bhairawa (Lumbini zone) and Namche Bazar (Sagarmata zone). In addition, 26 Japanese (14 males, 12 females) living in Kathmandu were also examined. Stool samples were collected by the cooperation of health centers and hospitals. The so-called thick smear method was used with cellophane instead of cover glasses. Some feces containing hookworm eggs were cultivated to obtain infective larvae and these larvae were observed with an electronmicroscope for species identification.

The number of cases examined was 737 (471 males, 266 females). Male children and you-

ths (1 to 20 year-old) constituted about half the cases examined (46.8%). The samples from those between 21 and 40 years of age amounted to 39.4%, while the sample was small (13.8%) for subjects above 40 years of age. From about 46 years of age, the population decreased as the age increased.

Results

1. Comparison of infection rates among areas surveyed

Table 1 shows that the total number of examinations was 737 (471 males, 266 females) in which 640 (403 males, 237 females) were positive. The positive rate was 86.8% (85.6% in male, 89.1% in females). Examinations revealed that 371 cases were with roundworms (50.3%); 325, hookworms (44.1%); 351, whipworms (47.6%); 9, pinworms (1.2%); and 1 case, tapeworms (0.1%). No other helminths were found.

The positive rate of infection in males was the lowest in Bhairawa (57.1%) and the highest in Baglung (100%). The lowest rate in females was also in Bhairawa (50.0%) and the highest in Syangja, Darbang and Namche Bazar (100%). Infection rates for the total sample indicated that Bhairawa was the lowest (53.8%), and Darbang was the highest (98.8%). Even in other places, the infection rates were rather high (more than 76.2%). No big difference was found between positive rates in females (89.1%) and that in males (85.6%). But, in Namche Bazar, the infection rate in females (92.0%) was much higher than that among males (71.1%), because of a high prevalence of roundworm

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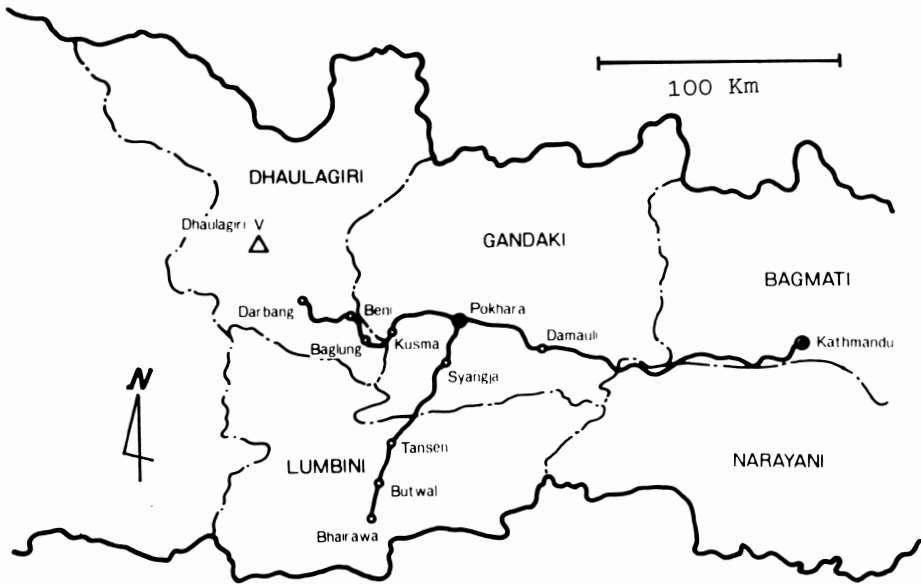


Fig. 1 Map of surveyed area

and whipworms in females.

The positive rate of helminth infection in Japanese was 34.6% (48.9% in males and 25.0% in females). The main species discovered was roundworm (35.7% in males, and 16.7% in females) and the secondary one was whipworm (14.3% in males and 8.4% in females). No positive case for hookworms or other helminths was found.

2. Correlation between the infection rate and the altitude of areas surveyed

The total positive rate of infection in the all areas examined had no correlation with the altitude (Table 1). However, the roundworm infection in both sexes tended to increase with the altitude ranging from Bhairawa (19.2%) to Namche Bazar (70.3%) ($r=0.745$, $p<0.01$). This tendency was observed also in males ($r=0.669$, $p<0.01$) and females ($r=0.801$, $p<0.01$).

At the locations below 1125m from the sea level, the positive rate of hookworm infection was the lowest in Bhairawa (23.1%) and the highest in Kusma (71.4%). The rates varied between 50% and 70% except in Bhairawa. In Tansen, the rate was 21.4% and in Namche Bazar only two cases of hookworms (0.2%) were found. There were cor-

relations between the altitude and the positive rate of hookworm infections in females ($r=-0.632$, $0.01<p<0.05$) and that of both sexes ($r=-0.632$, $0.01<p<0.05$), respectively.

The positive rate of whipworm infection was the highest in Baglung (77.9%) and decreased with the change of altitude either below or above 1,000m (the altitude of Baglung). The infection rates were 19.2% in Bhairawa (150m) and 13.9% in Namche Bazar (3,500m).

3. A relationship between age and infection rate (Table 2)

In males, the roundworm infection rate was the highest (73.3%) between 6 and 10 years of age. In females the maximum rate (74.2%) was also seen in the inhabitants between 6 and 10 years of age, except for the 66-80 years group, consisting of only 2 positive cases. After this peak, the positive infection rates in both sexes decreased with age, falling to around 20% at the ages 41 to 45 years of age. Above 46, the rate again increased.

In males, the positive rate of hookworm infection was as low as about 20% at 1 to 10 years of age. The rate increased with age and reached more than 80% at around 60 years of

Table 2 Prevalence of intestinal helminths by sex and age (M: male, F: female and T: total)

No.	Age groups		Number of cases examined			Number of positive cases			Number of positive cases with														
									Roundworm			Hookworm			Whipworm			Pinworm			<i>Taenia</i> sp.		
			M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
1	1~5	No.	36	33	69	27	26	53	17	18	35	6	8	14	13	14	27	1	0	1			
		%	/	/	9.4	75.0	78.8	76.8	47.2	54.5	50.7	16.7	24.2	20.3	36.1	42.4	39.8	2.8	0	1.4			
2	6~10	No.	45	31	76	38	28	66	33	23	56	9	7	16	16	13	29						
		%	/	/	10.3	84.4	90.3	86.8	73.3	74.2	73.7	20.0	22.6	21.1	35.6	41.9	38.2						
3	11~15	No.	94	27	121	79	25	104	61	20	81	40	9	49	34	10	44	1	0	1			
		%	/	/	16.4	84.0	92.6	86.0	64.9	74.1	66.9	42.6	33.3	40.5	36.2	37.0	36.4	1.1	0	0.8			
4	16~20	No.	57	22	79	50	22	72	29	12	41	36	12	48	37	11	48	1	0	1			
		%	/	/	10.7	87.7	100	91.1	50.9	54.5	51.9	63.2	54.5	60.8	64.9	50.0	60.8	1.8	0	1.3			
5	21~25	No.	62	36	98	58	33	91	25	24	49	37	16	53	46	17	63	1	0	1			
		%	/	/	13.3	93.5	91.7	92.9	40.3	66.7	50.0	59.7	44.4	54.1	74.2	47.2	64.3	1.6	0	1.0			
6	26~30	No.	55	34	89	48	30	78	21	22	43	25	6	31	33	21	54						
		%	/	/	12.1	87.3	88.2	87.6	38.2	64.7	48.3	45.5	17.6	34.8	60.0	61.8	60.7						
7	31~35	No.	34	14	48	26	13	39	10	6	16	15	10	25	19	6	25						
		%	/	/	6.5	76.5	92.9	81.3	39.4	42.9	33.3	44.1	71.4	52.1	55.9	42.9	52.1						
8	36~40	No.	27	28	55	25	26	51	7	9	16	17	19	36	12	17	29						
		%	/	/	7.5	92.6	92.9	92.7	25.9	32.1	29.1	63.0	67.9	65.5	44.4	60.7	52.7						
9	41~45	No.	24	13	37	16	10	26	5	3	8	11	7	18	7	2	9	1	0	1	0	1	1
		%	/	/	5.0	66.7	76.9	70.3	20.8	23.1	21.6	45.8	53.8	48.6	29.2	15.4	24.3	4.2	0	2.7	0	7.2	2.7
10	46~50	No.	9	11	20	9	10	19	5	3	8	5	6	11	5	5	10	1	0	1			
		%	/	/	2.7	100	90.9	95.0	55.6	27.3	40.0	55.6	54.5	55.0	55.6	45.5	50.0	11.1	0	5.0			
11	51~55	No.	8	8	16	8	6	14	4	2	6	5	11	6	4	5	9	1	0	1			
		%	/	/	2.2	100	75.0	87.5	50.0	25.0	37.5	62.5	12.5	37.5	50.0	62.5	56.3	12.5	0	6.3			
12	56~60	No.	10	5	15	10	4	14	2	3	5	8	1	9	6	1	7						
		%	/	/	2.0	100	80.0	93.3	20.0	60.0	33.3	80.0	20.0	60.0	60.0	20.0	46.7						
13	61~65	No.	4	2	6	3	2	5	1	0	1	3	1	4	2	1	3	1	0	1			
		%	/	/	0.8	75.0	100	83.3	25.0	0	16.7	75.0	50.0	66.7	50.0	50.0	25.0	0	16.7				
14	66~80	No.	6	2	8	6	2	8	4	2	6	4	1	5	3	1	4	1	0	1			
		%			1.1	100	100	100	66.7	100	75.0	66.7	50.0	62.5	50.0	50.0	0.17	0	0.13				
Total			471	266	737	403	237	640	224	147	371	221	104	325	237	124	361	9	0	9	0	1	1

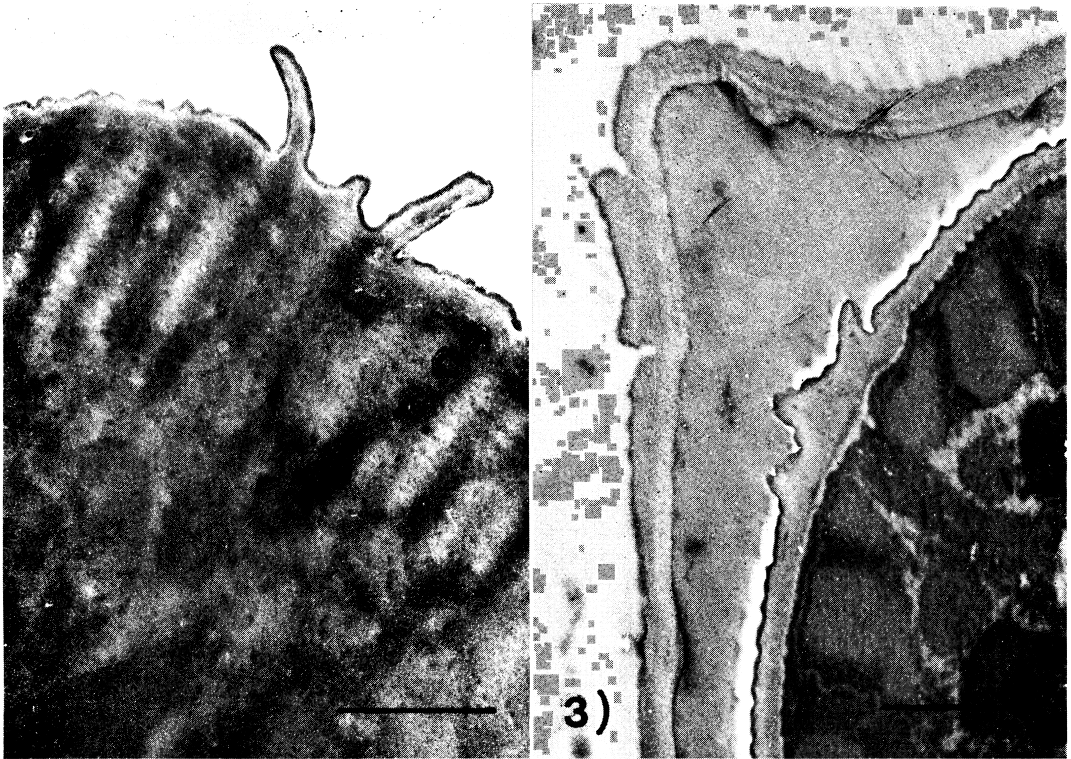


Fig. 2 Cross section of the infective larva of hookworm showing lateral ala on the cuticle. A elevated part was observed at the middle of the lateral ala on the cuticle. (Scale: $1\mu\text{m}$)

Fig. 3 Cross section of the infective larva of hookworm showing lateral alae both on the cuticle and the sheath. A small elevated part was observed at the middle of the lateral ala, and the edge of the lateral ala on the sheath was round. (Scale: $1\mu\text{m}$)

age. In females, the positive infection rate was highest (71.4%) in the subjects 31 to 35 years of age. After this peak the rate decreased with age. There was a correlation between the age and the positive rate of hookworm infection both in males ($r=0.788$, $p<0.01$) and in the total ($r=0.709$, $p<0.01$).

Whipworm infection rate in the total of male and female subjects was in the 36-40 percent range at 1 to 15 years and in the 46-65 percent range at other ages, except for the rate at the ages of 41 to 45 years (24.3 %).

The total infection rates were higher than 70% at all ages and even in the inhabitants at the age between 1 and 5, the rate was 76.8%.

4. Ultrastructural observation of the infective larvae of the hookworm

In the cross section, a small elevated part

was observed at the middle of the lateral ala on the cuticle (Figs. 2 and 3), and the edge of the lateral ala on the sheath was round (Fig. 3). Based on these features, hookworm larvae observed was identified as those of *Ancylostoma duodenale* (Inatomi, 1963).

Discussion

The positive rates for helminthic infections in this survey were much higher than the rates in Seti Zone of Western Nepal (42.5% infected with all species, 31.3% with roundworm, 8.8% with whipworm) reported by Kifune (1973). The dominant species found in the subjects of our and Kifune's surveys in Nepal was roundworm. In Nepal, the reason for the high prevalence of roundworm infection may attribute to the inadequate disposal of feces, dry weather from November to Decem-

ber, eating habit with hand and inadequate water-supply.

Iwamura (1965) reported cases with lung flukes in the middle mountainous area. However, cases with trematode infections were found neither by Kifune (1973) nor in the present study. The possibility of the presence of trematode seems very small because of the eating habits in Nepal.

In the present investigation, a specific examination method for pinworm was not applied and thus, the cases of pinworm infection were of low frequency (1.2%). Nevertheless, they are thought to be present in high density judging from the result using thick smear method.

A case of *Taenia* sp. infection was found. The possibility of *Taenia solium* infection is thought to be big, because 89 percent of the Nepali population is of Hindu (Thapa and Thapa, 1969) and they don't eat beef customarily.

The infection rate in Bhairawa was the lowest, mainly due to its geographical position near the Nepali border with India, *i.e.*, the area is the most developed among the areas surveyed. In Namche Bazar, a reason for the low prevalence of hookworm is thought to be the low temperature, which inhibits the development of hookworm larvae. The high rate of roundworm infection results, to a great extent, from the inadequate disposal of feces.

Roundworm and hookworm infections had correlation with the altitude of the areas surveyed. The positive rate of roundworm infections increased and that of hookworms decreased with the altitude. A typical example of these tendency was found in Namche Bazar, where the infection rate of roundworm was lower than that of hookworm in regions located below 1,000m, and on the other hand in the regions higher than 1,000 m *vice versa*.

The reason for the correlation between the positive rate of hookworm infection and the age is thought to be the increase in chances of infection due to the increased activity, *e.g.*, attending to farming.

Summary

A survey of helminth infections in man was conducted in 737 Nepali persons in the Gandaki, Dhaulagiri, Lumbini and Sagarmata zones of Nepal and in 26 Japanese living in Kathmandu from February to April in 1975 employing the so-called thick smear method. The results were as follows.

1) The overall helminth infection rate was 86.8% including roundworms (50.3%), hookworms (44.1%), whipworms (47.6%), pinworms (1.2%) and a *Taenia* sp. (0.1%).

2) The positive rate was the lowest in Bhairawa (53.8%) and the highest in Darbang (98.8%).

3) In Namche Bazar, roundworm infection rate was the highest (70.3%) and that of hookworms was the lowest (0.2%).

4) There was a correlation between the infection rate of roundworm and altitude, the rate being higher with the increase of altitude. On the other hand there was a reverse correlation between the infection rate of hookworms and the altitude, the rate being lower with the increase of altitude.

5) There was a correlation between the hookworm infection rate and the age, the rate being higher with age.

6) In Japanese persons living in Kathmandu, the positive rate of roundworm infection was 26.9% and that of whipworm was 11.5%. No positive case of other helminths was found.

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Specimens were collected through the cooperation of hospitals in Bhairawa (Dr. M. Joshi),

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ネパールにおける寄生虫感染

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ネパール国の Gandaki, Dhaulagiri, Lumbini, Sagarmata Zone に於ける11地区において寄生虫の感染状況を1975年2月～4月にかけて調査を行った。虫卵検査の対象人員は737名(男子471名, 女子266名)でセロファン厚層塗抹法を用いた。又, カトマンズ在住日本人26名についても検査を行った。結果は次の如くであった。

全体の虫卵検出率は86.8% (蛔虫50.3%; 鉤虫44.1%; 鞭虫49.0%)であり, 少数の蟯虫(1.2%)および *Taenia* (0.1%) が見られた。

Bhairawa 地区が最低(53.8%)の感染率を Dar-

bang 地区が最高(98.8%)の感染率を示し, Namche Bazar では蛔虫の感染率は最高(70.3%)で鉤虫のそれは最低(0.2%)であった。

高度の増加に伴い蛔虫感染率は高く, 鉤虫のそれは逆に低くなり, 蛔虫および鉤虫の感染率と高度との間に相関および逆相関関係が見られた。更に, 年齢と鉤虫感染率の間にも相関関係が見られた。

カトマンズ在住の日本人において蛔虫感染率26.9%, 鞭虫感染率11.5%であり, 鉤虫および他種寄生虫の感染は見られなかった。