

A survey of three Costa Rican communities for intestinal parasites

by

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(Received for publication April 1, 1965)

There is considerable information available on the extent of infections with intestinal worms and protozoa in Costa Rica. However, much of it is scattered and according to various officials of the Salubridad Pública, the Hospital San Juan de Dios and the Social Security Hospital systems there was considerable variation in the techniques used. Consequently comparisons of one area with another could not be made with any degree of accuracy. It is hoped that this brief account of parasitism in the inhabitants of three rural communities with different environments, made by the same technicians, and using the same techniques will prove of value as one of a series of reports on intestinal parasitoses of Costa Rica. This is based upon material collected during a pilot study to perfect the methodology of the multidisciplinary Diarrheal Disease project of the LSU International Center for Medical Research and Training.

METHODS

SELECTION OF SAMPLES.— The three communities surveyed were not selected at random but rather on the basis of their geography. All were approximately of equal size and the inhabitants of each worked in the same general area as that in which they lived.

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The first village selected, Paracito de Santo Domingo or Santa Rosa de Heredia, lies in the Province of Heredia and was chosen largely because of its propinquity to the capital city, while El Naranjo de Juan Viñas is further away (in Cartago Province), but still within two hours driving time of the laboratories in San José. The third community, Palmira, is situated in the Province of Guana-caste, and is so distant that the specimens had to be sent back by air.

ENVIRONMENT.— In all cases the environment of the family was examined and the sanitary conditions noted. In addition attempts were made to secure information on the type of occupation of those employed as well as making an economic evaluation of the household. Histories on each individual also were secured when physical examinations were made.

PHYSICAL EXAMINATION.— Stool specimens were taken on 848 individuals from these three villages. However, complete physical examinations together with histories were made only on 37 persons from El Naranjo and 102 individuals from Palmira. These data covered entire families and hence represented all age groups. Data included weight and height as well as other measurements as aids in determining the nutritional status of the individuals. Attempts were made to standardize the clinical examinations. Blood samples were obtained also.

TECHNIQUES.— Each fecal specimen was examined in the field for consistency, blood and mucus and this information was recorded on the stool container. If the stool was watery, mushy or revealed macroscopic evidence of blood and or mucus, three PVA fixed smears were made, dried and forwarded to the laboratory for staining and subsequent examination. Following this preliminary examination the stools were returned to the laboratory on wet ice. In cases where the delivery of the stools was delayed for approximately 24 hours a portion of the stool was preserved in 7.5 per cent formalin. Both fresh and preserved material were examined subsequently for parasites using the formalin-ether concentration technique (MGL) (7). The fresh stool specimens were examined by a Modified Stoll Egg Dilution Count (12) to determine the intensity of the infections with *Ascaris lumbricoides*, *Trichuris trichiura* and hookworm, based upon the number of eggs per gram of feces. If sufficient un-preserved material was available, the formalin-ether concentration technique (MGL) was run. The validity of the diagnosis of all preparations positive for *Entamoeba histolytica* that were made on fresh stools was confirmed also by means of PVA smears.

EPIDEMIOLOGIC OBSERVATIONS

GENERAL.— The three villages that were selected for these preliminary studies differed considerably. Consequently the environmental background of each will be discussed separately.

1. PARACITO DE SANTO DOMINGO.— This village lies northeast of the capital in San José Province at an elevation of 1160 meters. The houses were constructed primarily of wood and the floors varied from brick (in only a few), to wood or hard packed dirt.

The water came from a creek running through pastures and dairy farms which emptied into a reservoir tank in La Palma. The water was not treated. Practically every house had at least one faucet. However, the tank was too small for the number of people served and in some seasons there was a scarcity of water. The rainfall in San José (the closest weather station) averaged 1946.3 mm (77.4 inches) a year over the past 30 years.

No physical examinations were made on any of the 445 members of the 66 families. Most of the inhabitants worked on neighboring coffee fincas although some devoted their energies to other agricultural pursuits. All but 50 were examined for parasites by means of a single stool specimen.

2. EL NARANJO DE JUAN VIÑAS.— The second community to be examined was El Naranjo de Juan Viñas situated on the road to Turrialba at an elevation of about 1250 meters; it lies on the eastern side of the "Meseta Central". This town resembles a model government-financed community but the houses were erected about 1958 by the Hacienda Juan Viñas for their employees. The village has paved streets, well constructed concrete homes with concrete floors, flush toilets, an adequate sewage system, and a plentiful supply of piped water in every house. The rainfall over the past 10 years averaged 3652.4 mm/year (146.1 inches).

El Naranjo is a small compact community of 353 persons in 48 families. Most of those old enough to work are employed in the nearby coffee and sugar cane fincas. A total of 299 of these persons had their stools examined for parasites and 37 were given a physical examination.

3. PALMIRA.— The third village lies on the road to Filadelfia in Guanacaste Province at an altitude of 24 meters. The houses are mostly of clapboard construction with wooden or dirt floors with the roofs of galvanized sheet tin. The streets are ill kept and unpaved; the entire community seemed somewhat poverty stricken.

The water supply consisted of wells; 66 per cent have shallow dug wells while 28 per cent have deep wells. There is no record of the amount of rainfall. The dry season is hot and dusty and extends from December to May.

The 39 families making up this community consist of 244 individuals. The wage earners are employed on neighboring cotton, rice or bean fincas, or on the cattle ranches. One hundred fifty-four persons had their stools checked for parasites and 102 persons of all ages were given physical examinations.

RESULTS AND DISCUSSION

A total of 848 persons were examined from the villages of Paracito, El Naranjo and Palmira, numbers being 395, 299 and 154 respectively. Of these,

TABLE 1

Comparison of prevalence of intestinal parasitism of helminths and protozoa in Costa Rica with the Far East based upon a single stool examination

	THREE COSTA RICAN VILLAGES		SOUTH KOREA		OKINAWA		J A P A N					
	No.	%	No.	%	No.	%	OKAYAMA PREF.		YAMANASHI PREF.		KYSHU ISLAND	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Number examined	848	100	919	100	2172	100	1260	100	3055	100	2073	100
Number infected	810	95.5	868	94.5	1958	90.1	1126	89.4	3041	99.5	1953	94.2
Number with helminths	708	83.5	866	94.2	1912	88.0	1079	85.6	3038	99.4	1920	92.6
Number with protozoa	729	86.0	307	33.4	869	40.0	481	38.2	1647	53.9	688	33.2

TABLE 2

Summary of the prevalence of intestinal parasites in three Costa Rican communities

	PARACITO		EL NARANJO		PALMIRA		TOTALS	
	No.	%	No.	%	No.	%	No.	%
Persons Examined	395	100	299	100	154	100	848	100
Persons Infected	377	95.4	294	98.3	139	90.3	810	95.6
Persons with helminths	340	86.1	271	90.6	97	63.0	708	83.5
Persons with protozoa	341	86.3	257	86.0	131	85.1	729	86.0
HELMINTHS								
<i>A. lumbricoides</i>	163	41.3	162	54.2	18	85.1	343	40.4
<i>T. trichiura</i>	307	77.7	238	79.6	79	51.3	624	73.6
Hookworm	113	28.6	138	46.2	27	17.5	278	32.8
<i>S. stercoralis</i>	21	5.3	29	9.7	2	1.3	52	6.1
<i>H. nana</i>	13	3.3	19	6.4	1	0.6	33	3.9
<i>H. diminuta</i>	0	0	2	0.7	0	0	2	0.2
<i>E. vermicularis</i>	0	0	0	0	1	0.6	1	0.1
PROTOZOA								
<i>E. histolytica</i>	162	41.0	118	39.5	65	42.2	345	40.7
<i>E. histolytica</i> large	153	38.7	56	18.7	42	28.3	251	29.6
<i>E. histolytica</i> small	10	2.5	66	22.1	32	20.8	108	12.7
<i>E. coli</i>	248	62.8	174	58.2	89	57.8	511	60.3
<i>E. nana</i>	215	54.4	166	55.5	95	61.7	476	56.1
<i>I. butschlii</i>	94	23.8	56	18.7	30	19.5	180	21.2
<i>D. fragilis</i>								
<i>G. lamblia</i>	76	19.2	80	26.8	30	19.5	186	21.9
<i>T. hominis</i>	16	4.1	9	3.0	0	0	25	2.9
<i>C. mesnili</i>	69	17.5	45	15.1	11	7.1	125	14.7
<i>Balantidium coli</i>	3	0.8	2	0.7	0	0	5	0.6
<i>Isospora belli</i>	0	0	1	0.3	0	0	1	0.1
<i>E. hominis</i>	14	3.5	0	0	0	0	14	1.7

Comparison of infections by sexes and communities

PARASITES	PARACITO				EL NARANJO				PALMIRA				TOTALS			
	MALE		FEMALE		MALE		FEMALE		MALE		FEMALE		MALES		FEMALES	
	N°	%	N°	%	N°	%	N°	%	N°	%	N°	%	N°	%	N°	%
Number of individuals	203	100	192	100	147	100	152	100	70	100	84	100	420		428	
HELMINTHS																
<i>A. lumbricoides</i>	88	43.3	77	40.1	71	48.3	91	59.9	8	11.4	10	11.9	167	39.7	178	41.6
<i>T. trichiura</i>	156	76.8	151	78.6	112	76.2	126	82.9	34	48.6	45	53.6	302	71.9	322	75.2
Hookworm	59	29.1	52	27.1	81	55.1	57	37.5	12	17.1	15	17.9	152	36.2	124	29.0
<i>S. stercoralis</i>	11	5.4	10	5.2	15	10.2	14	9.2	1	1.4	1	1.2	27	6.4	25	5.8
<i>H. nana</i>	9	4.4	4	2.1	7	4.8	12	7.9	—	—	1	1.2	16	3.8	17	4.0
<i>H. diminuta</i>	1	0.5	—	—	1	0.7	1	0.7	—	—	—	—	2	0.5	1	0.2
<i>E. vermicularis</i>	—	—	—	—	—	—	—	—	—	—	1	1.2	—	—	1	0.2
PROTOZOA																
<i>E. histolytica</i> (all)	85	41.9	77	40.1	50	34.0	68	44.7	27	38.6	38	45.2	162	38.6	183	42.8
<i>E. histolytica</i> - large race																
<i>E. histolytica</i> - small race																
<i>E. coli</i>	117	57.6	125	65.1	87	59.2	87	57.2	36	51.4	53	63.1	240	57.1	265	61.9
<i>E. nana</i>	107	52.7	106	55.2	83	56.5	83	54.6	44	62.9	51	60.7	234	55.7	240	56.1
<i>I. bütschlii</i>	45	22.2	44	22.9	27	18.4	29	19.1	14	20.0	16	19.0	86	20.5	89	20.8
<i>D. fragilis</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>G. lamblia</i>	39	19.2	38	19.8	32	21.8	48	31.6	19	27.1	11	13.1	90	21.4	97	22.7
<i>T. hominis</i>	11	5.4	4	2.1	1	0.7	8	5.3	—	—	—	—	12	2.9	12	2.8
<i>C. mesnili</i>	35	17.2	32	16.7	18	12.2	27	17.8	4	5.7	7	8.3	57	14.0	66	15.4
<i>B. coli</i>	1	0.5	2	1.0	1	0.7	1	0.7	—	—	—	—	2	0.5	3	0.7

TABLE 4

Data on the prevalence of *A. lumbricoides*, *T. trichiura* and hookworm by age groups

Age Groups	Total Persons Examined	HELMINTHS					
		<i>A. lumbricoides</i>		<i>T. trichiura</i>		Hookworm	
		N	%	N	%	N	%
<1	28	1	3.6	2	7.1	2	3.6
1-3	77	33	42.3	48	62.3	3	3.9
3-5	64	37	57.8	56	87.5	11	17.2
5-9	154	78	50.6	126	81.8	38	24.7
10-14	118	51	43.2	94	79.7	37	31.4
15-19	80	36	45	60	11	50	62.5
20-29	107	41	38.3	84	78.5	52	48.6
30-39	87	34	39.1	67	77.0	36	41.4
40-49	59	19	32.2	40	78.0	24	40.7
50-59	35	7	20.0	18	51.4	14	40.0
60-64	20	11	55.0	14	70.0	6	30.0
65 & over	19	5	26.3	11	57.9	5	26.3
Total	848	353	41.6	620	73.1	278	32.8

810 or 95.5%, were infected; 708, or 84.5%, and 729, or 86%, respectively harbored worms and protozoa. While it should be borne in mind that these communities were not selected at random, nevertheless certain comparisons can be made with other areas and with previous surveys (Table 1). For example, a survey in South Korea made in 1948 on 919 persons revealed that 94.5 per cent were infected while of these 866, or 94.2 per cent, and 307, or 33.4 per cent, were infected with worms and protozoa respectively (3). These figures are roughly comparable with those secured on Okinawa and in many areas of Japan (Table 1) (1, 4).

It is interesting to speculate on the reasons for the lower prevalence of protozoa among persons studied in the Far East since the same techniques were employed on all surveys quoted. It has always been the contention of one of us (GWH) that the relatively low prevalence of protozoa and especially *E. histolytica* can be accounted for by the tea-drinking habits of Koreans, Okinawans and

Japanese (4). Actually very little unheated water is ingested in these countries. On the other hand, in Costa Rica much raw water is consumed. This is all the more reasonable because in Costa Rica all communities have piped water, and in fact, many houses have one or more spigots. It is also possible that some of these lines may become contaminated since one pipe line usually serves several areas and people tap them indiscriminantly thus creating more opportunities for contamination.

Table 2 gives the data by species of parasite as determined by a single stool examination among the inhabitants of these three Costa Rican villages. It is interesting and perhaps significant that over 40 per cent of the population examined were infected with *E. histolytica*. However, when this is broken down into large and small races, it will be noted that only about 30 per cent of the population are infected by the large race. It is also interesting to note that in these villages whipworm, *Trichuris trichiura*, is the predominant parasite, while *Ascaris lumbricoides* is second and hookworm is third (Table 2).

HELMINTHS.— Seven species of helminths and 11 species of protozoa were encountered. BROOKE *et al.* (2) reported 5 species of worms and 9 of protozoa in a smaller series of 134 persons from the Volcán-Angel Finca near Volcán de Buenos Aires, Costa Rica. Brooke *et al.* reported that *Trichuris trichiura* or whipworm (69%) was the predominant parasite followed by the hookworm (66%) and *Ascaris lumbricoides* (40%) while our data were *T. trichiura* (73.6%), *A. lumbricoides* (40%) and hookworm (32.8%).

PROTOZOA.— RUIZ and ALFARO (10) were the first to report *Dientamoeba fragilis* from Costa Rica. Since direct or PVA smears were run only on diarrheal specimens there was scant opportunity to detect these organisms in the current survey. RUIZ and LIZANO (11) examined a series of children for intestinal parasites and found 16 per cent infected with *E. histolytica*. BROOKE *et al.* reported 28 per cent with the large race of *E. histolytica*, while 30 per cent was detected in the current study. This figure of BROOKE *et al.* was increased to 36 per cent when an examination of stained slides was added. BROOKE *et al.* designated the small race of *E. histolytica* (*i. e.* cysts under 10 μ) as *E. bartmanni* while in this paper the term "small race" was used for those with the same measurements. BROOKE *et al.* found 34 per cent with *E. bartmanni* while we found only 12.7 per cent (see Table 2). This figure would have been higher except that less than 3 per cent of those examined carried this parasite in Paracito. In all, over 40 per cent of the people were infected with either the large or small race of *E. histolytica* (see Table 2). As might be expected there were a number of mixed infections.

COMPARISON BY SEXES.— A comparison of infections was made by sexes and communities (Table 3). There appear to be few if any significant differences, except perhaps in El Naranjo where the prevalence was higher in women who harbored more whipworms and *A. lumbricoides* than the men,

while the latter acquired more hookworms. In both El Naranjo and Palmira the women were more heavily infected with *E. histolytica* than the men while the reverse was true as far as *Giardia lamblia* was concerned (Table 3).

There is no satisfactory explanation of these phenomena.

COMPARISON BY AGES.— If the three most common helminths are considered by age groups it will be seen that whipworm is acquired earlier than either *A. lumbricoides* or hookworm (Fig. 1). It soon reaches its peak (88 %) which is maintained until the age of 40. However, ascariasis is acquired early also since over 50 per cent of those in the 3 to 5 age group are infected (Table 4). Thereafter *A. lumbricoides* infections tend to decrease slightly. Hookworm infections start slowly and gradually build up to a peak in the 15 to 19 year age group and then decrease.

It is believed that this paper constitutes the largest stool survey of rural communities covering all age groups, since other surveys (5, 6, 10, 11) were made primarily on children most of whom came from the vicinity of San José. The opportunity for reinfection is known to be great in rural communities which may account in part for the high prevalence of parasites herein reported. Furthermore the formalin-ether sedimentation (MGL) is known to be more efficient than some other stool examination methods which have been used in other studies (8, 9). It should be pointed out that if it had been practical to include a stained smear of every stool the results would doubtless have been much higher.

ACKNOWLEDGEMENTS

We wish to express our appreciation to Sr. Jorge Arturo Osborne who calculated the prevalence data for us.

SUMMARY

Single stool specimens were collected from 848 individuals from three rural communities of Paracito, El Naranjo and Palmira, Costa Rica. Examination by the F. E. sedimentation technique revealed 7 species of helminths and 11 species of protozoa. Over 95 % of the 848 persons examined were parasitized, 83.5 % with worms and 86 % with protozoa. Whipworm, *T. trichiura*, *A. lumbricoides* and hookworms were the most common worms encountered. *Entamoeba histolytica* occurred in about 40 % of the people while *Giardia lamblia* was found in 21.7 %. *Dientamoeba fragilis* was not encountered due to the method of examining the stools.

RESUMEN

Se practicaron 848 exámenes de heces, observando una única muestra, en personas de tres comunidades rurales de Costa Rica: Paracito, El Naranjo y

Palmira. El examen por la técnica de sedimentación de éterformol reveló 7 especies de helmintos y 11 de protozoarios. Más del 95% de las personas examinadas estaban parasitadas, 83.5% con gusanos y 86 % con protozoarios, *T. trichura*, *A. lumbricoides* y anquilostomas, fueron los gusanos más prevalentes. Se encontró *E. histolytica* en alrededor de 40 % de las personas, mientras que *G. lamblia* apareció en el 21.7%. *Dientamoeba fragilis* no apareció en ningún caso posiblemente debido a los métodos usados.

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Fig. 1 Comparison of three common intestinal helminths by age groups from three communities totalling 848 individuals.

