

Intestinal parasites in a Mayan-Indian village of Guatemala

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ABSTRACT: Fecal specimens were collected from 144 subjects in Santa María Cauqué, a Mayan-Indian village located in the Guatemalan highlands. The overall rate of intestinal parasites was 97.2 percent with rates for individuals species as follows: *E. histolytica*, 38.9 percent; *E. hartmanni*, 43.8 percent; *D. fragilis*, 7.6 percent; *Giardia*, 13.5 percent; *Ascaris*, 82.6 percent; and *Trichuris*, 53.5 percent. The rate of protozoa was 83.3 percent and of helminths, 87.5 percent. Amebae infections were most common in the 21-to-40-year-old age group, with a sharp rise from a fairly high level in early childhood throughout adolescence to adulthood.

Giardia, *Ascaris*, and *Trichuris* were more prevalent in persons under 20 years of age. Parasite rates were, in general, high throughout life.

The persons examined were family contacts of a cohort of children in whom protozoan infections had been found in early infancy. Contacts of 97 percent of the children were positive for one or more species of amebae, and contacts of 75.7 percent were positive for *E. histolytica*. Of the mothers examined, more than half were infected with *E. histolytica*. All of the children had relatives infected with *Ascaris* and *Trichuris*.

The high level of infection reflects the unsanitary living conditions in the village. It is probable that infections are transmitted through polluted surroundings, contaminated food and water, and poor personal hygiene.

INTRODUCTION

Recent studies carried out in Guatemala by the Institute of Nutrition of Central America and Panama (INCAP) indicate that infants born under protozoa conditions may acquire intestinal protozoa soon after birth.¹ The studies were carried out in Santa María Cauqué, a Mayan-Indian village of 1,300 inhabitants located at an altitude of 6,100 feet.

The general health of the community is unsatisfactory, as shown by the high mortality and morbidity rates due mainly to communicable diseases, malnutrition, and their interaction. Environmental sanitation and personal hygiene are poor. Families averaging five members live in crowded homes of only one or two rooms and usually share one or two sleeping mats or beds. Open floor fires within the house are used for cooking. Water obtained from reservoirs or faucets scattered throughout the village, usually contaminated with coliform bacteria, is transported and stored in earthen jars which are rarely washed. Adequate garbage or fecal disposals are not available, and the limited number of existing sewers are open. Few houses have privies of any sort, and these are probably not regularly used. Furthermore, indiscriminate defecation occurs in dooryards and fields.

Previous studies showing a high rate of parasitism in the village population² were suc-

ceeded by a follow-up since birth of a cohort of children. Intestinal protozoa and other infectious agents were frequently found in the first days or weeks of life.³ The early presence of organisms was transitory. Parasites were acquired during birth, but actual infection and colonization apparently occurred later, within a few weeks or months. Helminths appeared toward the end of the first year of life.

Parasitism in infants so young suggests a close association with infected individuals or environmental sources of infection. In this study, family contacts of the cohort children were surveyed to determine the rate of parasitism in this group, the most likely source of infection for the infants.

MATERIAL AND METHODS

Single fecal specimens from 144 persons (family contacts of 33 cohort infants) were collected during September 1965, and brought promptly to the health center in Santa María Cauqué, where they were preserved in formalin and polyvinyl alcohol fixative (PVA)⁴ within 2 hours after passage. The specimens were then shipped to the National Communicable Disease Center for examination. The formalinized specimens were concentrated by the formalin-ether sedimentation technique,⁵ and the PVA-fixed material was stained by the trichrome technique.⁶ Approximately one-half of the specimens were also examined by direct wet mounts. The entire area of the unstained wet mount was examined systematically, and

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the identity of the cysts was confirmed in the iodine-stained preparations. Trichrome stains were examined for 15 to 20 minutes. Differentiation of *Entamoeba histolytica* and *Entamoeba hartmanni* was based on careful measurements of the cysts which are morphologically characteristic of these two species.

RESULTS

Of the 144 persons examined, 140 or 97.2 percent were positive for one or more species of parasites. The overall rate of protozoan infections was 84.1 percent and of helminth infections, 87.5 percent. *E. histolytica* was found in 38.9 percent and *Dientamoeba fragilis* in 7.6 percent of the cases. The rates of *Ascaris lumbricoides* and *Trichuris trichiura* were 82.6 and 53.5 percent, respectively. Table I lists the species found and the rate of infection for each.

Multiple infections were common, and specimens with a single species of parasite were encountered only rarely. A total of 430 protozoan infections were found in 121 persons, of whom 79 had three or more species of amebae. The most frequent combination of amebae species was *Entamoeba coli* and *Endolimax nana*. Often, *E. hartmanni* and/or *Iodamoeba bütschlii* were also present. More than one-half of the children under 6 years of age were infected with three to five species of protozoa. Since the rates of individual amebae species were high, there was no need to calculate the combined

Amebic Prevalence Rate (APR) as an index of infection.⁷

Two hundred and ten helminth infections, mostly *Ascaris* and *Trichuris*, were found in 126 persons. Few other helminth species were encountered, although 7 persons (4.9%) were infected with hookworm (Table I). *Enterobius vermicularis* probably occurs more frequently than reported here, since fecal examination is not the method of choice for diagnosis.

Approximately equal numbers of males and females were examined. In general, the parasite rates for females were higher than for males, but the differences were not important (Table I).

The distribution of parasites by age, in 20-year spans, indicated that the rates of amebae infection were high in all ages, reaching a peak in the 21-to-40-year group; no significant differences were observed between sexes (Table II). Although the rates of most amebae species declined slightly in the group of subjects over 40 years of age, the level of infection remained high. For example, the rate of *E. histolytica* rose from 32.5 percent in the youngest group (0-20) to 55.3 percent in the middle one (21-40) and then declined to 34.8 percent in the oldest group (over 40). The distribution of flagellates and helminths was different (Table II). *Giardia*, *Ascaris*, and *Trichuris* prevailed mostly in the youngest group and declined as the host age increased, while *Chilomastix* was most prevalent in the oldest group.

TABLE I. FREQUENCY OF INTESTINAL PARASITES

Organism	Total No.	group (144) %	Males No.	(69) %	females No.	(75) %
Positive	140	97.2	67	97.1	73	97.3
No parasites found	4	2.8	2	2.9	2	2.7
<i>Entamoeba histolytica</i>	56	38.9	24	34.8	32	42.7
<i>Entamoeba hartmanni</i>	63	43.8	29	42.0	34	45.3
<i>Entamoeba coli</i>	105	72.9	47	68.1	58	77.3
<i>Endolimax nana</i>	77	53.5	34	49.3	43	57.3
<i>Iodamoeba bütschlii</i>	70	48.6	34	49.3	36	48.0
<i>Dientamoeba fragilis</i>	11	7.6	6	8.7	5	6.7
<i>Giardia lamblia</i>	19	13.2	6	8.7	13	17.3
<i>Chilomastix mesnili</i>	28	19.4	10	14.5	18	24.0
Combined protozoa	121	84.1	56	81.2	65	86.7
<i>Ascaris lumbricoides</i>	119	82.6	54	78.3	65	86.7
<i>Trichuris trichiura</i>	77	53.5	33	47.8	44	58.7
Hookworm	7	4.9	4	5.8	3	4.0
<i>Strongyloides stercoralis</i>	1	0.7	0	—	1	1.3
<i>Hymenolepis nana</i>	2	1.4	0	—	2	2.7
<i>Hymenolepis diminuta</i>	2	1.4	2	2.9	0	—
<i>Taenia</i> sp.	2	1.4	1	1.4	1	1.3
<i>Enterobius vermicularis</i>	2	1.4	2	2.9	—	—
Combined helminths	126	87.5	59	85.5	67	89.3

TABLE II. AGE AND SEX DISTRIBUTION OF INTESTINAL PARASITES

Organism	Age groups			Age groups-female			Age groups-male		
	0-20 (83) *	21-40 (38)	41+ (23)	0-20 (41)	21-40 (24)	41+ (10)	0-20 (42)	21-40 (14)	41+ (13)
Positive	96.4% (80)	100.0% (38)	95.7% (22)	95.1% (39)	100.0% (24)	100.0% (10)	97.6% (41)	100.0% (14)	92.3% (12)
<i>E. histolytica</i>	32.5 (27)	55.3 (21)	34.8 (8)	36.6 (15)	54.2 (13)	40.0 (4)	28.6 (12)	57.1 (8)	30.8 (4)
<i>E. hartmanni</i>	41.0 (34)	52.6 (20)	39.1 (9)	43.9 (18)	50.0 (12)	40.0 (4)	38.1 (16)	57.1 (8)	38.5 (5)
<i>E. coli</i>	63.9 (53)	86.8 (33)	82.6 (19)	68.3 (28)	91.7 (22)	90.0 (9)	59.5 (25)	85.7 (12)	76.9 (10)
<i>E. nana</i>	47.0 (39)	71.1 (27)	47.8 (11)	43.9 (18)	75.0 (18)	70.0 (7)	50.0 (21)	64.3 (9)	30.8 (4)
<i>I. bütschlii</i>	41.0 (34)	60.5 (23)	52.2 (12)	46.3 (19)	54.2 (13)	40.0 (4)	35.7 (15)	71.4 (10)	69.2 (9)
<i>D. fragilis</i>	7.2 (6)	13.1 (5)	— (0)	7.3 (3)	8.3 (2)	— (0)	7.1 (3)	21.4 (3)	— (0)
<i>G. lamblia</i>	19.3 (16)	5.3 (2)	— (0)	26.8 (11)	8.3 (2)	— (0)	14.3 (6)	— (0)	— (0)
<i>C. mesnili</i>	15.7 (13)	21.1 (8)	30.4 (7)	17.1 (7)	25.0 (6)	50.0 (5)	14.3 (6)	14.3 (2)	15.4 (2)
Combined protozoa	78.3 (65)	92.1 (35)	91.3 (21)	80.5 (33)	91.7 (22)	100.0 (10)	76.2 (32)	92.9 (13)	84.6 (11)
<i>Ascaris</i>	89.2 (74)	78.9 (30)	65.2 (15)	95.1 (39)	83.3 (20)	60.0 (6)	83.3 (35)	71.4 (10)	69.2 (9)
<i>Trichuris</i>	56.7 (47)	52.6 (20)	43.4 (10)	61.0 (25)	58.3 (14)	50.0 (5)	52.4 (22)	42.9 (6)	38.5 (5)
Combined helminths	94.0 (78)	89.4 (34)	69.5 (16)	95.1 (39)	87.5 (21)	70.0 (7)	88.1 (37)	92.9 (13)	69.2 (9)

* Figures in parenthesis denote number of persons.

The small number of persons in each age group prohibits a more refined age analysis; however, protozoa were frequently found in children 5 years old and younger. Rates in the 0-5 year group ranged from 11.4 percent for *D. fragilis* to 57.1 percent for *E. coli*. In this group, the rate of *E. histolytica* was 20 percent and of protozoa as a whole, 68.6 percent.

Data on the families showed that 25 (75.8 percent) of the 33 cohort children had contacts who were positive for *E. histolytica*; 32 (97.0 percent) had contacts positive for one or more species of amebae; and all 33 children had contacts positive for *Ascaris* and *Trichuris*. Of 18 mothers of the cohort children examined, 17 were infected with amebae in general, and 10 harbored *E. histolytica*.

The persons examined in the survey represented 44 family units located in all blocks of the village. In 43 of the homes, persons were positive for one or more species of parasites, and in 31 homes, they were positive for *E. histolytica*. Parasites were uniformly distributed among the homes, regardless of their location in the village area. The environmental sanitation and living conditions, as reflected in the

present findings, are basically the same throughout the village.

DISCUSSION

The persons examined were family contacts of 33 Mayan-Indian infants from a long-term field study conducted by INCAP.⁸ Intestinal protozoa were found occasionally in several of these children during the first days and weeks of life. The parasites were possibly acquired either by contact with the mother or attendants, during birth or after, or from contaminated fluids fed to the child.⁹ The high rate of parasitism among the family members provided a ready source of infection for infants and young children. Most of the latter had at least one contact who was positive for one or more species of protozoa, and more than three-fourths of them had contacts positive for *E. histolytica*. In addition, all but one of the mothers examined harbored amebae, and more than one-half were positive for *E. histolytica*.

The sample included more than 10 percent of the village population. Although persons were selected because of their relationships to the

cohort children, they were more or less representative of the village as a whole. Thus, the data obtained presumably reflect the level of parasitism in the community at the time of the survey.

The high rate of parasitism found in Santa María Cauqué obviously reflects the unsanitary environment and inadequate personal hygiene that prevails among the inhabitants. In these circumstances, ample opportunities to acquire parasites, particularly protozoa and *Ascaris* and *Trichuris* exist. The few hookworm infections were in persons who had visited the lowlands. Apparently there is no transmission of this helminth in the village.

The villagers' diet consists predominantly of carbohydrates, with a limited content of calories, protein, vitamin A, and riboflavin.¹⁰ Previous studies have revealed that inadequate nutrition and high carbohydrate diets are associated with amebic infections and growth of intestinal protozoa.^{11,16} However, what effect, if any, the high carbohydrate diet of the villagers may have on the parasite rates has not been determined.

As stated before, the people of Santa María Cauqué acquire intestinal parasites through several avenues: personal contacts, contaminated food, water and surroundings, and poor personal hygiene. None of these factors could be identified as the chief source of infection, and all of them probably are involved. Nevertheless, personal contacts may be less important than sanitary and hygiene factors. In the generally unsanitary conditions that exist therein, the villagers probably acquire protozoan infections from common environmental sources more often than by person to person contact. Several studies have suggested that once a family member becomes infected with *E. histolytica*, intrafamilial transmission is likely to occur because of close association^{17,19} Most of these reports, however, have

dealt with families living in rural areas with poor toilet facilities and water supplies which may have been common sources of infection for the family members. On the other hand, in a study of over 300 families in a suburban area in the United States, BROOKE *et al.*⁷ found that in homes with relatively good sanitation and personal hygiene, no significant transmission of protozoa occurred between family members. The only heavily parasitized family in the study lived in a rural area with somewhat unsanitary surroundings. The authors felt that the environmental conditions served as a common source of infection for family members, and that this factor rather than family contacts accounted for the infections. MACKIE *et al.*²⁰ have also observed that the rates of *E. histolytica* are higher among families living under unsanitary conditions than among those with adequate sanitary conditions. Furthermore, direct personal contact would not be responsible for the transmission of *Ascaris* and *Trichuris*. The high rates of these helminths suggest that polluted surroundings, contaminated food and water, and poor personal hygiene are important sources of infection.

Other studies in areas with similar conditions have revealed comparable rates of infection. In 300 people in Jeremié, Haiti, the following rates were found: *E. histolytica*, 41.1 percent; *E. hartmanni*, 33.7 percent; and *Ascaris*, 77.5 percent.²¹ Other workers have reported similar rates of *E. histolytica*: 36 percent in a rural area of Costa Rica,²² 34.2 percent in the Dominican Republic²³ and 35.5 percent in Cali, Colombia²⁴. The distribution of parasites among various age groups in these areas was similar to that observed in Santa María Cauqué, a finding which suggests that the environment and personal habits are the most important determinants of infection with intestinal parasites.

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RESUMEN: Se recolectaron 144 especímenes fecales en Santa María Cauqué, una población indígena Maya situada en el altiplano de Guatemala. La prevalencia total de parásitos intestinales fue 97.2 por ciento, acusando los siguientes porcentajes las especies individuales: *E. histolytica*, 38.9; *E. hartmanni*, 43.8; *D. fragilis*, 7.6. *Giardia*, 13.5; *Ascaris*, 82.6; y *Trichuris*, 53.5. Se encontró una tasa de 83.3 por ciento de protozoos y de 87.5 por ciento de helmintos. Las infecciones por amebas fueron comunes en el grupo de 21 a 40 años de edad, con un incremento notorio a partir de los niños pequeños hasta alcanzar niveles altos en los adolescentes y en los adultos. En las personas me-

nores de 20 años de edad, *Giardia*, *Ascaris*, y *Trichuris* fueron los más prevalentes. En general, se notó un alto porcentaje de parásitos.

Las personas examinadas eran contactos familiares de una cohorte de niños en quienes se demostraron infecciones por protozoarios a una edad muy temprana. Los contactos del 97 por ciento de los niños fueron positivos para una o más especies de amebas y los de 75.7 por ciento, positivos para *E. histolytica*. De las madres examinadas, más de la mitad estaban infectadas con *E. histolytica*, y todos los niños tenían parientes con infecciones por *Ascaris* o *Trichuris*.

El alto nivel de infección encontrado refleja las malas condiciones sanitarias prevalentes en la aldea. Es posible que las infecciones se transmitan a través de diversas rutas: alrededores contaminados, alimentos, agua poluta, y mala higiene personal.

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