PARASITOLOGICAL SURVEYS IN THE JOS PLATEAU, NIGERIA

KUNINORI SHIWAKU¹, HIROSHI TAKAHASHI², BERTRAM E. B. NWOKE³,
CELESTINE O. E. ONWULIRI³ AND GAD O. UFOMADU⁴

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Abstract: Surveys for schistosomiasis, intestinal parasitic infections and filariasis were carried out in 3 villages of the Jos Plateau, Nigeria, in the period between February and March, 1985. Of 668 fecal samples, 66.8 % were found to harbour parasitic eggs and protozoa. The overall prevalence of parasitic infections among villagers was as follows: hookworm, 40.3%; *Ascaris lumbricoides*, 9.1%; *Strongyloides stercoralis*, 0.3%; *Trichuris trichiura*, 0.4%; *Schistosoma mansoni*, 18.9%; *Taenia* sp., 0.1%; *Hymenolepis nana*, 0.1%; and cysts of *Entamoeba histolytica*, 6.7%; *Entamoeba coli*, 31.4%; *Iodamoeba bütschlii*, 11.1%; *Endolimax nana*, 2.5%; *Chilomastix mesnili*, 1.6%; *Giardia lamblia*, 1.5%. Hookworm was the predominant helminth, and the infective larvae of *Necator americanus* were found in 6 pupils using filter paper-cultures. The prevalence rates of hookworm infection varied significantly with villages; 53.9% at Sop, 33.3% at Jebu and 6.0% at Maigemu. Of the 344 inhabitants, 5.2% and 13.4% were found to harbour microfilariae of *Loa loa* and *Dipetalonema perstans*, respectively. Factors which may have contributed to the spread of these parasitic infections on the Jos Plateau are discussed.

INTRODUCTION

Nearly half of the people in Nigeria are living in the rural areas, and are engaging in farming. Water supply, sewage and refuse disposal are poorly organized in the rural areas. The villagers usually defecate directly on the ground. Propagations of helminths and protozoa are therefore facilitated by this practice. A report on the stool examination for ova and cysts by Azikiwe (1984) was the only available one on the parasitological situation in the Jos Plateau. He reported that hookworm and *A. lumbricoides* were the most common parasitic infestation, and *T. trichiura*, *E. coli*, *S. stercoralis*, *S. mansoni* and *G. lamblia* were found in 190 employees and their family members and 47 students of the University of Jos.

Between February and March, 1985, the inhabitants in 3 villages of the Jos Plateau were surveyed for filarial infections, schistosomiasis and intestinal parasitic infections with the aim of providing base line parasitological data.

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1 Department of Parasitology, Aichi Medical University, Yazako, Nagakute-cho, Aichi-gun, Aichi 480-11, Japan

2 The Japan International Cooperation Agency, University of Jos, Jos, Plateau State, Nigeria

3 Department of Zoology, Faculty of Natural Science, University of Jos, Jos, Plateau State, Nigeria

4 Parasitological Division, Nigerian Institute for Trypanosomiasis Research, Vom, Plateau State, Nigeria

MATERIALS AND METHODS

Study areas: The Jos Plateau is located in the central part of Nigeria, approximately 104 km from north to south, and 80 km from east to west. It rises steeply in the south-west by a 600 m scarp from a height of 750 m to a height of over 1,300 m above sea level. Most parts of the Plateau lie on this elevation except the Shere Hills which rise to heights of over 1,800 m (Figure 1). The vegetation of the Jos Plateau is the typical northern Guinea savanna. In Jos 94% of the rains fell within the 6 wet months of April to September in 1984. There was no rainfall between November and February during which period the relative humidity was low. The temperature varied between 12 and 32°C. The hottest month was March, and coincides roughly with the passage of the sun overhead. Two periods of low temperatures were re-

Figure 1 A: Map showing the location of Plateau State (black portion) in Nigeria.
 B: Map showing 3 villages examined in the Jos Plateau.
 ①: Sop, ②: Jebu, ③: Maigemu

corded. The first occurs in the middle of the wet season; the second coolest period occurs in the middle of the dry season as a result of the cool north-east hamattan wind from the Sahara Desert.

Three villages were selected for parasitological surveys on the Jos Plateau (Figure 1). Sop and Jebu lie within the Bauchi Local Government area in the south along the bank of the river Assob at a height of 800 m. These 2 villages are close to each other and the river Assob is the perennial one. Sop has many springs and Jebu, an irrigation canal. Maigemu lies within the Jos Local Government area in the north along the bank of the river Jarawa at a height of 720 m. The tributary of the river Jarawa near Maigemu is seasonal, and there are only some muddy puddles in the dry season. The inhabitants of these 3 villages are consisted of the Jarawa, Hausa and a small number of the Fulani people.

Fecal examination: The stool samples were collected in plastic containers which were distributed to the villagers and retrieved in the next morning. Samples were preserved in 10% formalin solution, and were examined after formalin-ether centrifugation technique (MGL method) by light microscopy. Filter paper-culture method was applied for fecal samples from 6 pupils at Sop to identify the species of hookworm.

Blood examination: Blood samples were taken from the finger tip at Sop and Jebu, and by veni-puncture at Maigemu during the time from 10 a.m. to 4 p.m. Thick films were prepared, dried overnight, dehemoglobinized, fixed by absolute methyl alcohol and stained with Giemsa.

Statistical analysis of the results: Statistical differences of parasite infections in 3 villages were assessed by ANOVA among the inhabitants aged 10 years old and more, as no subject below 9 years old was examined at Maigemu.

RESULTS

A total of 668 fecal samples of the inhabitants from 3 villages were examined and 446 (66.8%) were found to harbour parasites. The prevalence of parasitic infections was 72.8% at Sop, 55.7% at Jebu and 69.0% at Maigemu, respectively. The overall infection rate of people with individual parasites were shown in Table 1. Hookworm was the most prevalent intestinal helminth. As indicated in Table 2, the infection rate of hookworm was the highest at Sop (53.9%) and the lowest at Maigemu (6.0%). Differences in the prevalence of hookworm infection among the inhabitants at Sop, Jebu and Maigemu varied significantly ($p < 0.001$) with villages. There was no significant difference in prevalence of hookworm between males and females. Prevalence of hookworm infection at Sop was high in subjects of 10–29 years old, and low in 30 years old and more. The infective larvae of *N. americanus* were identified in all the 6 pupils at Sop using filter paper-cultures.

Table 3 demonstrates the prevalence of *S. mansoni* infection by age groups at the 3 villages. Eggs of *S. mansoni* were found in 32.9% at Sop and 4.7% at Jebu, but not at Maigemu. There were significant differences in the prevalence of *S. mansoni* infection in 3 villagers over 10 years old ($p < 0.01$) with villages. The high prevalence rate of *S. mansoni* at Sop was observed in the age group of 10–19 years old and was significantly lower in adults over 20 years old ($p < 0.005$). The highest infection rate was 61.9% in the age group of 10–19 years old at Sop. Twenty-four children below 3 years old examined were negative for the eggs of *S. mansoni*.

The overall prevalence of *E. histolytica* cyst was 6.7%; 6.2% at Sop, 6.6% at Jebu and 9.0% at Maigemu, with a peak in the age group of 10–19 years old. *E. coli* were the most common

Table 1 Prevalence of parasitic infections using formalin-ether centrifugation technique arranged by village

Village	Sop	Jebu	Maigemu	Total
Number examined	356	213	100	668
hookworm	192 (53.9)	71 (33.3)	6 (6.0)	269 (40.3)
<i>A. lumbricoides</i>	19 (5.3)	42 (19.7)	0	61 (9.1)
<i>S. stercoralis</i>	2 (0.6)	0	0	2 (0.3)
<i>T. trichiura</i>	1 (0.3)	2 (0.9)	0	3 (0.4)
<i>S. mansoni</i>	116 (32.6)	10 (4.7)	0	126 (18.9)
<i>Taenia</i> sp.	1 (0.3)	0	0	1 (0.1)
<i>H. nana</i>	0	1 (0.5)	0	1 (0.1)
<i>E. histolytica</i>	22 (6.2)	14 (6.6)	9 (9.0)	45 (6.7)
<i>E. coli</i>	90 (25.3)	56 (26.3)	64 (64.0)	210 (31.4)
<i>I. bütschlii</i>	41 (11.5)	20 (9.4)	13 (13.0)	74 (11.1)
<i>E. nana</i>	14 (3.9)	2 (0.9)	1 (1.0)	17 (2.5)
<i>C. mesnili</i>	4 (1.1)	4 (1.9)	3 (3.0)	11 (1.6)
<i>G. lamblia</i>	5 (1.4)	5 (2.3)	0	10 (1.5)

Numbers in parentheses are percentage.

Table 2 Prevalence of hookworm infection by age

Age group	Sop		Jebu		Maigemu	
	Number examined	Number infected	Number examined	Number infected	Number examined	Number infected
0-9	157	67 (42.7)	101	19 (18.8)	0	—
10-19	113	84 (74.3)	46	26 (29.7)	11	1 (9.1)
20-29	32	21 (65.6)	29	11 (37.9)	15	1 (6.7)
30-39	25	6 (24.0)	21	11 (52.4)	31	3 (9.7)
over 40	29	14 (48.3)	16	4 (25.0)	43	1 (2.3)
Total	356	192 (53.9)	213	71 (33.3)	100	6 (6.0)

Numbers in parentheses are percentage.

Table 3 Prevalence of *Schistosoma mansoni* infection by age

Age group	Sop		Jebu		Maigemu	
	Number examined	Number infected	Number examined	Number infected	Number examined	Number infected
0-9	157	38 (24.2)	101	0	0	—
10-19	113	70 (62.0)	46	4 (8.7)	11	0
20-29	32	3 (9.4)	29	4 (13.8)	15	0
30-39	25	4 (16.0)	21	1 (3.7)	31	0
over 40	29	1 (3.5)	16	1 (6.3)	43	0
Total	356	116 (32.6)	213	10 (4.7)	100	0

Numbers in parentheses are percentage.

Table 4 Prevalence of *Loa loa* and *Dipetalonema perstans* infections by age

Age group	Number examined	Sop		Number examined	Jebu		Number examined	Maigemu	
		<i>L. loa</i>	<i>D. perstans</i>		<i>L. loa</i>	<i>D. perstans</i>		<i>L. loa</i>	<i>D. perstans</i>
0-9	4	0	0	2	0	0	0	—	—
10-19	34	0	5 (14.7)	32	0	9 (11.6)	15	1 (6.7)	0
20-29	32	1 (3.1)	6 (18.8)	26	1 (3.9)	3 (11.6)	18	1 (5.6)	1 (5.6)
30-39	25	0	6 (24.0)	23	0	1 (4.3)	34	5 (14.7)	1 (2.9)
over 40	28	0	12 (42.9)	18	1 (5.6)	0	53	8 (15.1)	2 (3.8)
Total	123	1 (0.8)	29 (23.6)	101	2 (2.0)	13 (12.9)	120	15 (12.5)	4 (3.3)

Numbers in parentheses are percentage.

intestinal protozoa showing overall infection rate of 31.4%. The infection rate of *E. coli* at Maigemu was significantly higher than those at Sop and Jebu in age groups of over 10 years old ($p < 0.005$).

Blood examination was mainly carried out on adults because of the ease in collecting blood and the lack of manpower to cope with the large number (Table 4). At Sop and Jebu, 1.3% of blood sampled showed *L. loa* microfilariae and 18.8% revealed *D. perstans*. At Maigemu, 12.5% of the inhabitants examined were positive for *L. loa* microfilariae and 3.3% for *D. perstans*. The prevalence of *L. loa* at Maigemu was significantly higher than that at Sop and Jebu ($p < 0.05$). The infection rate of *D. perstans* at Sop and Jebu was significantly higher than that at Maigemu ($p < 0.005$). The microfilarial density ranged between 1 and 72 microfilariae (mean value 6.3) for *L. loa* and between 1 and 8 microfilariae (mean value 1.5) for *D. perstans* in about 30 mm³ blood at the study areas.

DISCUSSION

Hookworm was the predominant helminth in the 3 villages of the Jos Plateau. Some reports have shown that 2 species of human hookworm, *N. americanus* and *Ancylostoma duodenale*, are seen in several parts of Nigeria (Nwosu and Anya, 1980; Udonsi, 1984). It seems

that *N. americanus* is common on the Jos Plateau as the infective larvae of *N. americanus* were identified in all of 6 pupils using filter paper-cultures.

In Jos, temperatures are consistently above the 10°C ambient, which is the minimum temperature for hookworm development (Nwosu, 1978a). Temperature may therefore have little effect on the build-up of hookworm infection in these areas. Precipitation, on the other hand, tends to have a marked seasonal pattern. As the free-living stages of hookworms are highly susceptible to desiccation (Nwosu, 1978b), low humidity in the soil would tend to reduce transmission of hookworm. Even in the dry season, there are usually many springs and streams at Sop, thus supporting a highest infection rate of hookworm; conversely, the seasonality in the tributary of the river Jarawa at Maigemu, probably explains the lower prevalence observed. Accordingly, it seems that the differences in the prevalence of hookworm among 3 villages are attributable to the differences in the humidity of soil in the dry season.

S. mansoni and *S. haematobium* are widely distributed in Nigeria (Cowper, 1963; Kaneko and Odiachi, 1976; Pugh and Gilles, 1978; Hori and Odiachi, 1978). A lot of *B. pfeifferi* were found in the springs and streams at Sop and the irrigation canal at Jebu. Snails collected from Jebu had the fork-tailed cercariae which are the characteristic of *Schistosomatoidea*. The inhabitants were probably infected at Sop and Jebu while bathing or wading in the springs, streams and irrigation canal. Recently, the spread of schistosomiasis has been fostered by increased irrigation (WHO, 1980). It must be emphasized that adequate measures for schistosomiasis control should be made an integral part of water resource development projects.

S. mansoni infection at Sop increased with age, attained a peak at 10–19 years old and declined at 20 years old or older. The reason for this reduction of prevalence remain uncertain; but accumulating evidences suggest different mechanisms such as an immune mechanism and reduced water contact in the adults (Jordan and Webbe, 1982).

A survey of intestinal protozoan infections in Nigeria was performed on a large scale by Ogunba (1977) who collected stool samples from an Ibadan population including 3,400 children and 621 adults. Prevalence of *E. histolytica*, *E. nana* and *C. mesnili* were lower in the present study area than those in Ibadan, and prevalence of *E. coli*, *I. büttchlii* and *G. lamblia* were higher in the present area than those in Ibadan. It seems that these differences in prevalence of intestinal protozoa infections are due to the differences in the climate and social environment between the present area and Ibadan.

Recently, Hori and Odiachi (1978) and Hori *et al.* (1984) carried out surveys on loiasis in the southwestern region of Nigeria in which the infection rates of 3.8–28.9% were reported. In the present surveys it is evident that the Jos Plateau is endemic area for loiasis. Using thick smears, Wijiyiratne *et al.* (1982) reported the prevalence of *D. perstans* infection of 2.6% in a village in the Malunfashi district of Kaduna State which shares borders with Plateau State. Prevalence of *D. perstans* infection at the present study villages was higher than that reported by Wijiyiratne *et al.*

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ナイジェリア連邦共和国, ジョス高地における寄生虫調査

塩飽 邦憲¹・高橋 弘²・B. E. B. Nwoke³

C. O. E. Onwuliri³・G. O. Ufomadu⁴

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ナイジェリア, ジョス高地の 3 農村の住民を対象として 1985 年 2-3 月の期間に, 糞便検査によって腸管寄生蠕虫類・原虫類およびマンソン住血吸虫の検出を, 血液厚層塗抹検査により糸状虫ミクロフィラリアの検出を行った。その結果, 糞便検査を行った 668 名の住民のうち, 66.8% に何らかの腸管寄生虫およびマンソン住血吸虫の寄生を認め, 寄生率は鉤虫 40.3%, 回虫 9.1%, 糞線虫 0.3%, 鞭虫 0.4%, マンソン住血吸虫 18.9%, *Taenia* sp. 0.1%, 小形条虫 0.1%, 赤痢アメーバ 6.7%, 大腸アメーバ 31.4%, ヨードアメーバ 11.1%, 小形アメーバ 2.5%, メニール鞭毛虫 1.6%, ランブル鞭毛虫 1.5% であった。6 名の児童について糞便の濾紙培養検査を行い, 全てアメリカ鉤虫の感染幼虫と同定した。鉤虫の感染率は, 調査した 3 村で Sop 53.9%, Jebu 33.3%, Maigemu 6.0% と有意な差が認められた ($p < 0.001$)。334 名の住民について血液厚層塗抹検査を行い, 5.2% の住民よりロア糸状虫ミクロフィラリアを, 13.4% より常在糸状虫ミクロフィラリアを検出した。ジョス高地におけるこれらの寄生虫疾患の分布を規定する要因について, 若干の考察を行った。

1 愛知医科大学寄生虫学教室 2 国際協力事業団, ジョス大学医学部 3 ジョス大学理学部動物学教室 4 ナイジェリア・トリパノソーマ症研究所
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