Japan. J. Trop. Med. Hyg., Vol. 6, No. 3, 4, 1978, pp. 167–180

PREVALENCE OF HUMAN SCHISTOSOMIASIS IN THE TAVETA AREA OF KENYA, EAST AFRICA[1]

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Received for publication 1 August 1978

Abstract: A total of 963 individuals in three villages were examined for schistosomiasis by both skin test and schistosome ova detection in stool and urine in 1974. The antigen used for skin test was VBS adult *S. japonicum* antigen (1: 10,000 dilution). Stool and urine samples were examined through the concentration methods. Egg-positive rate was 62.2 per cent in Jipe, 68.0 per cent in Eldoro, 69.6 per cent in Kivalwa. Jipe was infested mostly by *S. mansoni*, Kivalwa by *S. haematobium* and Eldoro by both two schistosomes. The egg-positive rate was higher in females than in males in Eldoro. In Jipe and Kivalwa, however, the differences in the rate between males and females were not statistically significant. The rate increased with age in children, reached a peak between the ages of 5 and 14 years and then decreased gradually. The positive rate of skin test was 76.4 per cent in total, higher than that of stool and urine examinations. The skin reaction was weak or absent among many egg-positive children. The skin-test-positive rate increased as the age advanced and reached 95 per cent in inhabitants from 40 years up. The positive rate of skin test was higher among males than females in Jipe. No significant difference in the rate between males and females was found in Eldoro and Kivalwa. Among the egg-positive subjects there was no significant difference in skin reaction between *S. mansoni* infection and *S. haematobium* infection. In 1975 stool and urine samples from Jipe, Kivalwa, Kuwahoma and Chala were examined. Kuwahoma proved to be infested by *S. haematobium*. In Chala schistosome infection was rare. There exist villages infested by *S. mansoni* and/or *S. haematobium* in the small area. It seems that VBS adult *S. japonicum* antigen for skin test and the concentration methods for stool and urine examinations are of use in the epidemiological survey in the areas where *S. mansoni* and/or *S. haematobium* infections are prevailing.

INTRODUCTION

It was revealed by the previous investigations made by the Division of Vector Borne Diseases, National Public Health Laboratory Services, Kenya and some others that schistosomiasis mansoni and haematobia are prevailing in villages around

1 Studies on Schistosomiasis in Kenya, East Africa (Report 1) conducted by Schistosomiasis Research Team (Leader: D. Katamine), Institute for Tropical Medicine, Nagasaki University and Kenyan Counterparts, supported by a Scientific Research Grant from the Ministry of Education, Japan.
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Taveta Town located at the base of Mt. Kilimanjaro, near Kenya-Tanzania border, within the boundaries of Kenya (Highton, 1974). Some villages surrounding this town (i.e. Jipe, Eldoro, Kivalwa, Kuwahoma and Chala) were selected for our three years investigations into schistosomiasis in Kenya beginning in 1974. Jipe is a fishing village of Luo people totally depending on fishing in Lake Jipe. Eldoro, Kivalwa and Kuwahoma are situated along the irrigation canals from the Lumi River and Chala on the Lumi River. The inhabitants of these villages are engaged in cotton, maize and banana production or stock farming except some working at sisal estates.

The present paper reports the data collected on stool and urine examinations and skin test for schistosomiasis in the area during the first and second years of the investigations.

Materials and Methods

In the three villages, Jipe, Kivalwa and Eldoro, 1,170 individuals were subjected to stool and urine examinations and skin test using VBS *S. japonicum* antigen during the survey period of the first year (December, 1974). However, the statistics of three combined examinations were compiled from 963 inhabitants, because some of them did not provide enough quantities of stool and/or urine samples (Figure 1).

Stool examination: The fecal sample, at least 1 g, usually 3 to 5 g, was processed according to the MIFC method (Blagg *et al.*, 1955) which was modified by Ota and Sato (1957) for schistosome ova detection. Ten m*l* of MF solution and one drop of Tween 80 were added to each 1 g of stool sample and mixed well. The suspension was strained through gauze into a centrifuge tube. Approximately 2 to 4 m*l* of ether was poured into the tube for each 1 g of initial sample. The centrifuge tube was stoppered, shaken vigorously for 30 sec, left standing for 2 min and centrifuged at 1,600 rpm for 1 min. The plug under the ether was loosen and the supernatant was discarded. The deposit in the bottom of the tube was examined under microscope for schistosome ova. The MF solution consisted of 200 m*l* of stock solution, 250 m*l* of water, 25 m*l* of formalin and 5 m*l* of glycerine. To make 1,000 m*l* of stock solution, water was added to the mixture of sodium merthiolate 1 g, 500 m*l* of ethyl alcohol and 100 m*l* of acetone.

Urine examination: The urine sample, usually 100 to 200 m*l*, was provided at noon or in the early afternoon. Immediately, 4 m*l* of formalin was pipetted to each 100 m*l* of sample. The sample was then placed in the conical flask and sedimented for more than 30 min. The upper layer was discarded and the bottom layer was centrifuged at 1,000 rpm for 2 min. The sediment was examined microscopically.

Skin test: The antigen solution (1: 10,000 dilution of VBS extract of adult *S. japonicum*) was prepared after the method of Chaffee *et al.* (1954) with slight modification. Intradermal injection of 0.02 m*l* of VBS antigen solution was given to the volar surface of the forearm of each individual. At 15 min after injection the edge

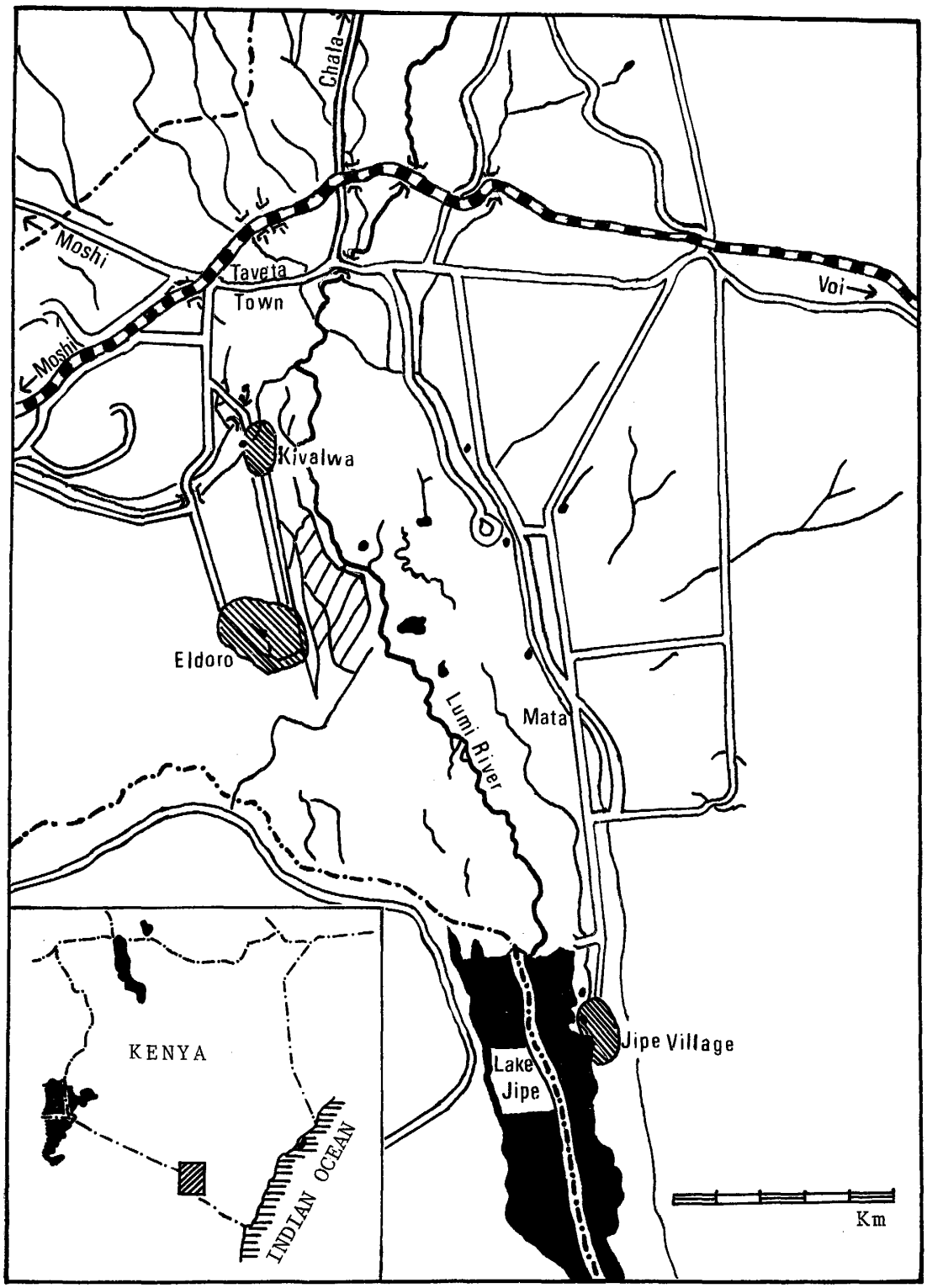

Figure 1 Map indicating three villages examined during the survey period of the first year. Hatched areas indicate the same villages; solid lines, the Lumi River, streams and irrigation canals; parallel lines, main roads in the area.

of wheal was outlined with a ball-point pen. The tracing was transferred to the paper with individual's name and other information by moistening with alcohol and pressing over the inked area. Two diameters of the wheal were measured at right angles. An average of diameters was designated as the wheal size. The wheals with sizes smaller than 8 mm in average diameter were classified as negative reaction, and the wheals with sizes 8 mm or more as positive reaction.

During the survey period of the second year (November, 1975) 173 individuals of the two villages (i.e. Jipe and Kivalwa) who were examined in the previous year, and 142 inhabitants of Kuwahoma as well as 302 inhabitants of Chala provided urine and stool samples. The samples were examined by the same methods as in the previous year's survey.

Results

As shown in Tables 1 and 3 the prevalence rates of schistosomiasis determined by stool and urine examinations in 1974 were 62.2 per cent in Jipe, 68.0 per cent in

Table 1 Results of stool and urine examinations for schistosome eggs in three villages of the Taveta area in 1974

Village	Number examined	Number infected	Eggs detected		
			S. mansoni	*S. haematobium*	Both together
Jipe	262	163 (62.2)	156 (59.5)	1 (0.4)	6 (2.3)
Eldoro	441	300 (68.0)	66 (15.0)	115 (26.1)	119 (27.0)
Kivalwa	260	181 (69.6)	5 (1.9)	159 (61.2)	17 (6.5)
Total	963	644 (69.6)	227 (23.6)	275 (28.6)	142 (14.7)

( ): %

Table 2 Positive rates for schistosome egg examinations and skin test by sex in three villages

Village	Sex	Number examined	Egg-positive (%)	Skin-test-positive (%)
Jipe	Male	148	64.2	85.1
	Female	114	59.6	71.1
	Total	262	62.2	79.0
Eldoro	Male	183	61.2	73.2
	Female	258	72.9	72.9
	Total	441	68.0	73.0
Kivalwa	Male	121	71.1	78.5
	Female	139	68.3	80.6
	Total	260	69.6	79.6
Totals	Male	452	64.8	78.5
	Female	511	68.7	74.6
Total		963	66.9	76.4

Table 3 Results of stool and urine examinations for schistosome eggs and skin test in three villages

Village	Number examined	Number passing eggs				Number skin-test-positive
		S. mansoni	*S. haematobium*	Both together	Total	
Jipe	262	156 (59.5)	1 (0.4)	6 (2.3)	163 (62.2)	207 (79.0)
Eldoro	441	66 (15.0)	115 (26.1)	119 (27.0)	300 (68.0)	322 (73.0)
Kivalwa	260	5 (1.9)	159 (61.2)	17 (6.5)	181 (69.6)	207 (79.6)
Total	963	227 (23.6)	275 (28.6)	142 (14.7)	644 (66.9)	736 (76.4)

( ): %

Eldoro and 69.6 per cent in Kivalwa. In Jipe *S. mansoni* eggs were detected in 156 individuals (59.5%), *S. haematobium* eggs in one and both together in six (2.3%). In Eldoro *S. mansoni* eggs were found in 66 individuals (15.0%), *S. haematobium* eggs in 115 (26.1%) and both together in 119 (27.0%). In Kivalwa *S. mansoni* eggs were detected in five individuals (1.9%), *S. haematobium* eggs in 159 (61.2%) and both together in 17 (6.5%). The results indicated the predominance of *S. mansoni* infection in Jipe, the predominance of *S. haematobium* infection in Kivalwa and nearly even occurrence of two species in Eldoro.

In Eldoro 112 males out of 183 (61.2%) and 188 females out of 258 (72.9%) were found positive for schistosome eggs (Table 2). Using the χ^2 test the difference in the egg-positive rate between males and females was statistically significant ($p<0.025$) in this village. In Jipe and Kivalwa the egg-positive rates seemed to be somewhat higher among males than females (Table 2), but the computed values of χ^2 were not statistically significant. As shown in Tables 2 and 3, the positive rates of skin test with VBS *S. japonicum* antigen were 79.0 per cent in Jipe, 73.0 per cent in Eldoro, 79.6 per cent in Kivalwa and 76.4 per cent in total, higher than those of egg examinations. The positive rate of skin test was higher among males than females in Jipe. The difference was statistically significant ($p<0.01$) in the χ^2 test. In Eldoro and Kivalwa, however, the data did not indicate any statistically significant difference in the positive rate of skin test between males and females.

The age distribution of egg-positive rate and that of skin-test-positive rate are shown in Table 4 and Figure 2. The youngest age of egg-positive individuals was two years. The egg-positive rate was 33 per cent in the age group of 1 to 4 years, 75 per cent in that of 5 to 9 years, and 80 per cent among teen-agers. In the older age groups the rate declined to 60 per cent. On the other hand, skin-test-positive rate increased as the age advanced, reaching 95 per cent in the age groups from 40 years up. Children of 9 years and downward have a higher egg-positive rate than the skin-test-positive rate (Figure 2). At every village the peak of the egg-positive rate was found either in the age group of 5 to 9, or in that of 10 to 14 years, and then gradually declined at the older age, remarkably in the cases of *S. haematobium* (Table 4, Figure 3).

There were found 541 skin-test-positive individuals among 644 egg-positive cases, or in 84 per cent. The rate was higher than the incidence of 61 per cent among the

Table 4 Positive rates for schistosome egg examinations and skin test by age in three villages

Age group (years)	Jipe			Eldoro			Kivalwa		
	Number examined	Percent egg-positive	Percent skin-test-positive	Number examined	Percent egg-positive	Percent skin-test-positive	Number examined	Percent egg-positive	Percent skin-test-positive
1–4	24	33.3	41.7	66	34.8	30.3	27	29.6	25.9
5–9	66	78.8	71.2	120	69.2	65.8	81	81.5	70.4
10–14	47	74.5	91.5	102	85.3	85.3	60	83.3	98.3
15–19	21	57.1	66.7	32	81.3	84.4	21	71.4	95.2
20–29	50	58.0	84.0	42	59.5	92.9	18	50.0	88.9
30–39	30	50.0	90.0	41	68.3	82.9	15	86.7	93.3
40–49	18	50.0	100	24	75.0	91.7	13	53.8	92.3
50–	6	50.0	100	14	71.4	100	25	52.0	88.0
Total	262	62.2	79.0	441	68.0	73.0	260	69.6	79.6

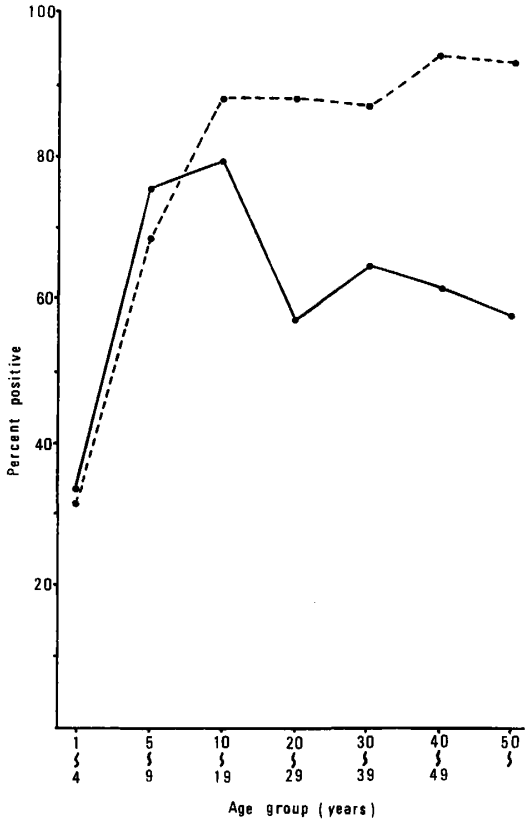

Figure 2 Egg-positive rates and skin-test-positive rates by age in the Taveta area. Circles connected by solid line indicate egg-positive rates; circles connected by broken line, skin-test-positive rates.

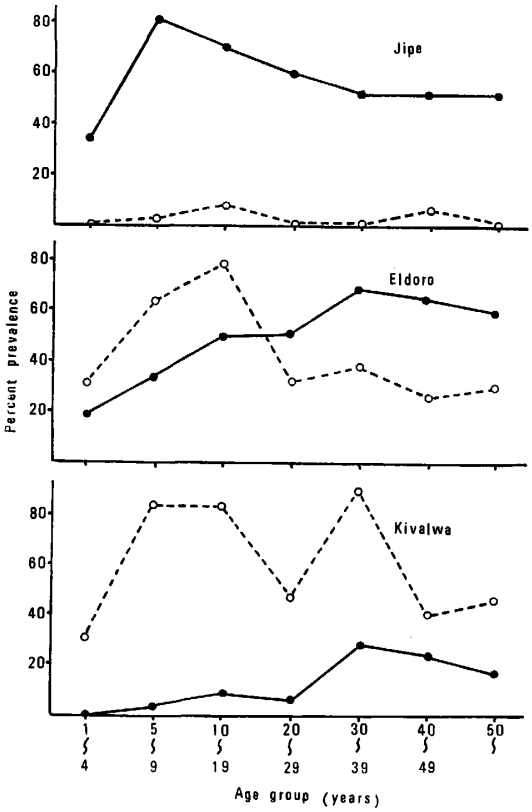

Figure 3 Prevalence of schistosomiasis mansoni and haematobium by age in three villages. Solid circles connected by solid line indicate rates of *S. mansoni* ova detection; open circles connected by broken line, rates of *S. haematobium* ova detection. Cases of double infection were included.

Table 5 Results of skin test among egg-positive subjects and egg-negative subjects from Jipe, Eldoro and Kivalwa

Village	Number examined	Number skin-test-positive	Number skin-test-negative	Positive for schistosome ova			Negative for schistosome ova		
				Number examined	Number skin-test-positive	Number skin-test-negative	Number examined	Number skin-test-positive	Number skin-test-negative
Jipe	262	207 (79.0)	55 (21.0)	163	138 (84.7)	25 (15.3)	99	69 (69.7)	30 (30.0)
Eldoro	441	322 (73.0)	119 (27.0)	300	242 (80.7)	58 (19.3)	141	80 (56.7)	61 (43.3)
Kivalwa	260	207 (79.6)	53 (20.4)	181	161 (89.0)	20 (11.0)	79	46 (60.5)	33 (39.5)
Total	963	736 (76.4)	227 (23.6)	644	541 (84.0)	103 (16.0)	319	195 (61.1)	124 (38.9)

( ): %

Table 6 Results of skin test in 644 subjects with schistosomiasis by type of eggs detected

	Number examined	Number skin-test-positive	Number skin-test-negative
S. mansoni	227	191 (84.1)	36 (15.1)
S. haematobium	275	229 (83.2)	46 (16.8)
Both together	142	121 (85.2)	21 (14.8)
Total	644	541 (84.0)	103 (16.0)

( ): %

egg-negative inhabitants. The difference was highly significant ($p<0.001$) in the χ^2 test. It must be emphasized, however, that there were 103 skin-test-negative persons among 644 egg-positive inhabitants, or in 16 per cent. Only 124 inhabitants were negative in both egg examination and skin test (Table 5). Among the egg-positive subjects, there was no significant difference in skin reaction between *S. mansoni* infection and *S. haematobium* infection, in the χ^2 test (Table 6). Under the age of 5 years, the positive rate of skin test seemed to be somewhat lower among *S. haematobium* infected children than *S. mansoni* infected children (Figures 4 and 7), but the computed value of χ^2 was not significant. In the same aged groups, the wheal sizes of skin reaction also seemed to be somewhat

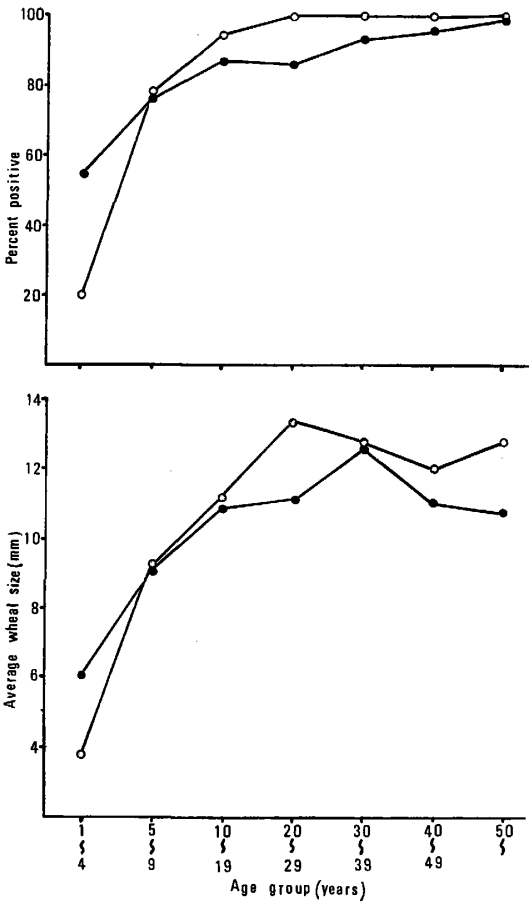

Figure 4 Rates of positive skin reactions and average wheal sizes by age in individuals with *S. mansoni* infection and those with *S. haematobium* infection. *S. mansoni* infected cases numbered totally 227 and *S. haematobium* infected ones 275. Solid circles, *S. mansoni* infection; open circles, *S. haematobium* infection.

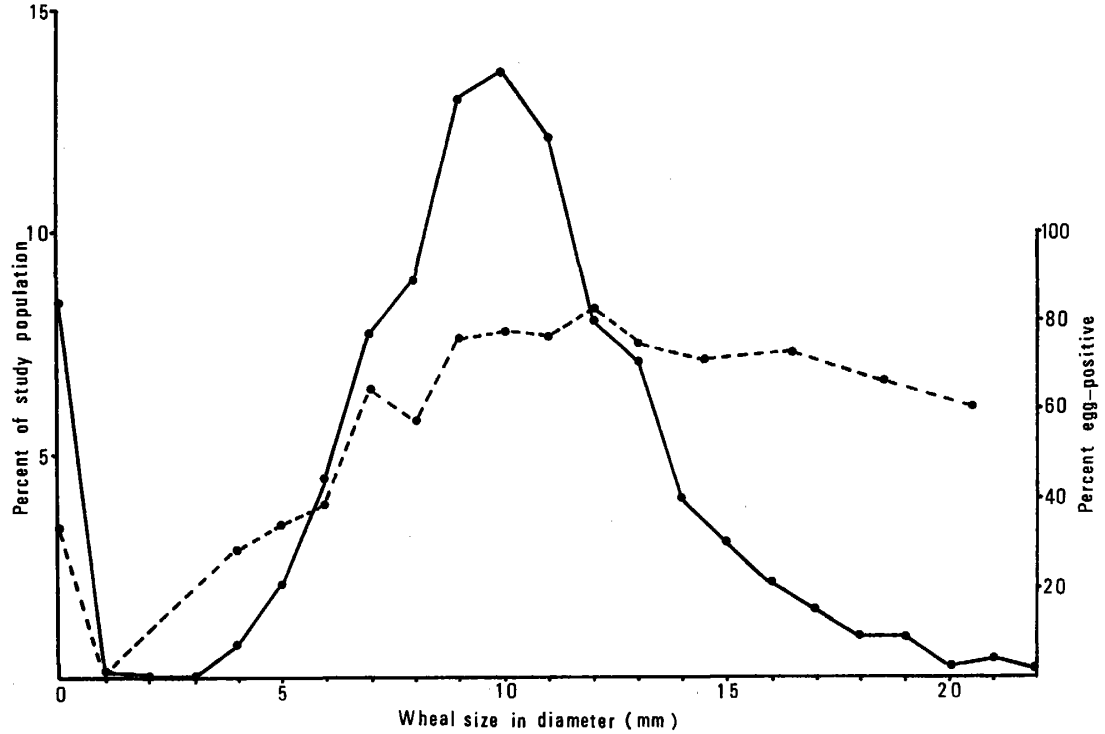

Figure 5 Percentages of individuals with different intensities of skin reaction in the study population and egg-positive rates related to wheal sizes.
Solid line connecting solid circles, distribution curve of wheal size; broken line connecting solid circles, distribution curve of egg-positive rate.

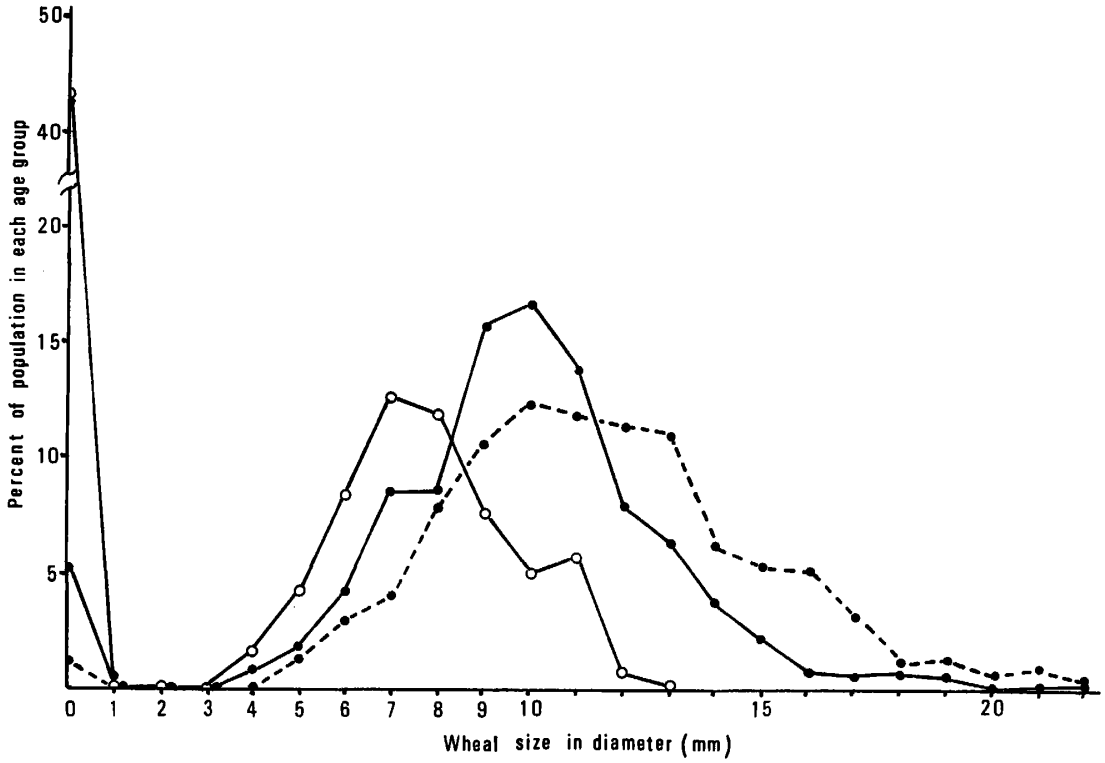

Figure 6 Intensity distribution of skin reactions in three age groups.
Solid line connecting open circles, 1–4 age group (114 individuals); solid line connecting solid circles, 5–19 age group (550 individuals); broken line connecting solid circles, group from 20 years up (296 individuals).

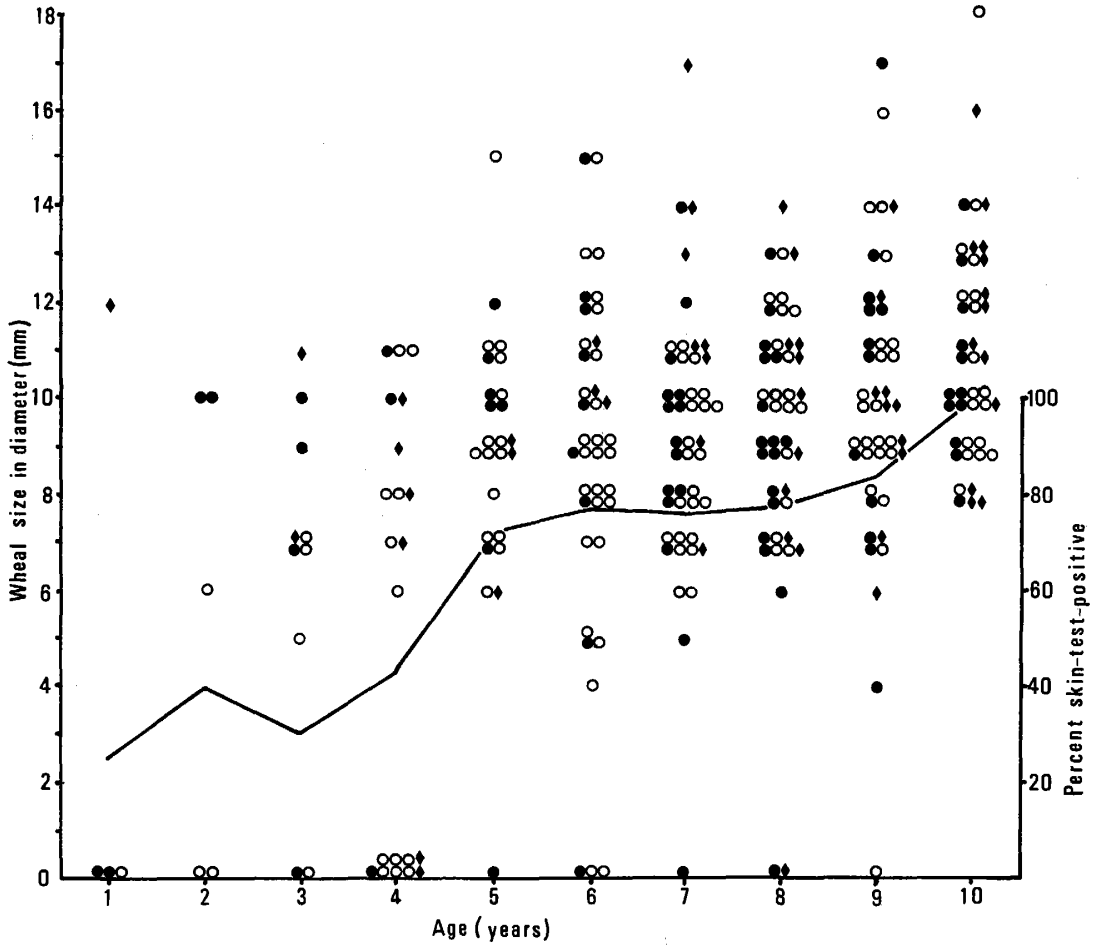

Figure 7 Results of skin test for subjects with schistosomiasis by age and type of ova detected, and rates of positive skin reactions of the subjects by age in the study population of 10 years and downward.
Solid circles indicate *S. mansoni* infected cases numbering totally 83; open circles, *S. haematobium* infected cases numbering 143; solid rhombi, cases of double infection numbering 57; solid line, rates of positive skin reactions by age.

smaller in *S. haematobium* infection than in *S. mansoni* infection (Figures 4 and 7), but 2.29 mm of the difference between means of the two groups whose variances were verified to be homogeneous by use of the F-distribution $\{F=1.4192<2.3779=F_{.95}(10, 19)\}$ was proved to be not significant in the t-test ($t=1.3706<2.045=t_{.05}$ for $v=29$).

The intensity distribution curve was plotted from the intensity of skin reaction which was studied on 963 inhabitants. It had two peaks, the first peak of negative reaction and the second peak of positive reaction around 10 mm in wheal diameter (Figure 5). When the subjects were divided into three age groups, under 5 years, of 5 to 19 years and from 20 years up, the peaks of distribution curves tended to shift to the right, or larger size of wheals occurred in the older groups (Figure 6). In other words, negative reaction decreased and intensity of skin reaction increased as the age advanced. As to the relation of reaction intensity to the egg-positive rate, eggs were proved in 70 to 80 per cent of the positive skin reaction group with a wheal size of

9 mm in diameter or larger, whereas the egg-positive rate was much lower in the skin-test-negative group with wheals less than 7 mm in diameter. On the other hand, eggs were detected in 29 to 35 per cent of the individuals with wheals which disappeared, remained in the same size, or increased 1 to 2 mm in diameter, mostly among children younger than 5 years of age (Figures 4 and 5). Most infected adults were positive for the skin test (Figure 4).

The results of stool and urine examinations carried out in 1975 also support the findings that *S. mansoni* infection is predominant in Jipe in contrast to high incidence of *S. haematobium* infection in Kivalwa. In Kuwahoma, which was not included in the previous year's survey, *S. mansoni* eggs were detected in seven individuals (5%), *S. haematobium* eggs in 52 (37%) and both together in two (1%) indicating predominance of *S. haematobium*. In Chala on the upper stream of the Lumi River schistosome eggs were found only in 25 individuals (8.3%) out of 302 examined inhabitants (Table 7).

Table 7 Results of stool and urine examinations for schistosome eggs in four villages of the Taveta area in 1975

Village	Number examined	Number infected	Eggs detected		
			S. mansoni	*S. haematobium*	Both together
Jipe	101	74 (73.3)	67 (66.3)	4 (4.0)	3 (3.0)
Kivalwa	72	57 (80.0)	0	55 (76.4)	2 (3.0)
Kuwahoma	142	61 (43.5)	7 (5.0)	52 (37.0)	2 (1.0)
Chala	302	25 (8.3)	16 (5.0)	7 (2.0)	2 (0.6)
Total	617	217 (35.1)	90 (14.5)	118 (19.1)	9 (1.5)

( ): %

Discussion

Thick smear method (Kato and Miura, 1954) were used to detect *S. mansoni* ova in stool samples by some investigators (Cook *et al.*, 1974; Warren *et al.*, 1974; Siongok *et al.*, 1976). In the present studies, however, the rationale to apply the MIFC method which was modified for schistosome ova detection by Ota and Sato (1957) to the examination of stool samples is that more than 1 g of sample can be examined by the concentration methods in contrast to 50 mg per slide by the thick smear method, and that the concentration method is, at least, a few times more sensitive than the smear method in spite of some ova missed in the process of concentration (Ota and Sato, 1957; Okabe *et al.*, 1960; Iijima *et al.*, 1962).

It is generally accepted that more *S. haematobium* ova are discharged into urine about midday than at other times in many endemic areas (Bennie, 1949; Stimmel and Scott, 1956; Jordan, 1960; Onori, 1962; Bradley, 1963; McMahon, 1976). In the present studies, urine samples were collected at noon or in the early afternoon, lest many egg-positive individuals should be overlooked. The urine samples were fixed with formalin, sedimented and centrifuged, although some ova might have been

lost in the process as pointed out by Olivier (1973).

Melcher's antigen has been recommended as the standard or reference antigen for skin test (Olivier, 1973), and the scapular region as a sensitive site for skin testing (Kagan *et al.*, 1961). Coca's *S. japonicum* antigen was reported to be a little less sensitive to children with schistosomiasis mansoni and/or schistosomiasis haematobia than *S. mansoni* antigen, although there was no difference in wheal size between the two antigens and the nitrogen content was 10 per cent less in the *S. japonicum* antigen (Kagan *et al.*, 1966). However, it was reported that *S. japonicum* antigen was effective in the skin test in *S. mansoni* endemic area in Brazil (Pellegrino *et al.*, 1962), that the reactivity of VBS antigen was similar to Melcher's antigen (Kagan *et al.*, 1961), and that VBS antigen was stable in antigenicity (Ishizaki, 1973). In the present studies VBS adult *S. japonicum* antigen was used in the three villages. The injection site was the volar surface of the forearm. If the scapular region had been used, every individual would have to remove the shirt and it would have been time-consuming and inconvenient especially for women.

It is interesting to find an endemic locale of *S. mansoni* infection (i.e. Jipe), those of *S. haematobium* infection (i.e. Kivalwa and Kuwahoma), that of two types of schistosome infections (i.e. Eldoro) and a locale where schistosome infection is rare (i.e. Chala) in this small area, presenting an ideal ground for comparative studies of two schistosome species.

There is, in general, little difference in sex ratio of the infection. The greater pervalence of schistosomiasis for females in Eldoro, a farming village may indicate a higher chance of exposure to schistosome cercariae for women in this locale through washing clothes and utensils and drawing water.

In the three villages surveyed in 1974, egg-positive rate increases rapidly with age in children, reaches a peak between the ages of 5 and 14 years and then gradually decreases. The decline appears to be more rapid in *S. haematobium* infection than in *S. mansoni* infection. Similar age prevalence relationships in schistosomiasis have been observed in some endemic areas (Pesigan, 1951; Clarke, 1967; Jordan, 1967; Siongok *et al.*, 1976).

It was reported that the positive rate for skin test with *S. japonicum* antigen was very low in children under the age of 10 years in *S. japonicum* endemic areas (Yokogawa, 1974), that more than 20 per cent schoolchildren passing *S. mansoni* ova were negative for skin test with Melcher's *S. mansoni* antigen in a hyperendemic area (McMahon, 1967); and that children below 5 years of age passing schistosome ova were far less reactive than the older individuals in endemic areas in Brazil (Kagan *et al.*, 1961). In the present studies the positive rate is lower for skin test than for egg examinations in children under the age of ten years. The wheal size is smaller in this age group than in the older age groups. These findings are essentially similar to those of previous workers. Kagan *et al.* (1966) reported that the children with schistosomiasis haematobia showed a higher skin reactivity to Coca's *S. mansoni* antigen and Coca's *S. japonicum* antigen than the ones with schistosomiasis mansoni in Southern Rhodesia. In the present studies, however, there is no significant difference in the positive rate of skin reaction between *S. haematobium* infected cases under the age of five years and the same aged *S. mansoni* infected cases. The wheal size of

skin reaction is not significantly different between the two groups, either. In the older age groups there seems to be no difference in skin reactivity between the two schistosome infections. There are possibilities, that the children with schistosomiasis haematobia are less reactive to VBS *S. japonicum* antigen than to Coca's antigens, and/or that the degree of hypersensitivity in the cases with schistosomiasis haematobia in the Taveta area is lower than that in Southern Rhodesia.

As is well known, skin test continues to be positive for 20 years or more after recovery from infection (Yokogawa, 1974), while the egg-positive rate reaches a peak in childhood or puberty with gradual decline in older age group. It is, therefore, not surprising to find that the positive rate of skin test becomes higher than that of egg examination in age group from 10 years up. The group of individuals who are skin-test-positive and egg-negative most probably includes some cases passing a small number of ova which escape detection even with the concentration methods, besides the cured individuals who had been treated with schistosomicides, and the ones with *S. bovis* infection (Sadun and Biocca, 1962) or other trematode infections (Hunter *et al.*, 1958; Sadun *et al.*, 1959) with which cross reactions occur. If the examinations for ova were repeated a few times as recommended by some investigators (Iijima *et al.*, 1962), the egg-positive rate would rise a little higher.

The results of the present investigations indicate that the concentration methods for schistosome ova and VBS adult *S. japonicum* antigen are of use in epidemiological surveys of the areas where schistosomiasis mansoni and/or schistosomiasis haematobia are prevailing. The results also support the view that *S. mansoni* and *S. haematobium* infections are still prevailing in this area.

Acknowledgments

The authors wish to express their appreciation to Kenyan Government Officials and people of Taveta District for their cooperation to the studies. A special debt of gratitude is due to Dr. J. N. Itotia, Director of the National Public Health Laboratory Services, Nairobi, and Dr. H. K. Githaiga, Parasitologist, Division of Vector Borne Diseases, National Public Health Laboratory Services, Nairobi, as well as Mr. R. L. Musa, Mr. J. Nandoya, Mr. H. Mwinga and Mr. K. Kokoi, Field Technicians, Medical Research Laboratory, Division of Vector Borne Diseases, Taveta, Coast Province, for helpful suggestions and assistance.

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東アフリカ・ケニア，タベタ地区における ヒト住血吸虫症の浸淫状況[1]

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1974年にタベタ地区の3村落の住民に皮内反応と検便，検尿による住血吸虫卵の検出を試み，963名の結果について集計を行った。皮内反応の抗原としては VBS adult *S. japonicum* antigen (1:10,000 dilution) を用い，糞便と尿の検体は集卵法にて検査した。虫卵陽性率は Jipe 62.2%, Eldoro 68.0%, Kivalwa 69.6% であった。Jipe では主に *S. mansoni*, Kivalwa では *S. haematobium* Eldoro では両種の浸淫が認められた。Eldoro では男性より女性に虫卵陽性率が高かったが，Jipe と Kivalwa では推計学的に虫卵陽性率の有意な性差は認められなかった。虫卵陽性率は小児では年齢と共に上昇し，5歳と14歳の間で最高値に達し，以後次第に減少した。皮内反応の陽性率は全体で76.4%で，虫卵陽性率より高い。小児では虫卵陽性者の多数で，皮内反応は弱いか或は全く反応を呈さなかった。皮内反応陽性率は年齢と共に増加し，40歳以上の住民では95%に達した。Jipe では女性より男性に皮反内応陽性率が高かったが，Eldoro と Kivalwa では性差は認められなかった。虫卵陽性の者では *S. mansoni* 感染者と *S. haematobium* 感染者の間に皮内反応の差は認められなかった。

1975年に Jipe, Kivalwa, Kuwahoma, Chala の村落住民に検便と検尿を行った。Kuwahoma では *S. haematobium* の浸淫が認められた。Chala では住血吸虫の感染は稀であった。この限られた地域にそれぞれ *S. mansoni*, *S. haematobium* の感染が流行する村落，両種の感染の流行する村落が存在することが確認された。これら両種の住血吸虫症の流行する地域の疫学的調査に於て，皮内反応に VBS adult *S. japonicum* antigen を，検便，検尿に集卵法を用い得ることが明らかにされた。

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1 ケニアにおける住血吸虫症の研究（第1報）本研究は長崎大学熱帯医学研究所に対する文部省特別事業費により行われた。
2 長崎大学熱帯医学研究所寄生虫学部門　3 ケニア国保健省公衆衛生研究所動物媒介疾患部門　4 九州大学医療技術短期大学部医動物学研究室