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Frequency of haematuria and proteinuria among *Schistosoma haematobium* infected children of two communities from Liberia and Tanzania

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Summary

The frequencies of haematuria and proteinuria among children of two rural communities with different *Schistosoma haematobium* endemicity from Liberia and Tanzania were compared. Although the prevalence and intensity of *S. haematobium* infections were lower in the Tanzanian community, the frequencies of haematuria and proteinuria were significantly higher when compared to the Liberian community. The semi-quantitative dip stick tests for haematuria and proteinuria showed a comparable, good specificity (haematuria 85%, proteinuria 80%), but a community-specific sensitivity. The dip stick test for haematuria detected 85% (proteinuria 82%) of all *S. haematobium* infected subjects in Tanzania compared to 68% (proteinuria 57%) in Liberia. The significance of these observations in relation to *S. haematobium* related morbidity is discussed.

Key words: *Schistosoma haematobium:* haematuria; proteinuria; morbidity.

Introduction

It is well established that haematuria and proteinuria are associated with *Schistosoma haematobium* infections and are indicators for the *S. haematobium* related morbidity pattern. Haematuria and proteinuria positively correlate with the intensity of *S. haematobium* infections reflected by egg counts (Wilkins et al., 1979; Feldmeier et al., 1982; Mott et al., 1983a). Chemical reagent strips for the diagnosis of haematuria and proteinuria have indicated to be effective for the

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screening of large populations to identify *S. haematobium* infected subjects (Mott et al., 1983b; Feldmeier et al., 1982). The present study was intended to compare the frequencies of haematuria and proteinuria between a Tanzanian and a Liberian community endemic for *S. haematobium*. The specificity and sensitivity of the dip stick tests for haematuria and proteinuria was also assessed for the two communities.

Material and Methods

Communities

The Liberian community studied comprises 3 villages (Flehla, Zeansue, Synea) of Central Liberia (Bong County), where *S. haematobium* is highly endemic (Saladin et al., 1980). The prevalence of sickel cell trait in people of the Kpelle tribe (the main tribe of the area) is 23% (Simbeye, 1979). The area is described in detail by Dennis et al. (1983) and Saladin et al. (1983). The Tanzanian community comprises a village (Kikwawila) in the Kilombero river plain (southeastern Tanzanian, Morogoro region). The area was found to be endemic for *S. haematobium* (Zumstein, 1983). The prevalence of sickle cell trait in the population of the Kilombero plain is estimated at 17%. The study area has been described in detail by Jätzold and Baum (1968) and Zumstein (1983).

Subjects

In Liberia a randomized sample of 267 children between 0 and 15 years was examined in 1980. In the Tanzanian community all the children between 0 and 15 years (N = 548) of the particular village were examined in 1982. Besides the urine examination for *S. haematobium* eggs, haematuria and proteinuria, all children underwent a comprehensive parasitological and clinical examination. The age/sex ratio of the two communities was similar.

Urine examinations

Urine was collected between 9 and 12 a.m. in plastic bags. The presence of blood and protein was semiquantitatively tested by dip sticks, i.e. for blood Sangur test (Boehringer Mannheim, FRG), for protein Albym test (Boehringer Mannheim) in Tanzania and Labstix (Ames, Stocke Pages, England) in Liberia. The Sangur test was read as following: neg. = 5 E/μl, + (5–15 E/μl), + + (30–100 E/μl, + + + (150 E/μl). The Albym- and Labstix tests were read as neg. = 0.3 g/l; + (0.3–1.0 g/l); + + (1–5 g/l), for Albym test, (1–3 g/l) for Labstix; + + + (>5 g/l) for Albym test, (>3 g/l) for Labstix.

S. haematobium eggs were detected by passing the urine through a 12 μm Nucleopore membrane (Nucleopore Corp., Plesanton CA, USA) in Tanzania or a Whatman filter (no. 3) in Liberia followed by microscopical examination of the filters as described elsewhere (Saladin et al., 1983; Zumstein, 1983).

Results

Table 1 summarizes the results of the prevalence, intensity, frequencies of haematuria and proteinuria among children between 0 and 15 years of the two communities studied. The prevalence of *S. haematobium* is relatively high in the Liberian community (70.8%) compared to the Tanzanian community with 29.6%. The intensity of infection is also higher in the Liberian community (78 vs. 28 eggs/10 ml urine). However, the frequencies for haematuria and proteinuria among *S. haematobium* infected subjects are significantly higher (Table 1,

Table 1. *S. haematobium:* prevalence, intensity, haematuria and proteinuria among two rural communities in Liberia and Tanzania, results from children between 0 and 15 years of age

	Tanzania	Liberia	χ^2
No. examined (males + females)	548	267	
S. haematobium infected (%)	162 (29.6)	189 (70.8)	
Intensity, geom. $\bar{x}$ ($\pm$ SD) (eggs/10 ml)	28 ($\pm$9)	78 ($\pm$8)	
Uninfected with haematuria (%)	42 (10.9)	10 (12.8)	A
Infected with haematuria (%)	139 (85.8)	129 (68.3)	B
Uninfected with proteinuria (%)	68 (17.6)	10 (12.8)	C
Infected with proteinuria (%)	133 (82.1)	108 (57.1)	D
Uninfected with haematuria + proteinuria	20 (5.2)	4 (5.1)	E
Infected with haematuria + proteinuria	122 (75.3)	94 (49.7)	F

Chi-square test (χ^2): A, C, E: not significant; B, D, F: 2 $p < 0.0005$

Table 2. Semiquantitative determination of haematuria with dip stick tests among *S. haematobium* infected children (0–15 years) in relation to mean egg outputs

	Haematuria (Sangur-Stick-Test)			
	negative	+	+ +	+ + +
Tanzania				
N examined**	23	12	3	124
Eggs/10 ml $\bar{x}$*	3	7	7	50
($\pm$ SD)	(3)	(5)	(7)	(8)
Liberia				
N examined**	60	37	71	21
Eggs/10 ml $\bar{x}$*	16	152	209	111
($\pm$ SD)	(6)	(5)	(6)	(8)

* $\bar{x}$ = geometric mean of eggs/10 ml urine
** No. of *S. haematobium* infected children examined

B, D, 2 $p < 0.0005$, chi-square) within the Tanzanian community. The frequencies for haematuria and proteinuria among uninfected (non *S.h.* infected) subjects are not significantly different when comparing the two communities (Table 1, A, C).

Thus, applying the dip stick technique for both communities revealed that the specificity is comparable (Table 1, haematuria 85%, proteinuria 80%) while the sensitivity showed significant differences (Table 1, haematuria 85.8% vs. 68.3%, proteinuria 82.1% vs. 57.1%). Combined measurements (haematuria + proteinuria) reflected a quite similar pattern of the two communities and revealed that the sensitivity could not be improved. Only the specificity was

Table 3. Semiquantitative determination of proteinuria with dip stick tests among *S. haematobium* infected children (0–15 years) in relation to mean egg outputs

	Proteinuria**			
	negative	+	++	+++
Tanzania				
N examined***	26	54	53	26
Eggs/10 ml $\bar{x}$*	4	10	63	324
(± SD)	(5)	(5)	(6)	(4)
Liberia				
N examined***	81	54	41	13
Eggs/10 ml $\bar{x}$*	23	110	364	476
(± SD)	(7)	(6)	(5)	(3)

* $\bar{x}$ = geometric mean of eggs/10 ml urine
** Tanzania = Albym-Stick-Test, Liberia = Labstix
*** No. of *S. haematobium* infected children examined

slightly better when applying the combined measurements (Table 1). Haematuria and proteinuria were associated with *S. haematobium* infections (Table 1) and correlated with the intensity of infection as reflected in Tables 2, 3 and Fig. 1. Tanzania children showed a high frequency of microhaematuria already at relatively low egg outputs (10 eggs 10 ml, cf. Fig. 1), while the Liberian children showed an increased frequency of haematuria and proteinuria above an egg output of 100 eggs/10 ml (Fig. 1); 64% of *S. haematobium* infected Tanzanian children excreting only between 1–10 eggs/10 ml were detected with the dip stick test for haematuria, while only 22% of the same group could be detected in Liberia with the identical technique. The dip stick test detected further 90% of all Tanzanian children with 10 eggs/10 ml compared to 60% in the range of 10–100 eggs/10 ml and 88% in the range of 100 eggs/10 ml among the Liberian children (Fig. 1). Macrohaematuria was observed in 8% (13/162) of the infected subjects in Tanzania and in 2% (4/189) of the infected subjects in Liberia. No sex related differences in respect to prevalence and intensity of *S. haematobium* infections as well as in respect to the frequencies of haematuria and proteinuria could be found in the two communities examined.

Discussion

The present comparative study between children of two communities of different *S. haematobium* endemicity demonstrates the well known positive correlation between prevalence and intensity of infection reflected by egg counts (Jordan and Webbe, 1969). Haematuria and proteinuria correlated with

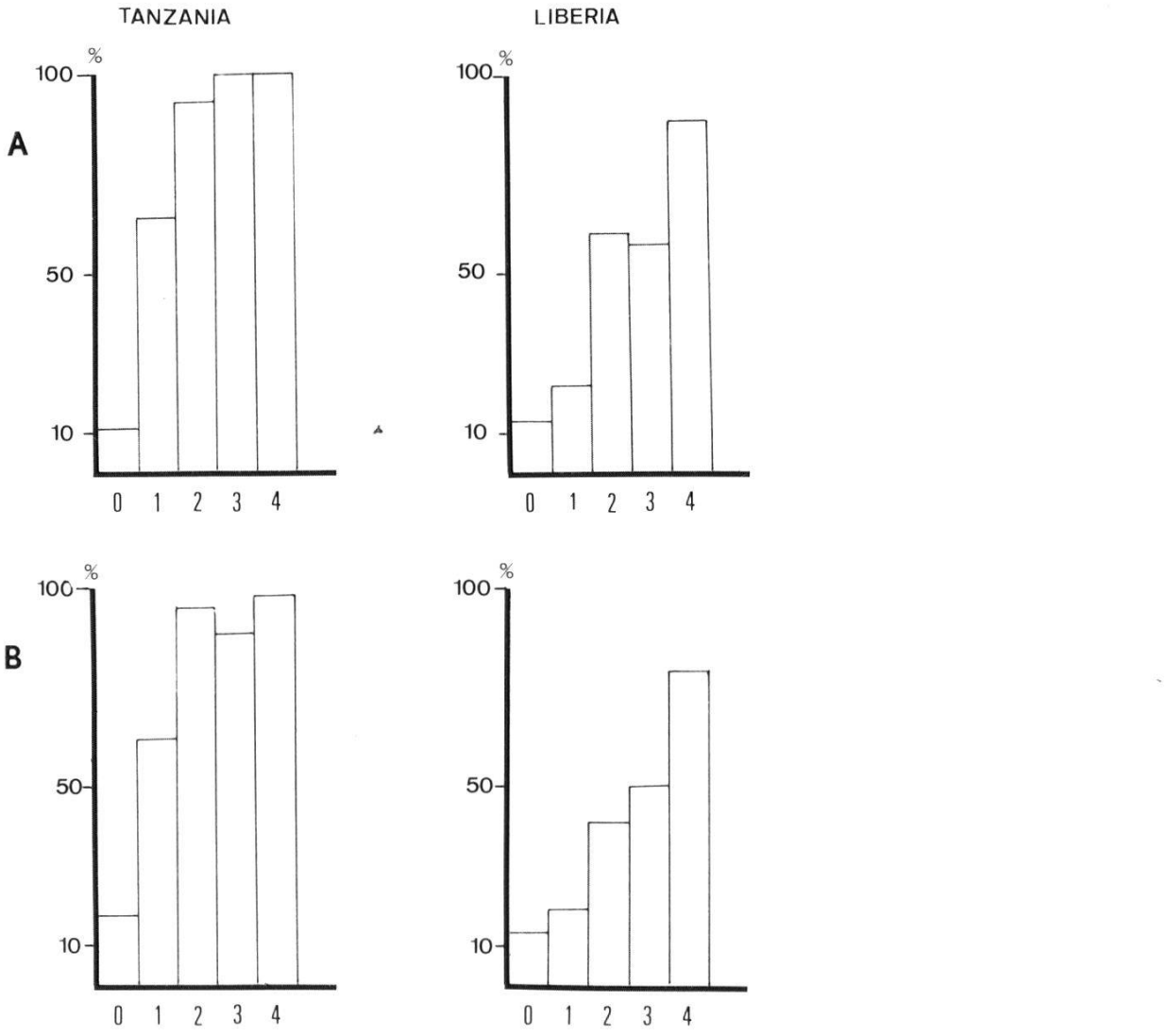

Fig. 1. Frequency of haematuria (A) and proteinuria (B) assessed by the semi-quantitative measurements with dip stick tests in relation to the intensity of *S. haematobium* infections (0 = negative, 1 = 1–10 eggs/10 ml urine, 2 = 11–50, 3 = 51–100, 4 = >100) among children of two rural communities in Tanzania (N = 548) and Liberia (N = 267).

the intensity of infection as described from other endemic areas (Briggs et al., 1971; Wilkins et al., 1979; Pugh et al., 1980; Feldmeier et al., 1982; Mott et al., 1983a).

It was interesting to note that the frequencies of haematuria and proteinuria were significantly higher in the Tanzanian community when compared to the Liberian children of the same age, although the prevalence and the intensity of infection were much higher in the Liberian community. Several studies (Warren et al., 1979; Mott et al., 1983a) have shown that the frequencies of haematuria and proteinuria correlate with the intensity of infection. This finding could be confirmed in both communities studied, but the present study demonstrated that the respective pattern of this correlation is clearly community-specific. There is no overall lower limit of the egg output, which is associated with haematuria already with low egg outputs (Fig. 1 and Zumstein, 1983).

Dip stick tests for haematuria or proteinuria and combined have been recommended to detect *S. haematobium* infections in communities (Wilkins et al., 1979; Briggs et al., 1971; Feldmeier et al., 1982; Mott et al., 1983a, b). The present study shows a good specificity of the dip stick tests for haematuria and proteinuria, but a distinct varying sensitivity when applied to two communities with different *S. haematobium* endemicity (Fig. 1). In spite of these differences, the present study also supports the idea that dip stick tests may be useful and economic tools to screen large populations for the presence of *S. haematobium* infections (Mott et al., 1983b). However, it seems that the significance of the dip stick tests has to be assessed for each endemic situation first; e.g. the dip stick tests for proteinuria and haematuria appeared effective to detect infected subjects in Tanzania while their sensitivity was low in the Liberian community.

Our results further indicate that the detection of haematuria alone is more sensitive and specific than proteinuria alone in both communities studied. Furthermore the sensitivity and specificity could not be significantly improved by combined measurements of haematuria and proteinuria (cf. Table 1). The observed differences in the frequencies of haematuria and proteinuria – also reflected in the varying sensitivity of the dip sticks tests – deserve further investigations. Haematuria and proteinuria are accepted indicators for *S. haematobium* related morbidity (Abdel-Wahab, 1982). Based on this, the observed differences between the two communities might indicate a different *S. haematobium* related morbidity pattern. Holzer et al. (1983) reported that the overall morbidity of *S. haematobium* was not striking in Central Liberia. In contrast, preliminary investigations indicate an expressed *S. haematobium* related morbidity for the Kilombero district in Tanzania (Furrer, 1981; Tanner et al., 1982). These observations support the idea that *S. haematobium* related morbidity is not alone governed by the intensity of infection reflected by egg counts. It might also be governed – besides the possibility of *S. haematobium* strain differences – by nutritional factors interrelated with the immune status and concomitant infections. This makes it further clear that observations on morbidity cannot be generalized and are only valid for the population under review.

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