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Urban transmission of urinary schistosomiasis in Dar es Salaam, Tanzania

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Summary

A cross sectional survey for *Schistosoma haematobium* infections was undertaken in 12 primary schools in the city of Dar es Salaam. The prevalence in the schools ranged from 5.3 to 55.1%, with an overall prevalence of 19.3%. More males (23.5%) than females (15.0%) were infected, and the highest prevalence was recorded in the 11–16 year age group. Intensity of infection was high, ranging from 12 to 96 eggs/10 ml urine in individual schools. 26% of the infected excreted more than 50 eggs/10 ml urine, and high rates of haematuria and proteinuria were observed in infected children. Interviews indicated that the majority of the children had acquired their infection in the city. Malacological surveys showed two potential vectors, *Bulinus (Physopsis) globosus* and *B. (Ph.) nasutus*, to be common in Dar es Salaam. Laboratory and field findings confirmed that these two species were vectors of *S. haematobium*. Factors responsible for continued transmission in this urban environment are discussed.

Key words: *Schistosoma haematobium;* urban transmission; vector snails; Tanzania.

Introduction

In large parts of the rural tropics the population is exposed to infections with schistosomiasis during everyday activities such as washing, fetching water for domestic purpose, rice farming and fishing. The human hosts contribute to continued transmission when defecating or urinating in or near fresh water where the vector snails are present.

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Urbanization affects the human living conditions and activities, and in an urban environment a reduced water contact combined with improved water supply and sanitation should reduce the risk of acquiring schistosome infections. However, only a few detailed studies of schistosomiasis under urban conditions have been conducted (Lemma et al., 1968; Ongom et al., 1974; Hira, 1974, 1975). The fast expansion of cities in the third world calls for more knowledge on this issue in order to help city planners and the city health officials to take measures to minimize or prevent schistosomiasis transmission in urban areas.

Schistosoma haematobium infections are endemic along the Tanzanian coast, whereas infections with *S. mansoni* as well as its *Biomphalaria* vectors are absent from this area (McCullough, 1972). In Dar es Salaam, a fast growing urban setting on the Tanzanian coast, efforts have been made to continuously provide expanding areas of the city with clean piped water, as well as to promote sanitation by encouraging the building and use of pit latrines.

This paper presents the results of a survey carried out in order to get an impression of the importance of *S. haematobium* transmission in the city of Dar es Salaam.

Materials and Methods

The study area

In common with other coastal climates in equatorial regions, that of Dar es Salaam can be generalized as hot and humid, with small seasonal and daily variations. Average rainfall, which is concentrated during the months of November (the short rains) and April–June (the long rains), is just under 1100 mm yearly, but there is considerable variation in rainfall from year to year.

The city is of fairly uniform relief. A feature of the city is the large number of swampy depressions and lakes, most of which are overgrown by swamp vegetation. In dry periods they contain a minimum of water or dry out completely, but during the rains they often flood the nearby ares. Also, a network of small streams and canals cut through the city, most of which drain off to the Indian Ocean via the Msimbazi creek.

The population of Dar es Salaam has increased from 0.3 million in 1970 to 1.3 million in 1981. The localities surveyed in the study were originally planned settlements, but with increasing migration into the city and expansion of industry, unplanned settlements have grown around these areas. All areas, however, have been provided with water in outdoor standpipes, largely satisfying the need for clean water for domestic purpose, and pit latrines are in common use. Throughout the city area, except for the city centre, gardening and small scale farming is practised, the main crops being vegetables, cassava, bananas, maize and rice.

Examination of schoolchildren

A survey for urinary schistosomiasis was conducted in 12 primary schools in the city of Dar es Salaam (Fig. 1). From each school, approximately 200 schoolchildren were selected equally representing all classes from standard one to seven (age range 7 to 19 years) and both sexes. Urine specimens were collected from these children between 9.00 and 13.00 h and 10 ml was examined for *S. haematobium* eggs using the syringe filtration technique (Mott, 1983). Further, each child was interviewed about age, sex, place of residence and travel activities.

405 urine specimens from two primary schools were examined for protein and blood using urinanalysis reagent strips (N-Multistix, Ames).

Malacological studies

Over a 1½ year period (September 1982–February 1984) several different types of water bodies, representing the areas of the surveyed schools, were periodically searched for molluscs using a scoop. Snails found were taken to the laboratory for identification and further studies. Some samples were sent to the Danish Bilharziasis Laboratory, Denmark, for confirmation of the identifications. In the laboratory, individual *Bulinus* sp. snails were examined for infection by exposing them to artificial light and looking for cercarial emergence.

Results

Schools and waterbodies surveyed in the study are indicated in Fig. 1. A total of 2418 schoolchildren (1195 males and 1223 females) were examined for *S. haematobium* infection. The overall prevalence was 19.3% and significantly more males (23.5%) than females (15.0%) were infected ($\chi^2 = 28.42$; df = 1; $p < 0.01$). Highest prevalence was recorded in the 11–16 year age group. 68.9% of the infected children denied having left the city.

Results from the individual schools are shown in Table 1. The prevalence varied from 5.3 to 55.1% and intensity from 12.3 to 96.4 eggs/10 ml urine. Statistical analysis showed a positive correlation between prevalence and intensity in the twelve schools (correlation coefficient 0.646; df = 10; $p < 0.01$). Highest prevalence and intensity were recorded from Kigogo Primary School.

26.7% of the infected schoolchildren excreted over 50 eggs/10 ml urine and 12% excreted over 200 eggs/10 ml urine. During collection of the urine specimens in the schools, visible haematuria was frequently seen, especially in schools with high prevalence, and examination of 405 urine specimens (from Magomeni and Makurumla Primary Schools) with urinanalysis reagent strips showed that infected children had a very high prevalence of haematuria and proteinuria when compared to non-infected children (Table 2).

Table 3 lists the various fresh water molluscs that were found during the malacological survey, and indicates the habitats occupied by the molluscs. The areas drained by the Msimbazi River system were rich in molluscan fauna, whereas areas north and south of this river system harboured fewer snails and snail species (Fig. 1 and Table 3).

Bulinus (Ph.) nasutus and *B. (Ph.) globosus* shedding cercariae of the mammalian type were found at location C and L (Fig. 1) respectively.

Molluscs of the genus *Bulinus* from Dar es Salaam were reared in the laboratory, and the first generation individually exposed to *S. haematobium* miracidia, to find out the potentiality of these snails as vectors of *S. haematobium*. The experiments showed *B. (Ph.) globosus* and *B. (Ph.) nasutus* to be susceptible to infection, and to be able to support cercarial production.

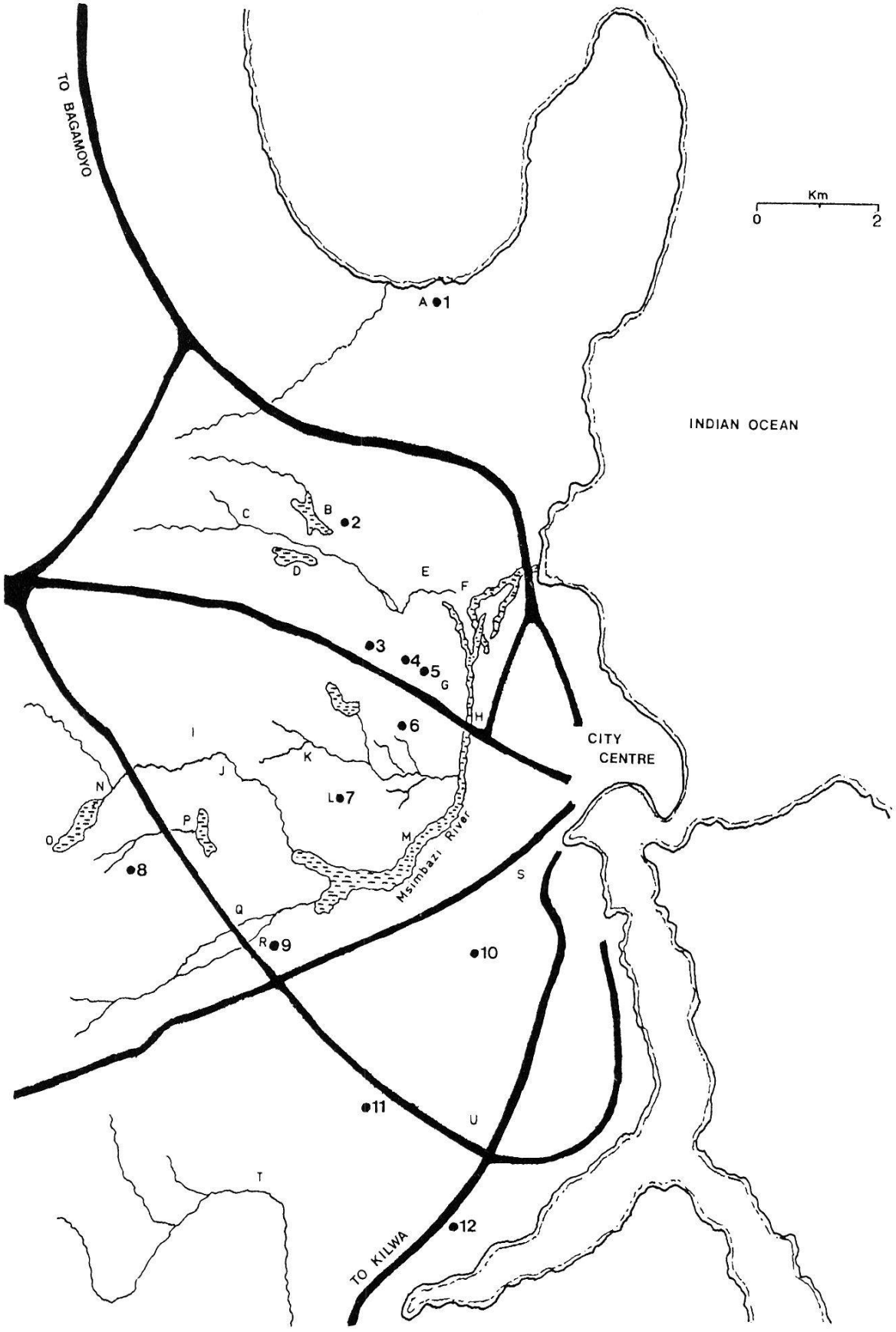

Fig. 1. Map of Dar es Salaam showing location of surveyed schools and areas surveyed for snails (● 1–12 schools surveyed; A-U: snail survey areas).

Table 1. Results of survey for urinary schistosomiasis in the 12 primary schools in Dar es Salaam

School	No. examined	No. infected	% infected	% of infected who never left the city	Intensity*
1. Msasani	186	23	12.3	82.6	27.7
2. Mwanyanamala	171	36	21.0	88.4	22.6
3. Makurumla	275	30	10.9	56.6	21.6
4. Turiani	264	37	14.0	59.4	12.3
5. Magomeni	204	30	14.7	70.0	17.3
6. Mzimuni	206	36	17.4	58.3	89.9
7. Kigogo	205	113	55.1	91.1	96.4
8. Tabata	157	67	42.6	82.0	35.4
9. Buguruni	198	31	15.6	64.5	26.0
10. Keko	187	10	5.3	40.0	18.0
11. Tandika	174	22	12.6	63.6	15.6
12. Mtoni	191	31	16.2	67.7	17.9
Total	2418	466	19.3	68.9	33.4

* geometric mean of eggs per 10 ml urine

Table 2. Examination of urine for protein and blood using dip sticks (Magomeni and Makurumla Primary Schools)

No. schoolchildren examined	405
% infected with *S. haematobium*	13.8
Intensity (geometric mean eggs/10 ml urine)	19.0
% infected with proteinuria	62.0
% uninfected with proteinuria	20.9
% infected with haematuria	64.2
% uninfected with haematuria	9.1

Discussion

The survey conducted for urinary schistosomiasis established that *S. haematobium* infections were common in schoolchildren in the city of Dar es Salaam. The high intensity of infection and the related morbidity expressed in the frequency of protein and blood in urine should be of serious concern to city health officials.

Prevalence and intensity of infection corresponds well to results from surveys carried out in urban schools in Tanga, another coastal town in Tanzania (Bailey and Davis, 1970), as well as in rural schools in other endemic areas of Tanzania (Forsyth and Bradley, 1966; Bailey and Davis, 1970; Rugemalila, 1979; Zumstein, 1983).

Table 3. Results of malacological survey in Dar es Salaam

Location	*Bulinus (Ph.) nasutus*	*B. (Ph.) globosus*	*B. forskali*	*Lymnaea natalensis*	*Pila ovata*	*Lanistes ovum*	*Melanoides tuberculata*	*Ceratophallus natalensis*	*Lentorbis jonodi*	*Afrogyrus coretus*	Description of habitat
A											salt marshes
B	×										rain pool
C	×		×			×					permanent pond
D	×			×	×		×				temporary stream
E	×			×							swamp
F	×					×					temporary pond
G		×	×	×		×	×	×			permanent ditch
H			×				×	×			rain pool
I	×					×					temporary stream
J	×					×	×				temporary pond
K		×		×							stream
L		×	×								temporary pond
M						×	×				river
N	×				×	×	×				stream
O				×							swamp
P			×		×	×		×			stream
Q			×	×		×				×	stream
R	×		×						×		permanent ditch
S				×			×				swamp
T		×		×			×				swamp
U				×		×					roadside ditch

Interviews with the schoolchildren indicated that most of them had acquired their infection in the city, and the finding of infected snails supports the impression that transmission takes place in Dar es Salaam.

Of the fresh water molluscs found during the malacological survey, *B. (Ph.) globosus* and *B. (Ph.) nasutus* are known to be vectors of *S. haematobium* in East Africa (Teesdale, 1954, 1962; Blair, 1956; MacLean et al., 1958; Webbe, 1959; McCullough et al., 1968). *B. (Ph.) africanus*, another vector in East Africa, has previously been reported from location T (J. Jelnes; pers. comm.), but was not found during this survey. Snails of the *B. forskali* complex were commonly found during the survey. Members of this group transmit *S. bovis* in E. Africa, but not human schistosomes (Christensen et al., 1983).

In susceptibility experiments in the laboratory it was possible to infect *B. (Ph.) globosus* and *B. (Ph.) nasutus* from Dar es Salaam with *S. haematobium* indicating that they both could act as intermediate hosts. Infected *B. (Ph.) globosus* and *B. (Ph.) nasutus* were found in the field and can therefore be regarded as being the intermediate hosts for *S. haematobium* in Dar es Salaam.

B. (Ph.) globosus was found in stagnant, fairly slow flowing polluted streams close to human habitations. Other workers have also reported finding

this snail in similar habitats (Blacklock and Thompson, 1924; Gerber, 1952). *B. (Ph.) nasutus* was found in residual pools in stream beds and roadside ditches of seasonal duration. This snail has been shown to be associated with similar habitats in other parts of Tanzania (Webbe and Msangi, 1958; Webbe, 1962; Webbe and Jordan, 1966). Aestivating snails were commonly observed during the dry season in temporary waterbodies and probably account for the sudden appearance of large snails as soon as the first rains started.

Few waterbodies in Dar es Salaam are free of the intermediate hosts of *S. haematobium*. The snails appear to be well adapted to the city environment. Most of the areas surveyed would experience flooding due to storm water drains emptying into these areas. In addition to this the snails seem to tolerate chemical pollution from factories which discard their waste into the rivers and streams.

During the field work numerous situations were seen which could account for transmission. In many parts of the city, especially during the hot hours of the day, boys were seen playing in streams and ponds. This, may account for the higher prevalence observed in boys.

Although communal piped water is provided in Dar es Salaam, some people find it more comfortable to carry their laundry to nearby streams, than to carry the water home. Also, frequent water shortages in the city resulted in people going to streams and ponds to fetch water, to wash clothes and bath. Rice farming, floods during the rainy season and the necessity of crossing rivers and streams where there are no bridges were other factors observed which frequently brought the city population into contact with water.

Therefore provision of piped water and promotion of sanitation alone does not control transmission of *S. haematobium* in cities located in endemic schistosomiasis areas. City health officials and city planners should take into consideration many other factors which contribute to transmission such as those mentioned above. Also school teachers have a major role to play in educating children regarding the disease, if *S. haematobium* infections in cities are to be controlled.

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Bailey D. R., Davis A.: The prevalence and intensity of *Schistosoma haematobium* in primary schoolchildren of Tanga, Tanzania. E. Afr. med. J. *47*, 106–117 (1970).

Blacklock D. B., Thompson M. G.: Human schistosomiasis due to *Schistosoma haematobium* in Sierra Leone. Ann. trop. Med. Parasit. *18*, 211–234 (1924).

Blair D. M.: Bilharziasis survey in British West and East Africa, Nyasaland and the Rhodesias. Bull. Wld Hlth Org. *15*, 203–273 (1956).

Christensen N. O., Mutani A., Frandsen F.: A review of the biology and transmission ecology of African bovine species of the genus *Schistosoma*. Z. Parasitenk. *69*, 551–570 (1983).
Forsyth D. M., Bradley D. J.: The consequences of bilharziasis, medical and public health importance in north-west Tanzania. Bull. Wld Hlth Org. *34*, 715–735 (1966).
Gerber J. H.: Bilharzia in Boajibu Parts 1 and 11. J. trop. Med. Hyg. *55*, 52–58, 79–93 (1952).
Hira P. R.: *Schistosoma haematobium* in Lusaka, Zambia. Trop. geogr. Med. *26*, 160–169 (1974).
Hira P. R.: Seasonal population densities of snails transmitting urinary and intestinal schistosomiasis in Lusaka, Zambia. Trop. geogr. Med. *27*, 83–92 (1975).
Lemma A., Demisse M., Mesengia B.: Parasitological survey of Addis Ababa and Debre Zeit schoolchildren with emphasis on bilharziasis. Eth. med. J. *6*, 61–67 (1968).
MacLean G., Webbe G., Msangi A. S.: A report on a bilharzia and molluscan survey in the Tanga district of Tanganyika. E. Afr. med. J. *35*, 7 (1958).
McCullough F. S.: The distribution of *Schistosoma mansoni* and *Schistosoma haematobium* in East Africa. Trop. geogr. Med. *24*, 199–207 (1972).
McCullough F. S., Eyakuze V. M., Msinde J., Nditi H.: Water resources and bilharziasis transmission in the Misungwi area, Mwanza District, North West Tanzania. E. Afr. med. J. *45*, 295–308 (1968).
Mott K. E.: A reusable polyamide filter for diagnosis of *Schistosoma haematobium* infection by urine filtration. Bull. Soc. Path. exot. *76*, 101–104 (1983).
Ongom V. L., Kahwa I., Zaramba S. M., Katende J.: *Schistosoma mansoni* infection in Kampala. E. Afr. J. med. Res. *1*, 135–138 (1974).
Rugemalila J. B.: Study on morbidity and intensity of *Schistosoma haematobium* infection. Trop. geogr. Med. *31*, 375–380 (1979).
Teesdale C.: Freshwater molluscs in the coast province of Kenya with notes on an indigenous plant and its possible use in the control of bilharziasis. E. Afr. med. J. *31*, 351–365 (1954).
Teesdale C.: Ecological observations on the molluscs of significance in the transmission of bilharziasis in Kenya. Bull. Wld Hlth Org. *27*, 759–782 (1962).
Webbe G.: A bilharzia and molluscan survey in the Handeni and Korogwe districts of Tanganyika. J. trop. Med. Hyg. *62*, 37–42 (1959).
Webbe G.: The transmission of *Schistosoma haematobium* in an area of Lake Province, Tanganyika. Bull. Wld Hlth Org. *27*, 59–85 (1962).
Webbe G., Jordan P.: Recent advances in knowledge of schistosomiasis in East Africa. Trans. roy. Soc. trop. Med. Hyg. *60*, 279–306 (1966).
Webbe G., Msangi A. S.: Observations on three species of Bulinus on the East Coast of Africa. Ann. trop. Med. Parasit. *52*, 302–325 (1958).
Zumstein A.: A study of some factors influencing the epidemiology of urinary schistosomiasis at Ifakara (Kilombero District, Morogoro Region, Tanzania). Acta trop. (Basel) *40*, 187–204 (1983).