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Schistosoma mansoni in infants (aged <3 years) along the Ugandan shoreline of Lake Victoria

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In two complementary epidemiological surveys of villages on the Ugandan shoreline of Lake Victoria, the putative occurrence of intestinal schistosomiasis in the local infants (children aged <3 years) was investigated. When, during the first survey, 136 mother-and-infant pairs from a total of 12 villages were studied, only 7% of the infants but 45% of the mothers were found to be egg-patent for *Schistosoma mansoni* infection. The use of dipstick tests for urine-circulating cathodic antigen indicated, however, a much higher prevalence, of approximately 40%, among the infants.

In the second survey, urine samples and multiple, not single, stool samples were collected from another 19 mother-and-infant pairs in two of the 12 study villages (Bugoto and Bwondha), and a standardized questionnaire was implemented. The prevalence of egg-patent infection was then found to be markedly higher in the study infants from Bugoto (86%) than in those from Bwondha (25%). A greater level of mother-and-infant water contact, a higher abundance of (infected) *Biomphalaria choanomphala*, and an unusual lakeshore topology may explain why *S. mansoni* infection was so much more common in the Bugoto subjects than in the Bwondha. All but one of the infants studied in the second survey were found to be anaemic (with <110 g haemoglobin/litre). Taken together, these children were less likely to be found infected with hookworm (16%), *Hymenolepis nana* (11%) or *Trichuris trichiura* (5%) than with *S. mansoni* (47%).

Infection with the parasites causing intestinal schistosomiasis can be common among the infants living in these lakeshore villages. Although the immediate and later-life clinical impacts of such infection have yet to be elucidated, such infants would probably benefit from regular de-worming. Mothers should be strongly encouraged to visit the nearest health-services clinic, with their infants, for any necessary anthelmintic treatment.

Human schistosomiasis is of considerable public-health importance in Africa, with *Schistosoma mansoni* the most geographically wide-spread of the causative agents (Chitsulo *et al.*, 2000; Savioli *et al.*, 2004; Southgate *et al.*, 2005). In Uganda, *S. mansoni* is endemic along many of the shorelines of the great East African lakes, and human infection with this parasite can be almost universal in some of the lakeshore villages (Kabatereine *et al.*, 1992, 2004; Stothard *et al.*, 2005). Most previous studies on *S. mansoni* in this area have focused on the general prevalence and intensity of human infection and the associated disease burdens before and after treatment

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(Kabatereine *et al.*, 1999, 2003; Vennervald *et al.*, 2005). Surprisingly little attention has been given to the pre-school children, particularly those aged <3 years, who live on the lakeshore. Children in this very young age-class are often thought to have too little contact with water carrying schistosome cercariae (e.g. while swimming and playing) to place them at any significant risk of infection (Jordan and Webbe, 1993). The general belief is that it is only as a child's mobility and confidence in the water develop that exposure to schistosome-infested water increases and infections are cumulatively acquired (Jordan and Webbe, 1993). While this may often be the case, the levels of passive water contact experienced by infants, as they are washed and bathed by their mothers, should not be ignored. Such contact may place infants at significant risk of infection, especially when the bathing water is freshly drawn directly from water bodies that are infested with cercariae. It may explain why, in Niger, for example, up to 14% of children aged <4 years may have patent *S. haematobium* infections (Pérel *et al.*, 1985).

Both in terms of transmission reduction and the dynamics of morbidity, interest is again increasing in schistosome infections acquired at such a very early age (Mafiana *et al.*, 2003). Bosompem *et al.* (2004), for example, found that the child-bathing practices in certain locations in Ghana passively placed infants at significant risk of infection and therefore even pre-school children should be considered for regular chemotherapy. Along the Ugandan shoreline of Lake Victoria, shaft wells and pit latrines often collapse because of their poor construction and the very soft lakeside soils, and these failures not only leave the lake as the main source of water for the lakeshore communities but also increase the faecal contamination of the lakewater. The image shown in Figure 1 is typical of the local bathing practices of mothers and their infants from these impoverished lakeshore villages. Unfortunately, despite the probably high levels of transmission that result from bathing in the lakewater, there are no recent data on the prevalence of intestinal schistosomiasis within the infants who live on the lakeshore. Such young children can be difficult to investigate, particularly using standard parasitological methods that have low sensitivities for the detection of schistosome infection. Schistosome-control programmes have therefore often been focused on older children, especially on school-aged children who can be accessed

FIG. 1. Mother-and-child bathing practices along the Ugandan shoreline of Lake Victoria can place infants at increased risk of passive exposure to schistosome-infested water. This girl (aged 18 months), who, for fear of drowning, has perhaps never yet fully entered the lake on her own, is passively exposed to schistosome cercariae by being regularly bathed, either by her mother or an older sister, in a basin filled with freshly-drawn lakewater.

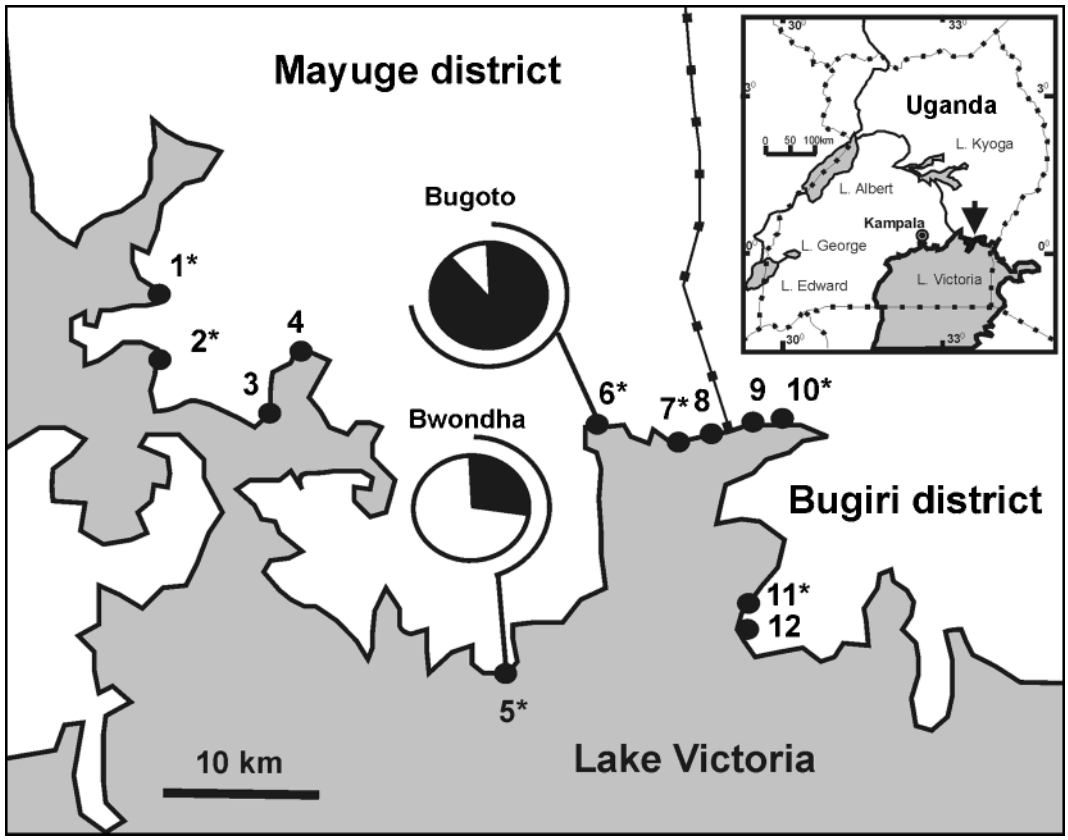

FIG. 2. A schematic map of Uganda (inset) and a more detailed map showing the locations of the lakeshore villages, of Walumbe (1), Nakalano (2), Kapaluko (3), Lwanika (4), Bwondha (5), Bugoto (6), Musubi (7), Kitumbezi (8), Nabyama (9), Wakawaka (10), Bumeru A (11) and Bumeru B (12), that were visited in one or both surveys. Each village in which at least one infant with an egg-patent *Schistosoma mansoni* infection was found is indicated with an asterisk (*). The prevalences of such infection recorded in 2004, in the infants (pie-charts) and their mothers (outer circle segments around pie-carts) from Bwondha and Bugoto, are depicted.

relatively easily, using school-based resources (Montresor *et al.*, 2002; Utzinger *et al.*, 2003; Savioli *et al.*, 2004).

The main aim of the present study was to draw attention to, and clarify, the occurrence of *S. mansoni* infection among infants (here defined as children aged <3 years) living along the Ugandan shoreline of Lake Victoria. Two complementary epidemiological surveys were conducted; the first to make a preliminary assessment across a relatively wide geographical area and the second to hone the initial findings, using a more robust (and labour-intensive) protocol for the detection of *S. mansoni* infection.

SUBJECTS AND METHODS

Participants and Study Design

The shorelines of Lake Victoria that fall within the Mayuge and Bugiri districts of south–eastern Uganda (Fig. 2) formed the study area. Two complementary surveys of mother-and-infant pairs were conducted in some of the lakeshore villages in this area.

FIRST SURVEY

The aim of the first survey, in September 2003, was to get only an initial idea of the geographical spread of the infection. Mother-and-infant pairs from 12 villages

(Fig. 2) were therefore investigated but only using a single stool sample (to detect egg-patent *S. mansoni* infections) and a single urine sample from each subject. The latitude and longitude of each study village were recorded using a handheld global-positioning system (eTrex; Garmin International, Olathe, KS). The inclusion criteria, which (during ad-hoc focus-group sessions) were carefully explained to interested mothers within each village, were that the mothers should have lived within a study village for at least 1 year, the associated infant(s) were to be aged between 5 and 36 months, and all of the subjects had to live within easy reach of the lakeshore. Overall, 136 consenting mother-and-infant pairs were selected, to give similar numbers of girls and boys. Each pair was given four specimen containers for the collection of stool samples (one from the mother and one from the infant) and urine samples (again, one from the mother and one from the infant) on the following day. A single 41.7-mg Kato–Katz thick smear was prepared (Katz *et al.*, 1972) from each stool specimen. The *S. mansoni*, hookworm, *Ascaris lumbricoides*, *Trichuris trichiura* and *Hymenolepis nana* eggs in each smear were then identified and counted under a light microscope (WHO, 2004). Each urine sample from an infant was tested for the urine-circulating cathodic antigen (CCA) of *S. mansoni*, using commercial dipstick tests (BV European Veterinary Laboratory, Woerden, The Netherlands, Holland) according to the manufacturer's instructions. No attempts were made to detect *S. haematobium*, which is not endemic in the study area.

SECOND SURVEY

To confirm the initial survey's findings, of infections within infants, two of the villages included in the first survey, Bwondha and Bugoto, were selected for a further survey, using a more comprehensive set of diagnostic procedures, in July 2004. In July 2003, immediately prior to the commencement of annual rounds of mass chemotherapy in the local schools, 86% of pupils in the primary school at Bwondha and 90% of those in the primary school at Bugoto had been found to be excreting *S. mansoni* eggs, with geometric mean intensities of 155 and 162 egg/g faeces, respectively (Stothard *et al.*, 2005). It was therefore assumed that, at the time of the second survey in the present study, the two villages were similar in terms of the local endemicity of *S. mansoni*. Owing to local difficulties in availability, only 19 consenting mother-and-infant pairs (12 from Bwondha and seven from Bugoto) were recruited for the second survey, with some selection to give similar numbers of male and female infants and to avoid the re-investigation of any villager included in the first survey.

PARASITOLOGY. Each of the mother-and-infant pairs recruited was given eight specimen containers, for the daily collection of stool samples from each subject on each of three consecutive days and the collection of a single urine sample from each subject on the final day. Duplicate Kato–Katz thick smears were prepared from each stool specimen, and each stool sample was also checked for parasite eggs by formol–ether concentration, using approximately 1 g faeces (WHO, 2004). A subject was designated 'infected' if at least one *S. mansoni* egg was detected in any of his or her stool samples. Intensity of infections were classified, according to the World Health Organization's guidelines (WHO, 1998), using the arithmetic mean number of eggs seen in the six Kato–Katz smears prepared for each subject.

All the urine samples, whether from the mothers or their infants, were checked with dipsticks for CCA.

HAEMATOLOGY. To make a preliminary assessment of the clinical significance of the intestinal helminth infections observed at Bwondha and Bugoto, a fingerprick sample of blood was collected from each subject. The haemoglobin concentrations in these blood samples were then determined, using a portable HemoCue® photometer (HemoCue, Ängelholm, Sweden)

according to the manufacturer's instructions. Mothers who had <120 g haemoglobin/litre were considered to be anaemic (WHO, 1998).

FAECAL BLOOD. To determine if occult blood was present in the subjects' stools, a Hemoccult® test (Beckman Coulter, Fullerton, CA) was performed on the third-day stool specimen from each subject. In these tests, a faecal sample with visible blood, taken from a heavily infected schoolchild from Bwondha, was used as a positive control.

CASE-HISTORY QUESTIONNAIRE. On the final day of sample collection, a short interview with a standardised case-history questionnaire was administered to each mother investigated, to help determine the mode of transmission of *S. mansoni* to infants and gather information on the mothers' knowledge, attitudes and practices towards schistosomiasis. The questionnaire was designed to determine the level and patterns of water contact for the mothers and their infants, in relation to washing and bathing activities, the length of contact for each activity, and the total amount of time spent/day, by each subject, at the lake. Questions pertaining to the health of the mother and child, and questions exploring the health-seeking behaviour of the mother, were also asked. The questionnaire was administered with the help of an officer from the local vector-control division who was fluent in the locally-used Bantu languages. (The questionnaire forms are available, upon request, from the corresponding author.)

MALACOLOGY

Malacological surveys were conducted in July 2003 and July 2004 at Bwondha and Bugoto, using a timed-search collecting strategy of 60 min/site on each occasion. Any *Biomphalaria* collected were placed in pots (with one snail/pot) and exposed to sunlight so that those shedding cercariae could be identified.

Ethical Considerations and Anthelmintic Treatment

Ethical approval for the study (application 03.36) was granted by the National Health System Local Research Ethics Committee of St Mary's Hospital, London, the Ugandan Ministry of Health, Kampala, and the Ugandan National Council of Science and Technology, Kampala. The members of the study communities were informed of the objectives, requirements and duration of the study in focus-group discussions before the informed consent of each adult villager, including the mothers of each enrolled infant, was obtained, either as a signature or a thumbprint in indelible ink.

Each subject found to be infected with *S. mansoni* or another helminth was given the appropriate anthelmintic medication after the collection of the final study samples, and was observed to swallow the tablets soon after ingesting some food. The mother of each infant found infected with *S. mansoni* was provided with an appropriate amount of praziquantel (40 mg/kg) in tablet form. The tablets for each infant were crushed and dissolved in flavoured glucose syrup (10 ml), which was then spoon-fed to the child. If necessary, the infant was also provided with a single (400 mg) albendazole tablet to chew. Each drug treatment was supervised and each treated subject was visited 1 day post-treatment, to see if he or she had experienced any adverse effects.

RESULTS

Parasitology

FIRST SURVEY

At each of the villages included in the first survey, the number of mother-and-infant pairs recruited varied according to their local availability, from 22 pairs at Walumbe to just five at Kapaluko. Overall, 136 pairs, with slightly fewer boys (48%) than girls (52%), were examined. The mean age of the infants investigated was 17.8

months. Examination of the faecal smears revealed that 45.4% of the mothers and approximately 7% of the infants (none aged <12 months) had egg-patent *S. mansoni* infections. A 30-month-old girl from Wakawaka was found to have 156 eggs/g faeces but every other *S. mansoni* infection detected was of light intensity (i.e. with <100 eggs/g).

Of the other intestinal helminths detected in the infants, hookworm (5.8%) was by far the most common, with *T. trichiura*, *A. lumbricoides* and *H. nana* each detected at a prevalence of about 0.7%. Of the mothers investigated, 58.2%, 1.4%, 0.7% and none were found positive for hookworm, *T. trichiura*, *A. lumbricoides* and *H. nana*, respectively.

Compared with the results of examining faecal smears, the testing of urine samples for CCA indicated a much higher prevalence of *S. mansoni* infection in the infants, of almost 40%. The youngest infant found CCA-positive was a 5-month-old boy from Kitumbezi, whose mother had egg-patent *S. mansoni* infection. Unfortunately, at the time of the first study, there were not enough CCA dipsticks available to test the mothers.

SECOND SURVEY

To confirm if the prevalence of *S. mansoni* infection in infants was consistent with that indicated, in the first survey, by the tests with the CCA dipsticks, an additional survey was conducted in July 2004. This second survey, on 19 mother-and-infant pairs who had not been included or treated in the earlier study, involved much more comprehensive searches for *S. mansoni* infections. Each subject provided three stool samples and one urine sample, with each stool sample being checked twice as separate Kato–Katz smears and once by formol–ether concentration, and every urine sample being checked for CCA.

The infants investigated, 58% of whom were male, had a mean age of 20.8 months. The examination of the Kato–Katz smears revealed egg-patent *S. mansoni* infections in 85.7% of the Bugoto infants and 25% of the Bwondha [Yates' $\chi^2=4.328$; degrees of freedom (df)=1; $P=0.037$], and in 71.4% of the Bugoto mothers and 28.6% of the Bwondha (Yates' $\chi^2=2.237$; df=1; $P=0.134$). With the exception of a single Bugoto infant, who had an infection of moderate intensity, all the infected infants detected had light infections. The geometric mean intensities of the egg-patent infections detected in the mothers were 78.1 eggs/g at Bugoto and 141.7 eggs/g at Bwondha.

The results of the dipstick testing of the urine samples indicated that 71.4% of the Bugoto infants, 50.0% of the Bwondha infants, 85.7% of the Bugoto mothers and 41.6% of the Bwondha mothers were CCA-positive.

If only the egg-patent (i.e. unequivocal) infections are considered, the general prevalence of *S. mansoni* infection in the infants investigated in the second survey was 47.4%. The prevalences of the other helminth infections recorded in these infants were 16% for hookworm, 11% for *H. nana*, 5% for *T. trichiura* and zero for *A. lumbricoides*.

Associations

Taking the data from the two surveys together, the odds ratio of an infant with an egg-patent *S. mansoni* infection having a mother similarly infected was 3.57 [95% confidence interval (CI)=0.9–14.1], which was statistically significant (z-statistic=-1.78; $P=0.036$). Although a female infant was found to be more likely to have an egg-patent *S. mansoni* infection than a male infant, the corresponding odds ratio, of 1.27 (CI=0.5–3.6), was not statistically significant ($P>0.05$).

Haemoglobin

The mean blood haemogloblin concentrations recorded in the infants were 99 g/litre (CI=$\pm$6.9) at Bugoto and 96 g/litre (CI=$\pm$10.6) at Bwondha. The lowest

concentration encountered in an infant was 60 g/litre, which was observed in a 6-month-old (egg-negative but CCA-positive) girl from Bwondha. The haemoglobin concentrations recorded in the mothers were generally higher, with means of 128 g/litre (CI= ±6.6) at Bugoto and 123 g/litre (CI= ±9.5) at Bwondha, although 14% of the Bugoto mothers and 50% of the Bwondha were still considered anaemic.

Faecal Blood

No occult blood was found in any stool specimen from any subject of the second survey.

Questionnaire

All the mothers interviewed affirmed that they washed their infants either at the lakeside or at home using a basin filled with water directly from the lake. Soap was frequently used for bathing and the majority of infants were bathed at least twice a day, often in the early morning and the late afternoon. The proportion of infants being taken to the lake by their mothers differed slightly between Bugoto (71.4%) and Bwondha (66.6%) — as Bwondha is situated some 30–40m above the lake whereas Bugoto is only 4–5 m above, it is, presumably, harder to carry a child to the lake from Bwondha.

The recalled duration of daily water contact for the mothers differed with the study village, with means (S.D.) of 28 (15) min at Bugoto and 10 (7) min at Bwondha. All of the mothers were unable to provide a clear description of what 'bilharzia' was or how it was caught and all appeared to know nothing of the preventive measures. Although the majority of mothers reported having repeated bouts of diarrhoea, abdominal pain and blood in stool and urine, a preliminary multiple regression analysis of these findings against infection status revealed no clear association with *S. mansoni*, and further analysis was not pursued.

Malacology

At Bugoto, in each of the two snail surveys, *Biomphalaria* snails (all *Bi. choanomphala*) were plentiful (approximately 200 were collected) and, when exposed to sunlight, about 7% released cercariae. At Bwondha, in contrast, only three or five *Biomphalaria* (again all *Bi. choanomphala*) were collected during each survey and none shed any cercariae (see Table).

Treatment

Although cumbersome and time-consuming, the dispersal of praziquantel tablets in glucose syrup for the treatment of infants by spoon-feeding proved to be very effective, well tolerated and without any immediate rejection of the medication. Compliance with the sweet-tasting albendazole tablets was also uneventful. No adverse reactions were recorded, within a day of treatment, in the infants. When questioned on the day following their treatment, the treated

TABLE 1. *An ad-hoc comparison between the Bugoto and Bwondha environments*

	Bugoto	Bwondha
Lakeshore profile (shallow shelving)	+++	+
Proximity to *Vallisneria* reed beds (closeness)	+++	+
Abundance of *Biomphalaria choanomphala*	+++	+
Shedding of cercariae by *Bi. choanomphala*	+	−
Proximity to pit latrines (closeness)*	++	−

*Although pit latrines were in place on the immediate Bugoto shoreline, these were non-functional, and the surrounding area was regularly used by younger children for defecation. As a consequence, schistosome eggs could be washed by rain into the lake, further intensifying contamination.

mothers reported having had mild abdominal pain, nausea and diarrhoea, but, given the infection status and general symptoms of these women, its unclear if these symptoms should be categorized as the adverse effects of treatment.

DISCUSSION

Taken together, the present results clearly show that children aged <3 years who live close to the northern shores of Lake Victoria are at very great risk of becoming infected with *S. mansoni*, with many such infants already excreting the trematode's eggs. As recorded in the questionnaire-based interviews with the mothers, such infections are probably acquired by the children's passive exposure to schistosome-infested water, when they are bathed in lake water by their mothers.

The schistosome infections in the infants are of concern for at least two reasons. Firstly, infected infants might play a hitherto unrealised role in maintaining local disease transmission. Though their infections tend to be less intense than those seen in their older neighbours, many such infants have regular, often multiple, daily contact with the lake and many have their soiled clothes rinsed and washed in the lake, adding to the *S. mansoni* eggs that contaminate the lake. While the majority of mothers reported using soap when bathing their infants — which presumably helps to protect the infants from cercarial penetration — there were occasions when soap was not used because of local shortages. Secondly, it remains unclear whether active infections acquired in very early childhood aggravate or attenuate the immediate or long-term clinical impact of *S. mansoni* infection. Some school-aged children from these lakeside environments can have very severe clinical forms of intestinal schistosomiasis, as illustrated by the child from Bwondha shown in Figure 3. It may well be that infection during early infancy plays some role in determining the spectrum of subsequent morbidity. Sub-clinical infection with intestinal parasites has been proposed as a major contributor to linear growth retardation in infants (Lunn, 2000) and it may be that *S. mansoni* also contributes towards this economic and healthcare burden (Martorell *et al.*, 1994).

FIG. 3. An unusually advanced and visually striking case of intestinal schistosomiasis in a 11-year-old child from Bwondha, with obvious hepato–splenomegaly. Given the detection of infant infections in the same village, the duration of infection in this child, which would commonly be assumed to be 4–5 years, might have been much longer, perhaps of 8–9 years, and this might better explain the well-developed morbidity.

The transmission of *S. mansoni* is known to be focal, even within an area that is highly endemic (Kabatereine *et al.*, 2004). The statistical imbalance between the prevalence of egg-patent infection recorded in the infants from Bugoto (85.7%) and that in the infants from Bwondha (25.0%) is perhaps yet another manifestation of this heterogeneity, albeit in a very young, naïve age-group. Curiously, the prevalence (and intensity) of *S. mansoni* infection in local school-age children was recently found to be almost the same in Bwondha (86%) as in Bugoto (90%) (Stothard *et al.*, 2005). Examination of the characteristics of these two villages revealed several notable differences that may effect levels of transmission to infants (see Table). The shelving of the shore at Bugoto, for example, is very gradual, and for several metres from the lake edge the water remains shallow ($\leqslant$25 cm), with no significant wave action. The expanse of calm shallow water provides a convenient platform for washing infants, and for the natural growth of beds of *Vallisneri*a, which start 2–3 m from the water's edge and provide a very conducive habitat for numerous *Bi. choanomphala*, many of which, at the time of the present study, were patently shedding cercariae. At Bwondha, in contrast, the lake is open to wave action and much more steeply shelving. Within 2–3 m of the shore the lake quickly deepens to approximately 1 m, with *Vallisneria* weed beds only beginning some 10 m from the shore. While *Bulinus trigonis* and *Bu. tranversalis*, could be collected in large numbers, *Bi. chaonomphala* was not at all common. From this cursory inspection, it is likely that Bugoto, with its poorer sanitation, higher levels of daily water contact and unusual topographic/biotic features, offers almost ideal conditions for the local transmission of *S. mansoni*.

While Bugoto probably represents a hotspot of transmission and is therefore not altogether typical of other lakeshore villages, infections could still be seen, in the first survey, in six further villages along the lakeshore (Fig. 2). Owing to time constraints and the number of villages to be investigated, a less labour-intensive method of diagnosis (a single Kato–Katz smear of a single stool sample/subject) had to be used for the first survey than for the second. The sensitivity of this method is known to be poor, especially where infections of light intensity predominate (Berhe *et al.*, 2004; Santos *et al.*, 2005). It is therefore likely that infections in some of the infants investigated in the first survey went unnoticed. To compensate for this insensitivity, De Vlas *et al.* (1993) developed and validated a pocket chart for estimating the true prevalence from that observed by investigating one stool specimen/subject. This chart indicates that the prevalence of egg-patent infection observed in the infant subjects of the first survey (7%) would result from a true prevalence of 30%–50% (De Vlas *et al.*, 1993, 1997). The prevalence of CCA-positivity in the same infants (about 40%) and the overall prevalence of egg-patent infection recorded, using more exhaustive testing, in the second survey (about 45%) fall within this range.

In the present study, egg-patent *S. mansoni* infection was only detected in subjects aged at least 12 months, and Pérel *et al.* (1985) made a similar observation for *S. haematobium*. In the present investigation, however, a child as young as 5 months, who was still breast-feeding, was found positive for CCA in his urine. Since not all CCA-positive infants had infected mothers, it seems more likely that the CCA-positive but egg-negative infants had pre-patent infections, in which there were only worm pairs that had not matured to the point of egg release, or were excreting too few eggs to be detected using Kato–Katz smears (Polman *et al.*, 2000; Van Dam *et al.*, 2004), rather than that they had acquired their CCA by passive transfer from their mothers (e.g. in colostrum). Given that the congenital transmission of African schistosomes is highly unlikely (Johansen *et al.*,

2002), these infant infections are no doubt contingent upon the specific water-contact behaviours of each mother (and/or those of older siblings who frequently look after young children). Most infected infants had infected mothers, presumably because an infant usually contacts the same water source as his or her mother.

The questionnaire-based interviews in the second survey revealed that, in the context of schistosomiasis, the knowledge, attitudes and practices of the mothers at Bugoto and Bwondha could be much improved, the mothers' present level of knowledge of the disease being negligible. Given the generally low levels of maternal literacy, any health messages would be best delivered verbally. Whilst all the participants of the present study welcomed the provision of anthelmintic treatment, which was well tolerated both by the infants and their mothers, the schistosome-related health-seeking behaviour of the mothers was poor (data not shown), as Mwanga *et al.* (2004) observed in Tanzania. The mothers interviewed delivered their babies at home, without accessing any local health services. It would clearly be beneficial to target local health education specifically at women of child-bearing age, not only to activate treatment-seeking behaviour for the benefits associated with de-worming (Savioli *et al.*, 2005) but also to provide such women with simple water-hygiene messages, such as the resting of any lake water (e.g. for 24 h) before use. The latter intervention would greatly decrease the chances of children being infected by being bathed in water drawn from the lake, since cercariae are an ephemeral larval stage. Given their present infection status and current lack of disease awareness, it remains a significant future challenge to mobilise and access regularly the mothers in these lakeshore communities, to provide them and their infants with anthelmintics and health information. In November 2004, the Ugandan Ministry of Health began co-ordinating annual Child Health Days (CHD). Although the associated activities are currently focused on measles vaccination, the administration of vitamin A and the treatment of geohelminths, it seems clear that, at least for the pre-school children who live close to the shorelines of the major Ugandan lakes, treatment for *S. mansoni* infection might also be usefully included in the CHD.

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