

Evolution of operational research studies and development of a national control strategy against intestinal helminths in Pemba Island, 1988–92

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Intestinal helminthic infections in Pemba Island, United Republic of Tanzania, have been perceived as a public health problem for many decades. School surveys in 1988 and 1992 and a community survey in 1991 were carried out to assess the distribution of prevalence and the intensity of these infections and to define the most effective strategy for control. The prevalence of helminthic infections exceeded 85% in all the surveys, and intensity was moderate. These studies identified the high-risk age groups, high transmission areas for different parasites, and the most cost-effective anthelmintic drug. This work is an example of how existing health systems and simple analytical tools may be used to generate useful data which, in turn, are used to define suitable intervention strategies. As a result, the Ministry of Health of Zanzibar has developed a national plan for the integrated control of intestinal helminths. This plan envisages periodic mass treatment of school-age children with mebendazole (500 mg, single dose, every four months) for the control of morbidity due to Ascaris, Trichuris, and hookworms.

Introduction

Infection with intestinal parasites is a widespread problem in the developing world (1, 2). The prevalence and severity of infection is especially high in many developing countries where health and sanitation facilities are unable to cope with the needs of an increasing population (3). The main burden of these infections is borne by young children, with adverse effects on their physical and mental development which may be long-lasting (4–6).

In Zanzibar, intestinal parasitoses are recognized as a major health problem.^a A schistosomiasis control programme was initiated in 1986, on the island

of Pemba, by the Ministry of Health of Zanzibar, with support from WHO, the Italian Ministry of Foreign Affairs, and the German Pharma Health Fund to deal with the high prevalence of infection with *Schistosoma haematobium* (7–13). As an extension to this programme, studies have been performed since 1988 to determine the extent of infection with soil-transmitted helminths such as hookworms, *Ascaris* and *Trichuris*, and to test the efficacy of low-cost anthelmintic drugs.

In this paper we present the results and conclusions from operational research studies carried out between 1988 and 1992. This work has led to the initiation of a national plan of action for the control of helminths by the Ministry of Health of Zanzibar in 1992.

Materials and methods

The health administration of the island of Pemba is under the Ministry of Health of Zanzibar. Other relevant features of the island have been described elsewhere (7, 8).

School surveys. Three school surveys were conducted between 1988 and 1992. In the initial survey of 1988, about 10% of the total school population were studied. The study population (3436 children from all classes; age range, 4–20 years) was from eight

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^a Zanzibar. Priority plan for health services 1991/2–1995/6. Ministry of Health of Zanzibar, 1991.

sery). The geometric mean egg was 136 for *Ascaris* and 74 for hookworm infection. Summary results from this study are presented in Table 1.

In the community survey in August 1991, 2247 individuals of all age groups from two towns (1109) and six villages (1138) were examined. Overall, 86.7% of the samples tested positive for helminth eggs (town population, 87.6%; villagers, 86.2%) (Table 2). As in the previous study, *T. trichiura* was the most prevalent infection at 76.0% (78.1% in towns and 74.4% in villages). The next most common infection was with hookworms; 60.8% of stools examined were positive for hookworm eggs (urban sample, 53.0%; rural sample, 68.0%). Interestingly there was a marked focality in the distribution of infections with this parasite. *Ascaris* infection was present in 48.2% of individuals examined (prevalence in the towns, 50.2%; villages, 46.7%). Fig. 2 shows prevalence and intensity of infection in relation to age. The age/intensity relationship is quite typical, showing that the main burden of the infection with *Ascaris* and *Trichuris* is borne by the school age group.

The community survey was followed, in early 1992, by a second school study. Data from 1120 children from the standard 5 classes of 35 schools showed that 1117 (99.7%) were infected with either one of the three helminths studied. Mean prevalence rates were 88.7% for *Trichuris*, 84.8% for hook-

worms, and 71.2% for *Ascaris* with mean egg values of 482, 463 and 218, respectively.

Subsequently, almost all students (99.9%) tested in the late 1992 school survey were infected with at least one parasite and overall prevalence rates of 97.4% for *Trichuris*, 90.4% for hookworms and 68.3% for *Ascaris* were recorded. Geometric mean egg values were 678, 427 and 203 for *Trichuris*, hookworm and *Ascaris* infections, respectively (Table 3). In this third survey a drug-efficacy trial was also conducted, the details of which are reported elsewhere (16).

Discussion

The high prevalence of intestinal helminths in many parts of East Africa is well documented (17-19). In Pemba, for example, an earlier study has suggested a high prevalence rate of helminth infections in a cohort representing 0.2% of the population, although this was only a qualitative study (20). In addition, in the island which is endemic for *S. haematobium*, a regular testing and treatment campaign has been successfully conducted in schools since 1986. These campaigns involved testing for haematuria using reagent strips and selective treatment of positive individuals with a single dose of praziquantel (40 mg/kg body weight) (7-13). This existing structure

Table 1: School survey, Pemba, 1988 (age range, 4-20 years)

School	No. examined	<i>Ascaris</i>		<i>Trichuris</i>		Hookworms		Total prevalence ^b (%)
		Prevalence (%)	Intensity ^a (epg)	Prevalence (%)	Intensity ^a (epg)	Prevalence (%)	Intensity ^a (epg)	
Uondwe	603	60.0	139	85.2	478	27.1	6	94.7
Chake (nursery)	101	47.5	40	68.3	132	10.9	1	80.2
Kojani	180	28.9	6	66.1	63	35.0	8	81.1
Pujini	296	66.8	213	72.6	234	74.7	379	99.3
Makombeni	153	93.5	5 652	96.7	1 700	92.2	1071	100.0
Shumba	543	31.3	9	72.6	84	71.3	126	89.8
Michakaini (Chake)	719	60.2	134	79.1	308	51.5	40	96.1
Kiwani	841	72.7	672	81.0	308	79.4	382	97.6
Total	3 436	58.7	136	78.8	257	58.9	74	94.4
Classification: ^c								
Heavy			5.7%		6.2%		7.3%	
Moderate			19.6%		36.1%		7.9%	
Light			33.4%		36.6%		43.7%	

^a The intensities (geometric means of epg) shown are for all the subjects examined.

^b Children with at least one of the parasites.

^c In Tables 1 to 3, heavy, moderate and light infections were classified as follows:

Heavy <i>Ascaris</i>	≥50 000 epg	Heavy <i>Trichuris</i>	≥10 000 epg	Heavy hookworms	≥ 10 000 epg
Moderate <i>Ascaris</i>	5 000-49 999 epg	Moderate <i>Trichuris</i>	1 000-9 999 epg	Moderate hookworms	3 000-9 999 epg
Light <i>Ascaris</i>	1-4 999 epg	Light <i>Trichuris</i>	1-999 epg	Light hookworms	1-2 999 epg

Table 2: Community survey, Pemba, 1991 (age range, 1–85 years)

Area	No. examined	<i>Ascaris</i>		<i>Trichuris</i>		Hookworms		Total prevalence ^b (%)
		Prevalence (%)	Intensity ^a (epg)	Prevalence (%)	Intensity ^a (epg)	Prevalence (%)	Intensity ^a (epg)	
Town								
Chake Chake	614	55.9	53	76.5	94	41.0	11	86.6
Wete	495	43.3	23	80.0	162	67.9	87	88.7
Subtotal	1 109	50.2	37	78.1	119	53.0	29	87.6
Village								
Makangale	215	52.8	36	68.4	87	78.1	229	92.1
Kiuyu	197	36.0	13	69.0	73	70.6	108	78.2
Shungi	290	50.7	38	69.4	69	46.6	18	81.9
Pujini	152	45.4	36	89.5	278	80.3	224	93.4
Ngwachani	152	52.0	55	80.3	182	72.2	123	86.8
Mzingani	132	39.4	31	80.3	220	76.5	214	87.9
Subtotal	1 138	46.7	31	74.4	115	68.0	97	86.2
Total	2 247	48.2	33	76.0	115	60.8	54	86.7
Classification: ^c								
Heavy			0.0%		0.4%		0.4%	
Moderate			6.6%		20.0%		5.5%	
Light			41.6%		55.6%		54.8%	

^a The intensities (geometric means of epg) shown are for all the subjects examined.

^b Children with at least one of the parasites.

^c For classification, see footnote c in Table 1.

provided a good base for studying the situation with intestinal helminths in the island between 1988 and 1992. All activities in the schools were performed in collaboration with the health team from the nearest primary health care unit (dispensary), with the full involvement of school teachers and community leaders. This was an opportunity to strengthen the existing health care system and to promote a more comprehensive and integrated approach. The results of this research has led to the evolution of the control strategy discussed below.

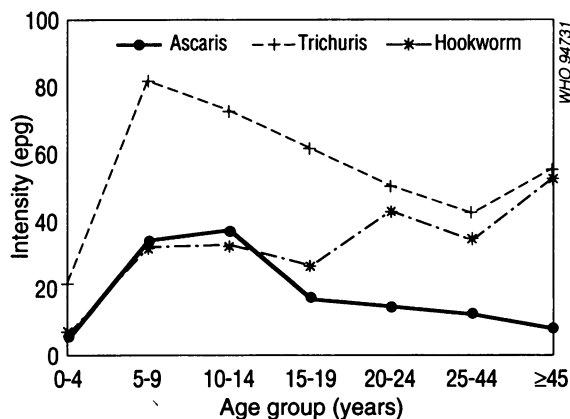
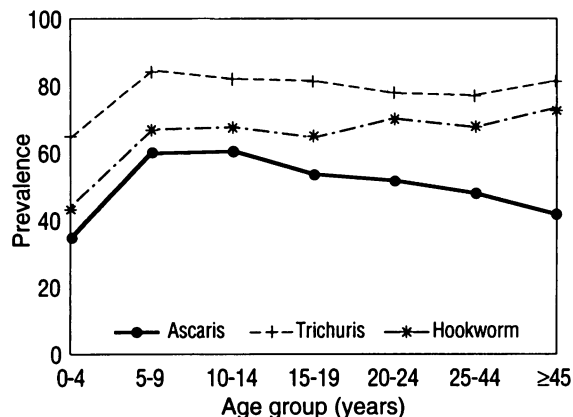
In the initial survey of 1988, a very high cumulative prevalence of helminthic infections was found (94.4%, representing the number infected with any one parasite), thus confirming earlier reports (20) and our suspicion that intestinal helminths were indeed a major public health problem among school-children in Pemba. In particular, the school at Makombeni had the highest prevalence and intensity values recorded in this study. This may be explained by the high population density and lack of sanitation, resulting in heavy faecal contamination of the environment. In contrast, the lower rates seen in the island of Kojani are probably due to the local habit of defecating on the shores during low tide.

Our second survey in 1991 was planned to clarify two important issues for the implementation of future control strategies. There was a need to obtain

good epidemiological data related to the community, representing all age groups and preferably incorporating communities from different parts of the island, and to identify an effective, safe and cheap single-dose anthelmintic that could be included in the control programme. To this end, 446 individuals in the population that received therapy with 500 mg mebendazole were followed up, one and four months after treatment. The results showed that this single-dose regimen was effective, leading to both good cure rates (especially in *Ascaris* infection) and a marked decrease in intensity of infection with all three parasites (21). Although marked differences ($P < 0.001$) were found in the distribution of the three nematodes by place (villages or towns), no significant variation was noticed between urban and rural areas. This latest finding, confirmed by a subsequent study (22), suggests that the same interval between treatments for control of morbidity might be adopted for children in urban and rural schools.

The third survey in late 1992 was planned as an extension of the previous one, being a drug-efficacy trial comparing the single-dose regimens of 500 mg mebendazole and 400 mg albendazole. The outcome of the drug efficacy study is reported elsewhere (16), with the results showing that generic mebendazole was as effective as albendazole against *Ascaris* and slightly more effective against *Trichuris*. Against

Fig. 2. Distribution of prevalence and intensity of helminthic infections, by age, in the community survey, Pemba, 1991. Intensity is reported as the geometric mean of the whole population group (positive and negative subjects).



hookworm, generic mebendazole had lower cure rates than albendazole, but it decreased the intensity of infection by more than 80%. This finding has major implications for sustaining the large-scale control programme in Zanzibar, because generic mebendazole can be obtained at about US\$ 0.02 per dose.

During this series of research studies, there were continuing discussions and constant reassessment of our strategy by a joint working group made up of responsible staff from the Zanzibar Ministry of Health and Ministry of Education and WHO staff. As a result, we believe that we have achieved our initial objectives to determine disease prevalence,

intensity, and distribution as accurately as possible and to define appropriate intervention.

The most important achievement has been the definition of control strategies included in the Zanzibar Ministry of Health's National Action Plan for Control of Helminths. This plan envisages an integrated approach for the control of both schistosomiasis and soil-transmitted helminths based on WHO recommendations (23).^b For schistosomiasis the objective is to maintain the low levels of morbidity already reached on the island through selective population chemotherapy with the aid of reagent strips for haematuria and treatment with praziquantel targeted at schoolchildren (23). Owing to the significant reduction in morbidity achieved by the original six months retreatment schedules, schoolchildren are now retreated at one-year intervals. For the soil-transmitted helminths the specific target is to obtain, within two years, a reduction in intensity of infection of 60% for *Ascaris*, 30% for hookworms, and 20% for *Trichuris* in schoolchildren. To achieve this outcome, periodical mass treatment of schoolchildren with a single dose of mebendazole 500 mg was adopted as the most cost-effective strategy for the control of morbidity, as recommended by WHO for endemic areas.^b It was agreed to treat the children every four months because of the very high reinfection rate (21). Although repeated mass chemotherapy on a target group might have an impact in reducing the contamination of the environment, the control of transmission of helminthic infection cannot be achieved and sustained without intensive health education, particularly of children, through the school system together with promotion of environmental health through community involvement in building, maintaining and using latrines. WHO's Rural Environmental Health Unit is planning to undertake operational research in Pemba within the helminth control programme to promote affordable and acceptable sanitation in schools.

The evaluation of the programme impact on morbidity due to intestinal helminths will be monitored once a year in samples of the standard 5 classes. A specific evaluation of the impact of the school-based deworming programme on nutritional status, by measuring micronutrients and through anthropometric indices in the school-aged population, has been implemented in early 1994.^c

^b Health of schoolchildren: treatment of intestinal helminths and schistosomiasis. Unpublished document WHO/CDS/IPI/CTD/92.1, 1992.

^c Stoltzfus RJ et al. Evaluation of the nutritional impact of a school-based deworming program in Zanzibar. Unpublished, 1994.

Table 3: School survey, Pemba, 1992 (age range, 6–12 years)

School	No. examined	<i>Ascaris</i>		<i>Trichuris</i>		Hookworms		Total prevalence ^b (%)
		Prevalence (%)	Intensity ^a (epg)	Prevalence (%)	Intensity ^a (epg)	Prevalence (%)	Intensity ^a (epg)	
Wingwi	106	50.0	37	96.2	433	99.1	1 223	100.0
Mchambandogo	345	72.5	249	97.4	577	95.1	624	100.0
Minungwini	201	76.1	445	96.0	594	97.0	646	99.5
Ole	566	56.9	59	95.4	424	94.0	515	100.0
Ziwani	417	70.7	207	97.8	637	89.9	346	99.8
Wawi	697	78.3	433	99.0	978	93.1	569	100.0
Pujini	91	58.2	114	98.9	764	51.6	24	100.0
Ngwachani	194	67.0	395	99.0	1 222	82.0	275	99.5
Kiwani	299	64.5	243	98.0	837	82.3	225	100.0
Kengeja	286	66.8	201	96.2	644	90.9	432	99.3
Total	3 202	68.3	203	97.4	678	90.4	427	99.9

Classification:^c

Heavy	1.0%	0.7%	0.9%
Moderate	22.5%	43.6%	10.4%
Light	44.8%	53.1%	79.1%

^a The intensities (geometric means of epg) shown are for all the subjects examined.

^b Children with at least one of the parasites.

^c For classification, see footnote c in Table 1.

The decision to concentrate our monitoring and intervention efforts on school-age children is based on generally accepted findings showing that these individuals harbour the most intense infections, a fact which is reconfirmed in our study, and that intervention in this group achieves the maximum return per treatment in terms of morbidity reduction (4).^d More importantly, schoolchildren are among the most accessible groups for monitoring and treatment of both schistosomiasis and intestinal helminths.^b Indeed, school health programmes including parasite control were identified in the World Bank's 1993 Report (2) as one of the most cost-effective of public health interventions, and were included in a short list of five global public health priorities. Similar considerations led WHO and UNDP, in collaboration with the Rockefeller and Edna McConnell Clark Foundations, to initiate the Partnership for Child Development programme in 1992. This international programme seeks to evaluate the use of school-based services, including anthelmintic delivery, as a means of improving the health and the education of school-age children.

Another population group at high risk for helminth-associated morbidity are women of child-bearing age who are particularly prone to iron-deficiency anaemia associated with hookworm infection. The government of Zanzibar, in collaboration with WHO, is currently planning further studies on the impact of helminth control on maternal and child health.

In conclusion, the work described in this paper is an example of how existing health systems and simple analytical tools may be used to generate useful data which, in turn, are used to define suitable intervention strategies. Although planning, management and programme operation will be different from one country to another, most health care structures are capable of introducing and sustaining the very simple technology involved.^e

^e See footnote b on p. 187.

Acknowledgements

We thank the dedicated staff of the Helminth Control Team, the teachers, and the population of Pemba Island whose enthusiastic collaboration and participation made this study possible. We are also grateful to Dr A. Gabrielli, Dr L. Di Matteo and the late Professor I. de Carneri for

^d Informal consultation on intestinal helminths infections. Unpublished document WHO/CDS/IP/90.1, 1990.

their contribution in training the local health staff; Dr K.E. Mott, Dr A. Davis, Dr D. Cioli and Dr H. Nieve for their encouragement and support; Dr D.A.P. Bundy for his most useful comments and Professor P.G. Smith and Mr H. Dixon for their advice on data entry and analysis. Special thanks to SmithKline Beecham Pharmaceuticals Ltd, Janssen Pharmaceutica Ltd and Pharmamed Ltd for the generous gift of anthelmintics used in the surveys. This study was initiated and financially supported by WHO (Division of Communicable Diseases and Division of Control of Tropical Diseases), the German Pharma Health Fund, and the Direzione Generale per la Cooperazione allo Sviluppo in the Italian Ministry of Foreign Affairs.

Résumé

Evolution des travaux de recherche opérationnelle et élaboration d'une stratégie nationale de lutte contre les helminthes intestinaux dans l'île de Pemba, 1988-1992

Dans l'île de Pemba, en République-Unie de Tanzanie, les helminthiases intestinales sont depuis longtemps reconnues comme problème de santé publique. Des enquêtes ont été réalisées, dans les écoles en 1988 et 1992 et dans l'ensemble de la communauté en 1991, pour évaluer la distribution de la prévalence et de l'intensité de ces infestations et définir la stratégie de lutte la plus efficace.

La prévalence des infestations était supérieure à 85% dans toutes les enquêtes, avec une intensité modérée. Ces enquêtes ont permis d'identifier les groupes d'âge à haut risque, les zones de forte transmission pour les différents parasites, et l'anthelminthique ayant le meilleur rapport coût-efficacité. Ce travail illustre la façon dont les systèmes de santé existants et des outils analytiques simples peuvent être employés pour fournir des données utiles, qui à leur tour serviront à définir des stratégies d'intervention appropriées. A la suite de cette étude, le Ministère de la Santé de Zanzibar a élaboré un plan national de lutte intégrée contre les helminthes intestinaux. Ce plan prévoit le traitement périodique de l'ensemble des enfants d'âge scolaire par le mébendazole (500 mg en prise unique une fois tous les 4 mois), afin de combattre la morbidité due à *Ascaris*, à *Trichuris* et aux ankylostomes.

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