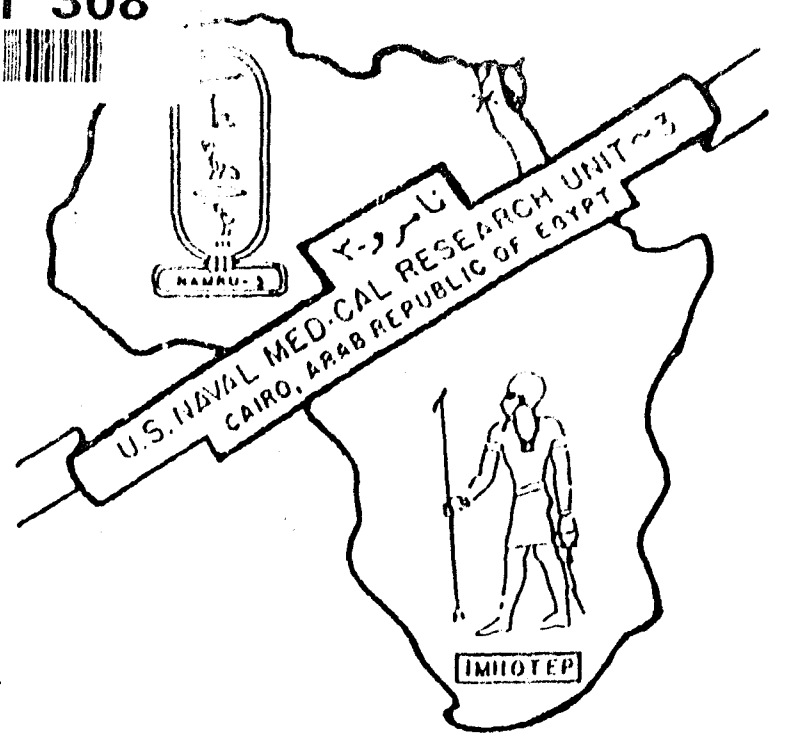

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EVALUATION OF UNICEF/ARAB REPUBLIC OF EGYPT/WHO SCHISTOSOMIASIS CONTROL PROJECT IN BEHEIRA GOVERNORATE

BY

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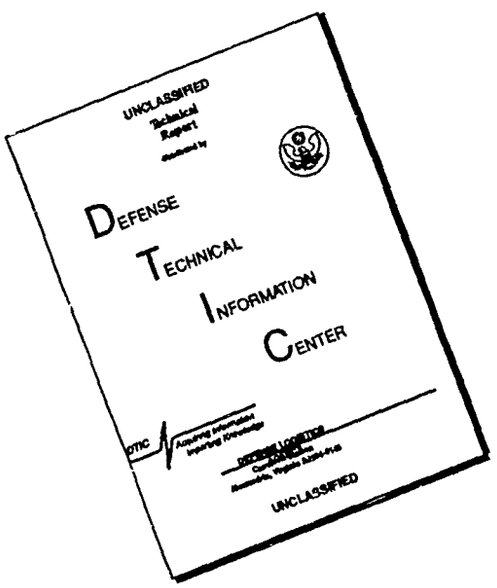

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EVALUATION OF UNICEF/ARAB REPUBLIC OF EGYPT/WHO SCHISTOSOMIASIS CONTROL PROJECT IN BEHEIRA GOVERNORATE

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Abstract. We evaluated the UNICEF/Government of Egypt/WHO Schistosomiasis Control project in 2 districts of Beheira Governorate of the Nile Delta during 3 weeks in February 1988. The project, begun in 1983, was focused on reducing prevalence, intensity, and morbidity due to schistosomiasis by providing diagnosis and treatment with praziquantel to schoolchildren. Schools were visited twice. Following the completion of the school surveys, the program was extended into the community. Chemotherapy was delivered by mobile and static teams. The evaluation indicated that, with respect to accuracy of diagnosis, record-keeping, and coverage of targeted populations, project tasks were performed exceedingly well by highly motivated, well-supervised mobile teams. Static teams in rural health centers were less successful in providing diagnosis and chemotherapy to village populations. We resurveyed 6 randomly selected schools to assess the impact of chemotherapy. Overall, the prevalence of *Schistosoma mansoni* infection was reduced from 60.3% to 24.8% between the first and second surveys (~1 year apart) and was still lower (41.1%) than initial levels up to 3 years after the last treatment with praziquantel. The percentages of those with ≥ 34 *S. mansoni* eggs/slide using the Kato-Katz technique showed a marked and prolonged decrease (17.1% to 0.3% to 2.2%). The prevalence of *S. haematobium* infection dropped from 37.6% to 5.5% and was still 9.9% at the time of the evaluation. The percentages of those with ≥ 50 *S. haematobium* eggs/10 ml urine dropped less dramatically (17% to 4.4% to 11.9%). Mobile teams conducting vigorous chemotherapy programs targeted at schoolchildren can have long-lasting benefits in terms of prevalence and intensity.

Schistosomiasis is one of the most important public health problems affecting Egyptians, especially inhabitants of the rural farming communities of the Nile Delta.[1] Currently, 15–30% of Egypt's population of ~50 million is infected with *Schistosoma mansoni*, *S. haematobium*, or both, depending on the estimate used; the disease causes significant morbidity and mortality.[1–4] In 1983, UNICEF, WHO, and the Government of Egypt agreed to initiate a schistosomiasis control project in 2 highly endemic districts of the Beheira Governorate in the Nile Delta. Peak prevalence and intensity (heavy infections) rates of schistosomiasis in Egypt occur in school-age children.[1,3] The program attempted to provide diagnosis and treatment with praziquantel to all children attending school. What follows is an evaluation of the project, carried out in February 1988.

MATERIALS AND METHODS

Project description

The project is presented in detail elsewhere.[5] Diagnosis and treatment of schistosomiasis were accomplished by mobile and static teams. Four mobile teams visited schools and communities; each consisted of a medical doctor, 2 laboratory technicians, 2 clerks, 1 nurse, 2 laboratory workers, and 1 driver. Mobile teams were selected and trained especially for the project; their only tasks were to diagnose and treat schistosomiasis. In contrast, no new personnel were hired for the static teams, and they had a wide range of other responsibilities in addition to those of the project. The static teams consisted of the personnel assigned to the rural health units and were generally comprised of 1 doctor, 1 laboratory technician, 1 clerk, and 1 nurse. Static teams provided diagnosis and treatment to people who came to the rural health units.

Beginning in 1982, all schools in the Abu El Matameer district (population ~160,000, including 31,000 schoolchildren) and Abo Homos district (population ~247,000, including 47,000 schoolchildren) were visited by a mobile team. Each child was asked to submit a urine and a stool specimen. These were examined for schistosomiasis on site using the Kato-Katz thick

smear method for stool specimens[7] and a syringe-Nytrel filter technique for urine samples.[8] Infected children were weighed and treated with praziquantel, 40 mg/kg body weight. The teams returned to the school until all children absent at the initial visit were examined. This procedure was repeated twice in each school with an interval of ~1 year between visits.

Diagnosis and treatment for schistosomiasis were provided to community members other than schoolchildren. During the school surveys, community members were encouraged to come to rural health centers where they were examined and, if necessary, treated by the static teams. When the school surveys were completed, the mobile teams extended the control program into the village councils, where they systematically examined the population, excluding only children examined in the schools. Village councils are the major subdivisions of districts. They include a main village, satellite villages, and small groups of households. Main villages have a rural health center and a school. Satellite villages have no school, no rural health center, and usually have a population ~1,000.

Evaluation process

The evaluation was carried out in Egypt from 29 January through 17 February 1988 and included data collection in the project districts and preparation of a report. The terms of reference specified an evaluation of how well the program was implemented by examining the specific tasks carried out, determination of the impact of praziquantel on the prevalence and intensity of *S. mansoni* and *S. haematobium* infection in schoolchildren and in the community, identification of problems occurring in implementing the program as planned, and consideration of the relevance of this control intervention to schistosomiasis control in the Nile Delta region of Egypt.

Validation of diagnosis

S. mansoni. To determine the validity of the diagnosis of *S. mansoni* by mobile teams, results from stool specimens examined by these teams were compared with those from a reference laboratory. Mobile teams rather than static teams were evaluated because they carried out ~80% of the stool and urine examinations performed during the project. The U.S. Naval Medical Research Unit No. 3 (NAMRU-3) Parasitology Division participated as the reference laboratory.

One hundred and fifty-seven stool specimens were randomly selected from among those collected during the surveys in schools. Additionally, one known *S. mansoni*-negative stool specimen was obtained from a member of the evaluation team. Each specimen was divided into 2 equal portions; 1 was examined by the mobile team and the other by the reference laboratory. Specimens were transferred to the reference laboratory by automobile and examined the next day. The results of the readings from the 2 groups were then compared.

To compare accuracy of microscopic diagnosis, thick smears were prepared from each portion using the Kato-Katz technique. Thick smears from portions processed and examined first by each mobile team were recoded by the evaluation team and sent to the reference laboratory and vice versa. Neither the reference laboratory nor the mobile teams knew the results of the other nor could they determine which 3 slides came from the same portion. Egg counts obtained from the triplicate smears were averaged, and these averages were transformed to logarithms. The geometric mean number of eggs/g feces (epg) obtained from readings by the mobile teams and by the reference laboratory were compared using Student's *t*-test.

S. haematobium. The Nytrel-filtration technique used by the mobile teams in examining urine samples for *S. haematobium* was observed. On randomly selected specimens, 1 of the team members examined the filter under a microscope to verify the accuracy of the diagnosis.

Data recording and analysis

The results of the stool and urine examinations were recorded by the microscopists. These results were later transferred to survey forms containing additional patient information, including name, age, sex, weight, and the number of praziquantel tablets given. A sample of 100 microscopy records in each of 6 schools (see below) were examined to ascertain how stool and urine egg counts for specific individuals corresponded with those on the survey forms.

Hand-tabulated data summaries (for all sur-

TABLE 1

Concordance of Schistosoma mansoni *diagnosis performed by mobile teams of the UNICEF/Government of Egypt WHO Schistosomiasis Control Project and NAMRU-3 Parasitology Laboratory using a single Kato-Katz thick smear*

		Aliquots examined by reference laboratory		
		Positive	Negative	Total
Aliquots examined by mobile teams	Positive	90	5	95
	Negative	6	57	63
	Total	96	62	158

veys) from each of the 6 schools and 4 villages selected in the evaluation (see below) were checked by the evaluation team. All individual records (found on the survey forms) included in these summaries were entered into a computer, analyzed, and compared with hand-tabulated data.

Coverage in the school surveys was assessed by obtaining records of the number of children registered in the school at the time of each survey and comparing those with the records from the mobile teams. Population estimates for main and satellite villages were obtained and compared with the records of the mobile teams. Records from selected static teams in the rural health centers were reviewed to estimate population coverage achieved by the static teams.

Impact on schistosomiasis

Schools. Primary schools were stratified by prevalence of schistosomiasis (both *S. mansoni* and *S. haematobium*) at the time of the initial survey (<50%, 50–89%, or ≥90%). One school from each group was randomly selected in each district, for a total of 6 schools. During the evaluation period, these 6 schools were visited by the mobile teams. All children were examined for schistosomiasis and, if necessary, treated exactly as was done in the earlier surveys.

Cohort. Records of previous surveys were used to identify by name children examined during each survey, including the evaluation survey; a cohort of 530 children could be identified from 5 schools (in 1 school a cohort could not be identified). The results from each survey were then compared.

Community. To determine the impact of schistosomiasis on the community, satellite villages were stratified according to the time interval since the previous survey (<1 year or ≥1 year). One satellite village in each group was surveyed in each district during the evaluation period, for a total of 4 villages. Although the mobile teams systematically examined the total population, including those living in larger villages, satellite villages were selected because their size (~1,000 inhabitants) made it possible to re-examine the residents during the evaluation

RESULTS

Validation of diagnosis

S. mansoni. One hundred fifty-eight specimens were processed and examined by both a mobile team and the reference laboratory. The concordance of results based on a single Kato-Katz smear is presented in Table 1. Agreement was excellent; 90 specimens (57%) were positive by both the team and the reference laboratory, and 57 specimens (36%) were negative in both. In only 11 instances (7%) was there disagreement, and the divergent results were equally distributed. The percentages of discordant results are not statistically significant.

Egg counts obtained by reading triplicate smears were also very similar. The mean epg was 68.9 for slides examined by the mobile teams and 84.9 for those examined by the reference laboratory. These differences were not statistically significant.

S. haematobium. The proportion of infection caused by *S. haematobium* in the school survey was much lower than that caused by *S. mansoni* (Table 2). The syringe filtration technique used by each of the mobile teams was observed and found to be performed correctly. However, Lugol's iodine solution was not used to stain eggs in the specimens prepared during the observation period. Spot checks of positive and negative filters by the evaluation team gave results identical to those of the mobile teams.

Data recording and analysis

All egg counts had been accurately transcribed from the microscopy records to the survey and treatment forms. Computer-generated data sum-

Page 424 missi

tion in the satellite villages was reduced even in the villages surveyed 1 year later (Table 3). In the village (C) where intensity was high initially, it was also reduced. The prevalence of *S. haematobium* infection was low in these 4 randomly selected satellite villages. However, in the 1 village (D) where *S. haematobium* infection was 10%, both prevalence and intensity were significantly reduced at the time of the second survey 7 months later.

DISCUSSION

The concordance between laboratory results obtained by the mobile teams and those of the reference laboratory was excellent. The demonstrated ability of the mobile teams to diagnose schistosomiasis correctly attests to the quality of training and supervision the teams received and lends credence to the data suggesting that the program had a significant impact on the prevalence and intensity of schistosomiasis. It was impossible in the time available to evaluate the diagnostic accuracy of the static teams; there were ~150 rural health centers in the 2 districts, each with a team. However, static teams performed <20% of the total examinations.[9] The ability to diagnose schistosomiasis under field conditions is necessary for chemotherapy-based control strategies.[9] These data support those from other areas demonstrating that schistosomiasis can be accurately diagnosed and treated under field conditions.[9, 10]

Coverage was high in the schools, largely because the schools were revisited until all students were examined. Cooperation was excellent among those attending on any given day; virtually every child provided a stool and urine sample. However, in Egypt and elsewhere, some school-age children do not attend school and thus may not be reached by such programs. In this study, girls were absent from school more often than were boys. Additionally, emigration of students before follow-up examinations and refusal to take treatment could also affect results. In some studies, treatment compliance was less and emigration highest in older (>15 years) children.[12] It is unlikely that many schistosomiasis control programs could expend the necessary resources for multiple visits to achieve the degree of coverage attained in this project.

Population coverage by the static teams based in rural health centers was low. The static teams were smaller than the mobile teams (4 persons instead of 9), they had many other responsibilities in the rural health units, the turnover of personnel (especially physicians) was rapid, and physicians were only available part-time. There was no effective campaign to encourage people to go to rural health units for diagnosis and treatment of schistosomiasis. Indeed, most people expected that the mobile teams would move into the community after the school surveys were finished. Many villagers preferred to await the arrival of mobile teams. However, in future interventions it would be difficult, if not impossible, to ignore the potential contribution to schistosomiasis control of the ~1,300 rural health centers (potential static teams) in the Nile Delta, which are within convenient reach of the vast majority of the rural inhabitants. An important issue for future planning is how and to what extent these obstacles to the use of rural health units can be overcome.

There was a persistent reduction in the prevalence and intensity of schistosomiasis infection in schoolchildren and in the general population as many as 3 years after treatment with praziquantel. This effect was most marked with *S. haematobium* infections, in which both the prevalence and intensity remained lower than base line levels. The prevalence of *S. mansoni* infections increased towards pre-treatment values, while the intensity remained low. Although the efficacy of chemotherapy in reducing sequelae of schistosomiasis over the long term was not measured, the UNICEF Project achieved its goal of reducing schistosome egg burdens in the target population. These results are consistent with those from other research projects in corroborating that chemotherapy reduces high worm burdens (and thus egg excretion), the major risk factor for disease, for relatively long periods of time.[4,13-18] In only a few areas, mass chemotherapy has had little effect on morbidity and intensity of infection, possibly because of very high infection rates.[19]

Transmission of *S. haematobium* (in contrast to *S. mansoni*) was low, as evidenced by the sustained reduction in infection prevalence. There is no evidence that treatment with praziquantel prevents reinfection or decreases selectively the rate of reinfection with *S. haematobium*. Thus, if the results were exclusively caused by the drug, there should have been a similar response with *S. mansoni*. When resistance to reinfection after

TABLE 3

Prevalence and intensity by survey of S. mansoni *and* S. haematobium *infection in randomly selected villages pretreated population chemotherapy by months between chemotherapy and the evaluation survey*

Village	No. examined		Months between surveys	Prevalence*				Intensity†			
				S. mansoni		S. haematobium		S. mansoni		S. haematobium	
	Survey 1	Survey 2‡		1	2	1	2	1	2	1	2
A	492	131	1	72	13	0	0	0	1	0	0
B	751	857	7	36	25	13	5	1	0	20	0
C	231	264	12	79	11	1	0	23	3	13	0
D	1,152	909	13	82	56	0	0	1	2	0	0

* Percentage of persons infected.

† For *S. mansoni* the percentage of infected persons with ≥ 14 eggs/Kato-Katz slide (≥ 816 epg); for *S. haematobium* the percentage of infected persons with ≥ 50 eggs/10 ml urine.

‡ For each survey persons were examined for the presence of schistosomes (stool and urine sample) and infected individuals were treated with praziquantel. Survey 2 was done at the time of the evaluation.

treatment of *S. haematobium* and *S. mansoni* has been demonstrated, older children (>10 years) appear to be more resistant, probably due to acquired immunity; this would not have affected the age groups in this evaluation (the majority were 6–9 years).[20,21] However, this may have been a factor in the more dramatic reductions observed in the 4 satellite villages evaluated. There was no evidence that selective treatment for *S. haematobium*, e.g., metrifonate, was given between surveys.

This degree of sustained low *S. haematobium* transmission following chemotherapy has rarely been observed and may be, in part, due to the reduced risk of reintroduction of the parasite because of the background of reduced prevalence in the region as well as the excellent chemotherapy coverage achieved in the schools.[22] During the past 10 years, the work of numerous investigators has confirmed that profound changes have occurred in the Nile Delta in the epidemiology of schistosomiasis, namely, a striking decrease in the distribution and overall prevalence of *S. haematobium*.[23,24] During the 1950s, the prevalence of *S. haematobium* was 60–70%, but by 1984 it was only 7% in a sample of villages from 70 of the 71 districts in the 8 governorates of the the Nile Delta.[23] An equally remarkable decrease in the population levels of *Bulinus truncatus*, the vector snail, was associated with this decrease. The decrease in *B. truncatus* may be related to ecological alterations caused by the long-term process of damming the Nile.[26]

The evaluation demonstrated that this school-based chemotherapy program in Egypt was effective. Control programs targeted to schoolchildren are relatively easy to organize and administer. Since children have the highest prevalence and intensity of schistosomiasis infection in Egypt,[4,9] diagnosis and treatment of children should reduce morbidity. Similar studies in other countries have also demonstrated that chemotherapy to schoolchildren is a practical strategy to reduce the prevalence, intensity, and associated morbidity of infection with *S. haematobium* and *S. mansoni*.[12,15,22] It is clear that praziquantel is not only a safe and effective drug against *S. mansoni*, but that it is well-accepted in village or school-based programs despite the relatively common occurrence of transient, generally mild, side effects. In this project, refusal of the drug was extremely rare. Indeed, once programs were initiated in communities, there was widespread public demand for diagnosis and chemotherapy. A number of issues remain to be clarified, however. It is not known how cost-effective this strategy is in relation to other ways of providing diagnosis and treatment. How frequent it is necessary to re-treat is not known, nor, correspondingly, is there sufficient evidence to indicate the long-term impact on morbidity if reinfection occurs.

Despite the fact that selected population chemotherapy may not interrupt transmission of *S. mansoni*, the intensity of infection in the population is reduced for relatively long periods of time. Although prevalence may increase rapidly after chemotherapy as a consequence of re-infection, the intensity of infection (and the morbidity) tends to remain low for periods of ≥ 1 year. As seen in Table 2, the intensity of *S. mansoni* infection in schoolchildren remains < ½ that of pre-treatment levels some 3 years after chemotherapy. The obvious operational and financial implication of these findings is that chemotherapy coverage every 2–3 years may be effective

in reducing intensity and morbidity, thus greatly reducing program costs.

The cost of praziquantel has declined rapidly in recent years, and the trend continues. The drug is available via governmental channels at a greatly reduced cost, and in the private sector in Egypt the price is much reduced due to intense competition in the pharmaceutical industry. The rapid decline in the retail cost of praziquantel via governmental (~$1.50 U.S. per treatment) and private (~$3.00 per treatment) sources bring this drug within reach of most of the Egyptian population. Further reductions in drug costs are anticipated.

Adequate population coverage for diagnosis and chemotherapy of schistosomiasis may be achieved by building on the existing health network of rural health centers in the Delta and by linking their diagnostic capabilities with both private and public sources of chemotherapy. Schistosomiasis control can thus be integrated with the control of other health problems. Recent experience in the highly successful oral rehydration program in Egypt has demonstrated that the mass media can be remarkably successful in modifying health-related behavior, specifically, behavior related to acquisition of medications (e.g., oral rehydration salts). A similar program on schistosomiasis has been developed for Egyptian television. Furthermore, it has been seen that the private sector (physicians and pharmacists) can respond to these demands in a parallel fashion. The major obstacles to overcome are motivating the population to seek diagnosis (since *S. mansoni* infection is often asymptomatic) and providing reliable and convenient diagnostic services. Consideration of ways to overcome these obstacles may suggest realistic and cost-effective approaches. For example, the diagnostic capabilities of rural health centers might be greatly enhanced (in terms of accuracy and volume) through imaginative use of training, enhanced supervision, financial incentives, quality control of results, and coordination of laboratory capabilities with community needs. Also, ways to ensure diagnosis of infection in local schoolchildren could be developed. Finally, efforts to modify behavior, particularly in young children, to prevent fecal and urine contamination of canals could also be tried.

Appropriate evaluation of control programs is necessary to understand the reasons for successes and failures and to maximize the cost-effectiveness and the benefits derived from such programs. Documentation of such interventions is important for future planning. A major issue in duplicating the approach used here in other areas is the degree to which the supervision, training, and use of mobile teams can be replicated.

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