A SCHISTOSOMIASIS PILOT CONTROL PROJECT IN LINDU VALLEY, CENTRAL SULAWESI, INDONESIA

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INTRODUCTION

The Lindu valley surrounds Lake Lindu in central Sulawesi, Indonesia. Its elevation is more than 900 metres and its area is about 100 square kilometres. There are 4 villages and a new settlement area in the valley with a total population of around 2,500. The population lives on subsistence agriculture, cultivating rice, and fishing. Only a small part of the valley is cultivated. The valley is very isolated and communication is poor.

The valley is known to have been endemic for schistosomiasis since 1937 (Muller and Tesch, 1937). In 1969 the Government started the Gumbasa irrigation project in the Palu valley. Lake Lindu is situated at the headwater of the Gumbasa river drainage system. Since it was possible that schistosomiasis might spread from the Lindu valley to the Palu valley, the schistosomiasis research project was initiated in 1971 by the Ministry of Health. Following epidemiological studies (Carney *et al.*, 1974; Sudomo and Carney, 1974; Van Peenen *et al.*, 1973; Cross *et al.*, 1975) and a clinical trial(Hardjawidjaja *et al.*, 1976), a pilot control project was started in 1975 (Dazo *et al.*, 1976).

This pilot control project was basically an intervention study, which consisted of :

(1) reduction of source of infection by treating positive cases.
(2) reduction of vectors by spraying the foci with a molluscicide and by application of agro-engineering technology.
(3) reduction of human contact with cercariae infested water by promoting environmental sanitation and health education.

This report discusses results achieved from January 1975 through October 1976. Since the agro-engineering program was not started until March 1977, its effects will be discussed in a subsequent report.

MATERIALS AND METHODS

Study areas : For this study the village Anca (pop.390) with its farming area in Paku was chosen as the intervention area, while Langko (pop.455) with its rice-fields in Lombu was taken as the comparison area. (Fig. 1.)

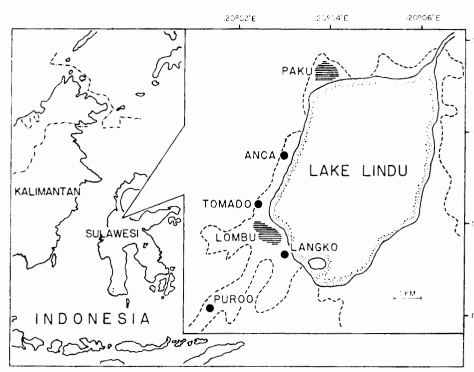

Fig. 1—Showing project area in Lindu Valley, Central Sulawesi.

Diagnosis and treatment of positive cases: Baseline data were obtained in Anca and Langko in January 1975. The inhabitants

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were asked to submit their faeces for 3 consecutive days. The modified Kato method (Katz *et al.*, 1973) was used to examine the faeces for schistosome eggs. A person was negative if 3 successive stool specimens were negative for schistosome eggs and a person was considered positive if one or more of the consecutive stool specimens was positive. Positive cases, who were considered not too risky to be treated and who were in the valley when the treatment team was there were treated with Niridazole (Ambilhar), 20 mg per kg bodyweight a day for 7 days. The treatment program was evaluated in October 1976 using the same methods and criteria.

Spraying of foci : Snail densities and snail infection rates were measured from September 1974 in the foci of Anca, Paku and Lombu. The Ring method (Pesigan *et al.*, 1958) was used to measure the snail density. Each month about 240 ring samples were taken in the intervention area and in the control area. Each snail was crushed and examined to obtain snail infection rates. The spraying programme was started in September 1975 in foci at Anca and Paku using Niclosamide (Bayluscide). A 20-40 mg/l solution of Bayluscide was applied at the rate of 10 litre per 100 square metres. The spraying programme was repeated monthly.

Rat-trapping : The endemicity of schistosomiasis was measured by monthly rat-trapping in both the intervention and comparison areas. From April 1974, 100 traps were set monthly in Paku and Lombu and left for 3 days. The captured rats were dissected and examined for the presence of schistosome worms to calculate infection rates.

Environmental sanitation and health education : In September 1975 the village Anca was provided with a piped water supply and two communal latrines. Two shallow manually operated wells were constructed in Paku. The villagers were encouraged to use the latrines and to obtain water from wells or piped supply instead of going to the river where they were exposed to schistosome cercariae.

RESULTS

Treatment of the infected persons : There were 345 persons examined in Anca, 246 of whom were found infected. Of these 180 persons were treated with Niridazole, only one did not complete the treatment course because of drug related adverse side effects.

In Table 1 results of prevalence surveys in January 1975 and October 1976 are tabulated. There was a marked decrease in prevalence in the intervention village, Anca, but in the control village there was also a significant decrease ($p < 0.01$). Of 152 infected residents of Anca who were treated, 82% were negative

Table 1

Prevalence of schistosomiasis before and after intervention.

Village	Before, Jan. 1975.		After, Oct. 1976.		X^2 test
	No. exam.	No.pos. (%)	No. exam.	No.pos. (%)	
Anca intervention village	345	246 (71.3)	350	91 (26)	X^2=140.96 P<0.001
Langko control village	404	220 (54.5)	387	170 (44)	X^2=8.35 P<0.01

in October 1976, however, 63% of the non-treated yet infected persons also were negative at the follow up examination (Table 2). Although the difference in becoming negative between the treated and non-treated was significant ($p < 0.01$), the percentage of the non-treated persons who become negative was extremely high (63%).

Table 3 compares non-treated infected persons in Anca and Langko. In Anca 63% became negative while in Langko only 42% converted. The difference was significant ($p < 0.01$).

Table 4 compares the follow up of initially non-infected persons in Anca and Langko. In Anca 12% became positive, while in Langko 32% coverted from negative to positive. The difference was again significant ($p < 0.01$).

Spraying of foci : Table 5 shows the snail density and infection rates in foci Anca, Paku and Lombu before and after spraying. A small decrease in snail density in the sprayed area was observed, but the density was still relatively high. Snail infection rates both before and after spraying were very low.

Rat-trapping : Table 6 compares the infection rates of rats in Paku and Lombu before and after intervention. In Paku there was a significant decrease ($p < 0.001$) in rat-infection rate (before intervention 18% and after intervention 9%), while in Lombu it remained unchanged (24% and 28% respectively; $p > 0.3$).

DISCUSSION

Mass-treatment of schistosomiasis has been regarded as unsafe, due to side effects of drugs, particulary antimony compounds. When Niridazole was clinically tested for treating schistosomiasis patients from Lindu, it was effective and fairly well tolerated (Hardjawidjaja *et al.*, 1976). Warren and Mahmoud (1975) concurred that Niridazole was the drug of choice since it was reasonably effective and relatively safe.

Table 2

Reexamination of infected persons from Anca in October 1976.

Group	No. examined	Schistosomiasis	
		positive	negative
Treated	152	27 (18)	125 (82)
Not treated	62	23 (37)	39 (63)

Percentage shown in parenthesis. $X^2 = 8.145$; $P < 0.01$.

Table 3

Reexamination of not treated infected persons from Anca and Langko in October 1976.

Village	No. examined	Schistosomiasis	
		positive	negative
Anca	62	23 (37)	39 (63)
Langko	194	112 (58)	82 (42)

Percentage shown in parenthesis. $X^2 = 7.220$; $P < 0.01$.

Table 4

Reexamination of non infected persons from Anca and Langko in October 1976.

Village	No. exam.	Schistosomiasis	
		positive	negative
Anca	69	8 (12)	61 (88)
Langko	162	51 (32)	111 (68)

Percentage shown in parenthesis. $X^2 = 9.045$; $P < 0.01$.

Table 5

Snail densities and infection rates before and after spraying with Niclosamide.

Area	Before (Sept.1974-Sept.1975)		After (Oct.1975-Sept.1976)	
	Density/m^2	Infection rate	Density/m^2	Infection rate
Anca	135	1.0%	78	1.0%
Paku	96	1.2%	57	1.4%
Lombu (control)	50	2.0%	37	1.3%

Table 6

Result of rat-trapping before and after intervention.

	Paku (intervention area)		Lombu (control area)	
	No.exam.	No.pos.(%)	No.exam.	No.pos.(%)
Before Sept.1974-Sept.1975	404	74 (18)	204	49 (24)
After Oct.1975-Sept.1976	479	45 (9)	222	62 (28)

$X^2 = 14.207$ $P < 0.001$. $X^2 = 0.652$ $P > 0.3$.

Table 7

Number of cercariae per square metre per day before and after spraying.

Area	Before	After
Anca	2.7	1.6
Paku	2.3	1.6
Lombu	2.0	1.0

In this study, Niridazole was used to mass-treat infected persons as outpatients in the endemic area. Of the 246 known schistosomiasis cases in Anca, 180 cases (73%) were treated, and only one could not finish the treatment course due to side effects of Niridazole. After one year 80% of the treated cases were negative (Table 2). Niridazole thus appears relatively safe and effective for mass-treatment of schistosomiasis in Indonesia.

Intervention not only has lowered the human prevalence rate (Table 1), but also lowered significantly the human incidence rate (Table 4) and wild commensal rodent infection rates (Table 6), suggesting that intervention decreases not only the prevalence of human cases, but also the transmission of the disease. Due to intervention the transmission in Anca subsequently was significantly lower than in Langko.

In the follow up of the non-treated yet infected persons in Anca and Langko (Table 3), the percentage of infected persons becoming negative in both villages was high, 63% in Anca and 42% in Langko. The difference was significant ($p < 0.01$). Since the percentage was higher in Anca, where the transmission was lower, we suspected, that more infected persons become negative, if the transmission was actually lower. In other words, infected persons, if not reinfected, spontaneously become negative after sometime. The question is, how long is this interval ?

In October 1976 the incidence rate in Anca was 12%, and in Langko 32% (Table 4), the difference was 20%. In the same period the difference between the percentage of infected persons becoming negative in Anca and Langko was 21% (Table 3). If we assume that the correlation between incidence rate and the percentage of infected persons staying positive is a linear one, then using Fig. 2, we can estimate the percentage of infected persons that will be positive after 19 months, if the incidence rate is zero. Extrapolation of the Langko-Anca line to its intersection with "incidence rate zero line" indicates that 25% of the infected persons stay positive after 19 months. We can further calculate, exponentially, the percentage of infected persons staying positive after 38 months and after 57 months, and the results are 6.25% and 1.5% respectively. Thus, we can estimate that after 57 months or 4.75 years almost all of the infected persons will become

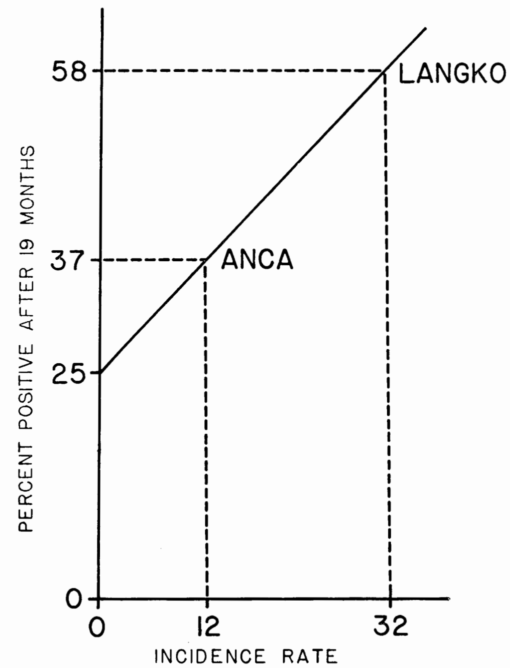

Fig. 2—Correlation between incidence rate and percentage positive.

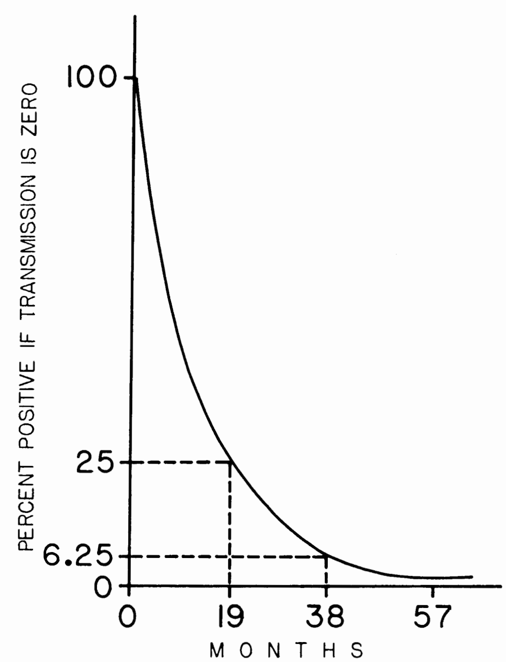

Fig. 3—Correlation of time and % positivity if transmission is zero.

negative, if the incidence rate is zero (Fig. 3). Hairston (1965) calculated the life span of *S.japonicum* as 4.5 years, which agreed with our results.

According to Warren (1973), in most endemic areas the proportion of the intermediate hosts which are shedding cercariae tends to be very low, in Leyte it was 4.7% (Pesigan *et al.*, 1958), and in Lindu it was 1 - 2% (Table 5). If one infected *Oncomelania* produces two cercariae per day (Warren, 1973), then from Table 5 we can calculate how many cercariae there are per day per sq. m. in the different foci. The results are shown in Table 7.

Although there were reductions in the number of cercariae per sq. m. per day in the sprayed foci of Anca and Paku (40% and 30%), there was an even bigger drop (50%) in the control focus of Lombu. Thus, spraying with a 20-40 mg per litre solution of Bayluscide, at a rate of 10 litre per 100 sq.m. does not seem to be effective.

The significant decrease in prevalence observed in the control village Langko (Table 1) and the high percentage of previously infected persons who become negative for schistosomiasis without treatment in Langko (Table 3), may have been the result of the reduction in cercarial density shown in Table 7.

SUMMARY

This pilot control project was an intervention study, consisting of : 1) treating the positive cases with Niridazole; 2) spraying the foci with Niclosamide; 3) improving the water supply system and construction of public latrines.

The intervention not only has lowered the human prevalence rate, but has also lowered the transmission of the disease in that area. Niridazole appeared relatively safe and effective, the cure rate after one year was 80%. Spraying the foci with Niclosamide 20-40 mg per litre did not appear very effective.

Using this epidemiological data it was estimated that infected persons would become spontaneously negative after 4.75 years, if there was no reinfection.

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