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EFFECT OF TREATMENT REGIMEN ON REINFECTION OF SOIL-TRANSMITTED HELMINTHIASES IN THE PHILIPPINES

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The control of soil-transmitted helminthiases, namely: ascariasis. trichuriasis and hookworm infection, particularly in developing countries like the Philippines is definitely not an easy thing to do. This is because of the several factors that come into play in their transmission. Some of these factors are poor environmental sanitation, poor personal hygiene, lack of health education, inadequate supply of potable water in the area and low economic status of the people.

Several studies have been done in the recent past in an attempt to determine the most practical yet most effective method of controlling the soil-transmitted helminthiases particularly ascariasis which is usually the most common of them all. Some of these studies focused on the determination of the minimum effective dose of anthelmintics (Chen, E.R. *et al.*, 1980, Abidin, S.A.N. *et al.*, 1980); frequency of drug administration (Chen, E.R. *et al;* 1983); the use of medicinal plants with anthelmintic properties (Unhanand, M. 1980; Unhanand, M. *et al.*, 1980; Keittivuti, B. *et al.*, 1983; Sahu, R. B. *et al.*, 1983, Unhanand, M. *et al.* 1983), comparison of mass over selective treatment (Cabrera, B. D. *et al.*, 1983) and clinical trials and review of new broad spectrum anthelmintics (Harinasuta, C. 1980; Harinasuta, C. 1980; Dissanaike, A.S. *et al.*, 1980; Kobayashi, A. 1980; Yokogawa, M. 1980, Abidin, S.A.N. *et al.*, 1980; Seo, B.S. 1980; Margono, S.S. *et al.*, 1980; Muttalib, M.A. *et al.*, 1983; Kan, S.P. *et al.*, 1983; Keittivuti, A. *et al.*, 1983; Kan, S.P. 1983; Ismail M.M. *et al.*, 1983, Yokogawa, M. 1983).

This paper is a compilation of data on several methods tried in the field by the author using the various treatment regimen of soil-transmitted helminthiases. Stool examination follow-up was done after each treatment regimen to determine reinfection rates of ascaris, trichuris and hookworm infections.

It must be emphasized here that reinfection is an important factor to consider in attempting to control soil-transmitted helminthiases in a given community or the entire country. A previous report by Cabrera B.D. 1978 has shown that the significant rise in reinfection rates for ascaris, trichuris and hookworm among subjects given treatment only once were 4 months for ascaris and 2 months for both trichuris and hookworm. It is for this reason that this work was done inasmuch as very few other studies in the past have considered this particular aspect in control programs.

Table 1. Comparison of Reinfection Rates of Ascariasis Among Children in Three Selected Areas, 1983.

Place	*Post Treatment Stool Follow-up (Months)*			
	3rd	*6th*	*9th*	*12th*
Puting Sapa* (155)	3.2	82.2	94.8	97.7
Pangpang** (37)	4.5	30.0	52.9	—
San Narcisco*** (51)	9.0	13.6	43.9	64.1

* = Treatment given only once (group 1).
** = Treatment given every 4 months for one year (group 2).
*** = Treatment given every 4 months for 3 years (group 3).
( ) = Number of study subjects

Materials and Methods

Preliminary stool surveys were made to determine the prevalence of ascariasis, trichuriasis and hookworm infection. From this data, we were able to select the subjects to be included in the treatment. Broad spectrum anthelmintics were then given to those found positive for eggs of any of the 3 soil-transmitted helminths. This was followed by a reexamination of the stool of all treated subjects, 10-14 days after treatment. All those found negative for eggs became the subjects for the re-infection rate study. About 243 children and 221 adults were involved in the three reinfection rate studies, done separately and at different times and areas. All study subjects gave zero reinfection rates during the first month observation. The succeeding stool examinations were done at the 3rd, 6th, 9th and 12th months. It is from the results of these post-treatment stool follow-up that reinfection rates were determined. The methodology applied were practically the same for all the 3 groups except for the frequency and duration of treatment regimen.

The three reinfection studies were divided into 3 groups based on the frequency and duration of the treatment regimen. Hence, in group 1 the subjects were treated with Pyrantel pamoate and/or Mebendazole 10 mg/kg body weight single dose or 100 mg twice a day for 3 days respectively. This treatment regiment was given only once and the second year was devoted to reinfection rate determination. In group 2 the subjects were given Flubendazole alone and Flubendazole with Levamisole, 500 mg tablet single dose and 500 mg tablet plus 10 mg Levamisole tablet respectively. The treatment was given every 4 months for one year; then followed by reinfection rate determination every 3 months lasting for only 9 months. In group 3, the subjects were given Oxantel-pyrantel (Quantrel) 5mg/kg

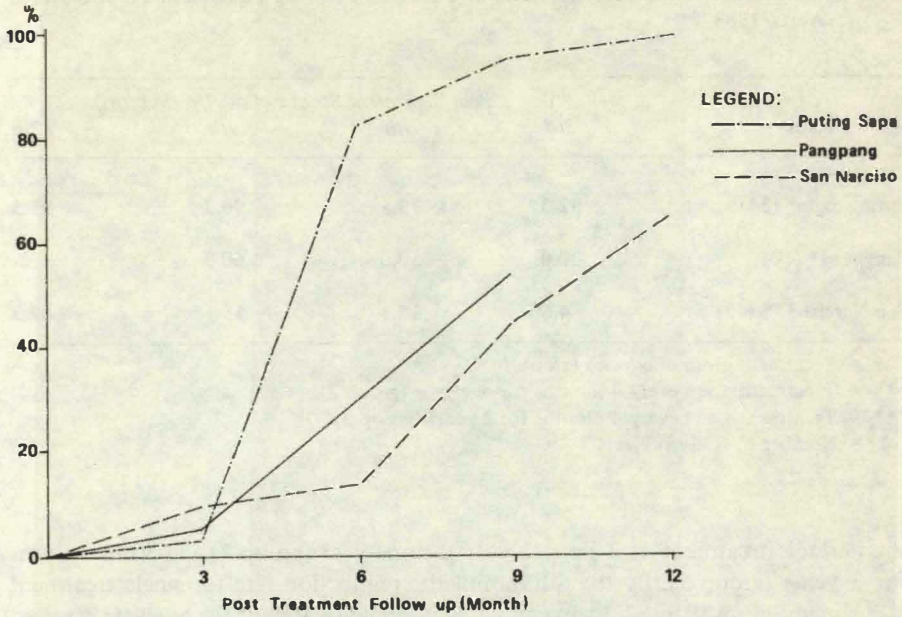

Figure 1. Comparison of Reinfection Rates of Ascariasis Among Children in Three Selected Areas.

body weight single dose every 4 months for the first two years, then 10 mg/kg. body weight single dose every 4 months for one more year or a total of 3 years. The 4th year was devoted to reinfection rate determination.

Results and Discussion

The 3 groups included in the present study came from three selected areas in the Philippines. The subjects were composed of both children and adults. The pre-treatment prevalence rates of ascaris, trichuris and hookworm among children in the 3 selected areas were 83, 93 and 69 percent respectively for group 1; 63, 88 and 24 percent respectively for group 2 and 77, 86 and 17 percent respectively for group 3. Among adults in the same order of helminths, the prevalence rates were 81, 93 and 76 percent for group 1; 50, 89 and 32 percent for group 2 and 71, 83 and 12 percent for group 3.

The reinfection rates of ascariasis among children following a successful treatment from the 3 groups is shown in Table 1 and Figure 1. The data on the 3rd month in table 1 appears to be in agreement with previous findings. The reinfection rates from the 3 areas ranged from 3 to 9 percent. It is very evident in this table particularly from the 3rd to the 12 months, that single treatment regimen (group 1), gave the fastest and the highest reinfection rates when compared with

Table 2. Comparison of Reinfection Rates of Trichuriasis Among Children in Three Selected Areas, 1983.

Place	*Post Treatment Stool Follow Up (Months)*			
	3rd	*6th*	*9th*	*12th*
Puting Sapa* (84)	52.3	79.5	90.3	91.5
Pangpang* (10)	30.0	50.0	60.0	–
San Narciso*** (43)	4.5	12.1	15.1	62.3

* = Treatment given only once (group 1).
** = Treatment given every 4 months for one year (group 2).
*** = Treatment given every 4 months for 3 years (group 3).
( ) = Number of study subjects

the periodic treatment of 3 times a year for one year (group 2) and 3 times a year for 3 years (group 3). By the 6th month the reinfection rate for single treatment was already more than 82.2 percent, while periodic treatment for one year resulted only in 30 percent reinfection. The result in periodic treatment for 3 years gave a much lower reinfection rate of 13.6 percent. Looking at the 9th month, single treatment resulted in 94.8 percent reinfection rate as compared to 52.9 and 43.9 percent reinfection rates for one year and 3 years treatment regimen respectively. At 12 months post treatment, single treatment gave a 97.7 percent reinfection rate of 64 percent. From past experience we presume that the reinfection rate of group 2 on the 12th month would be a little higher than group 3, probably around 70 percent.

The reinfection rates of trichuriasis are shown in Table 2 and Figure 2. At the 3rd month post treatment, trichuriasis reinfection rates for single and periodic treatment for one year were 52.3 and 30.0 percent respectively, while periodic treatment for 3 years was only 4.5 percent. At the 6th month, single treatment and periodic treatment for one year gave 79.5 and 50.0 percent reinfection rates respectively while periodic treatment for 3 years gave a 12.1 percent rate. At the 9th month, the reinfection rates for single and periodic treatment for one year were 90.3 and 60.0 percent respectively, while periodic treatment for 3 years was 15.1 percent. At the 12th month, rates of 91.5 and 62.3 percent were obtained for single and periodic treatment respectively. As in the case with ascariasis, the reinfection rates of trichuriasis were lower in the periodic treatment for a period of 3 years than in the other treatment regimen.

The hookworm reinfection rates in the 3 groups representing various treatment regimen are shown in Table 3 and Figure 3. It is quite apparent that reinfection rates in periodic treatment for a year and also periodic treatment for 3 years were

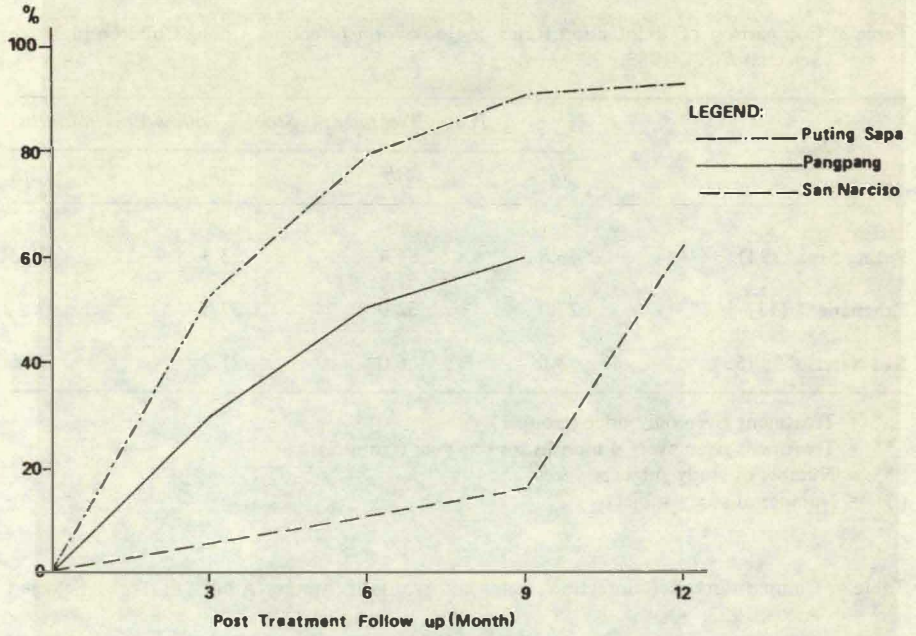

Figure 2. Comparison of Reinfection Rates of Trichuriasis Among Children in Three Selected Areas.

very much lower when compared to the rates obtained under a single treatment regimen.

Of the three soil-transmitted helminths where single treatment regimen was applied, ascaris has the lowest reinfection rate (3%) at the 3rd month observation period while trichuris and hookworm have much higher reinfection rates (52 and 47%) respectively. This is probably because it takes around 4 months for ascaris to show a significant rise in reinfection while trichuris and hookworm need only 2 months for a significant rise in reinfection (Cabrera, B.D. 1978). At the 6th month, single treatment reinfection rates for ascaris, trichuris and hookworm were about the same, around 80 percent. With periodic treatment for one year (group 2) the reinfection rates for ascaris and hookworm were about the same (30%) but higher rates (50%) were obtained with trichuris. In the periodic treatment for 3 years (group 3), the reinfection rates for ascaris and trichuris, were about equal 13 and 12 percent, but lower rates for hookworm were obtained (6%). At the 9th month, single treatment reinfection rates for the three helminths were about equal with rates over 90 percent. With periodic treatment for one year, trichuris had the highest reinfection rate, followed by ascaris, with hookworm having the lowest rate. The Pangpang study on reinfection (group 2) was terminated at the 9th month due to non-cooperation of the subjects. The rates for the periodic treat-

Table 3. Comparison of Reinfection Rates of Hookworm Infection Among Children in Three Selected Areas, 1983.

Place	*Post Treatment Stool Follow-Up (Months)*			
	3rd	*6th*	*9th*	*12th*
Puting Sapa* (94)	46.8	84.4	93.3	93.3
Pangpang** (43)	27.0	32.0	37.8	–
San Narciso*** (53)	3.0	6.0	21.2	24.5

* = Treatment given only once (group 1).
** = Treatment given every 4 months for one year (group 2).
*** = Number of study subjects.
( ) = Number of study subjects

Table 4. Comparison of Reinfection Rates of Ascariasis Among Adults in Three Selected Areas, 1983.

Place	*Post Treatment Stool Follow-up (Months)*			
	3rd	*6th*	*9th*	*12th*
Puting Sapa* (145)	0.0	50.8	84.7	95.7
Pangpang** (21)	2.5	6.6	12.9	–
San Narcisco*** (55)	3.6	9.3	20.7	28.7

* = Treatment given only once (group 1).
** = Treatment given every 4 months for one year (group 2).
*** = Treatment given every 4 months for 3 years (group 3)
( ) = Number of study subjects.

ment for 3 years (group 3) were the lowest when compared to groups 1 and 2. The same trend was maintained at 12th month post treatment observation.

Looking at figures 1, 2 and 3 for ascaris, trichuris and hookworm respectively, it appears that single treatment regimen (group 1) gave the highest and fastest reinfection rates in all the three soil-transmitted helminthiases. This rate was followed by the periodic treatment regimen for one year (group 2) and the lowest reinfection rates for the three helminths were obtained from the periodic treatment regiment for 3 years (group 3).

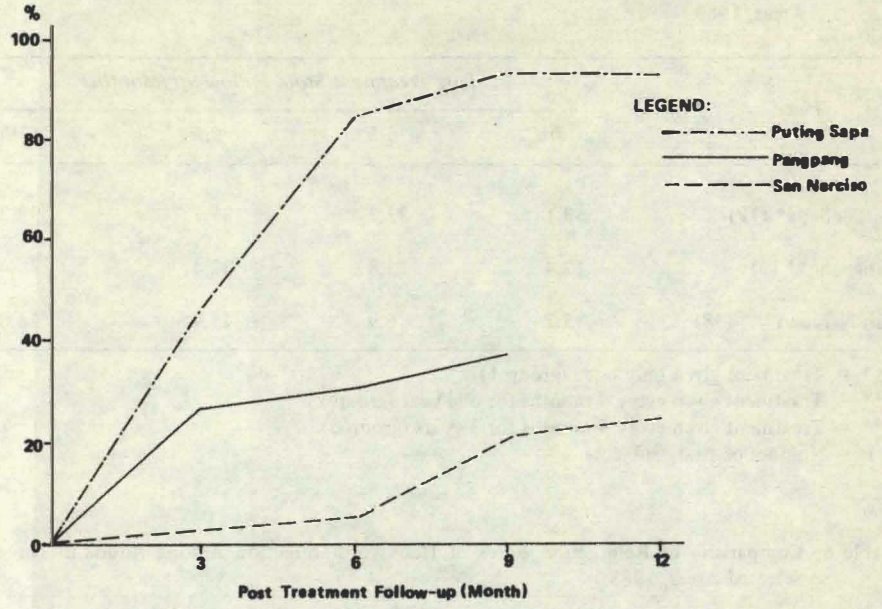

Figure 3. Comparison of Reinfection Rates of Hookworm Infection among Children in Three Selected Areas.

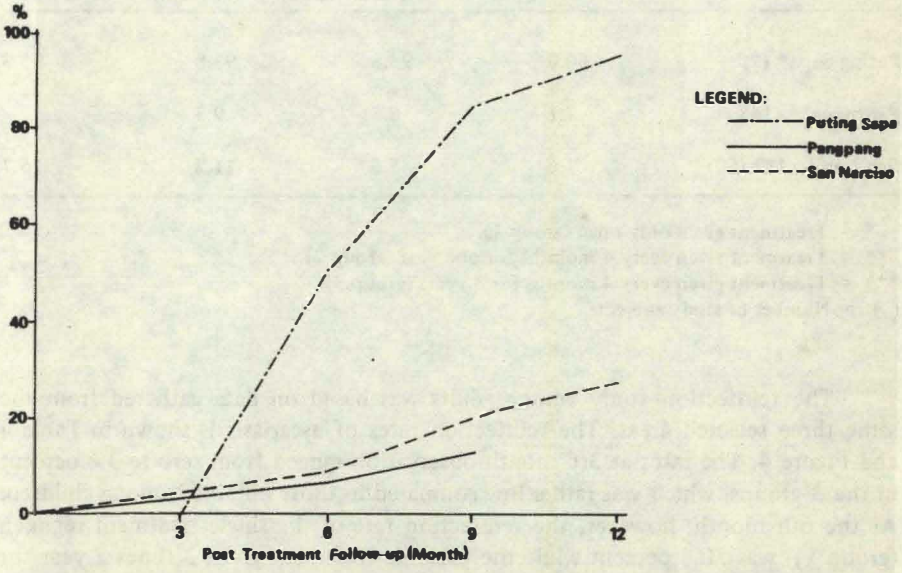

Figure 4. Comparison of Reinfection Rates of Ascariasis Among Adults in Three Selected Areas.

Table 5. Comparison of Reinfection Rates of Trichuriasis Among Adults in Three Selected Areas, 1983.

Place	*Post Treatment Stool Follow-up (Months)*			
	3rd	*6th*	*9th*	*12th*
Puting Sapa* (79)	53.1	83.7	89.1	93.2
Pangpang** (9)	12.4	25.8	32.4	–
San Narcisco*** (38)	5.2	6.9	15.4	26.6

* = Treatment given only once (group 1).
** = Treatment given every 4 months for one year (group 2).
*** = Treatment given every 4 months for 3 years (group 3).
( ) = Number of study subjects

Table 6. Comparison of Reinfection Rates of Hookworm Infection Among Adults in Three Selected Areas, 1983.

Place	*Post Treatment Stool Follow-up (Months)*			
	3rd	*6th*	*9th*	*12th*
Puting Sapa* (7)	60.0	93.8	93.8	95.3
Pangpang** (14)	7.1	8.5	9.3	–
San Narciso*** (60)	1.6	5.6	11.2	15.7

* = Treatment given only once (group 1).
** = Treatment given every 4 molnths for one year (group 2).
*** = Treatment given every 4 months for 3 years (group 3).
( ) = Number of study subjects.

The reinfection study among adults was based on data gathered from the same three selected areas. The reinfection rates of ascariasis is shown in Table 4 and Figure 4. The rates at 3rd month observation ranged from zero to 3.6 percent in the 3 groups, which was rather low compared to those obtained among children. At the 6th month, however, the reinfection rate of the single treatment regimen (group 1) was 50.8 percent while the periodic treatment given 3 times a year for one year (group 2) was only 6.6 percent and 9.3 percent for the periodic treatment 3 times a year for 3 years (group 3). At the 9th month, the reinfection rate for

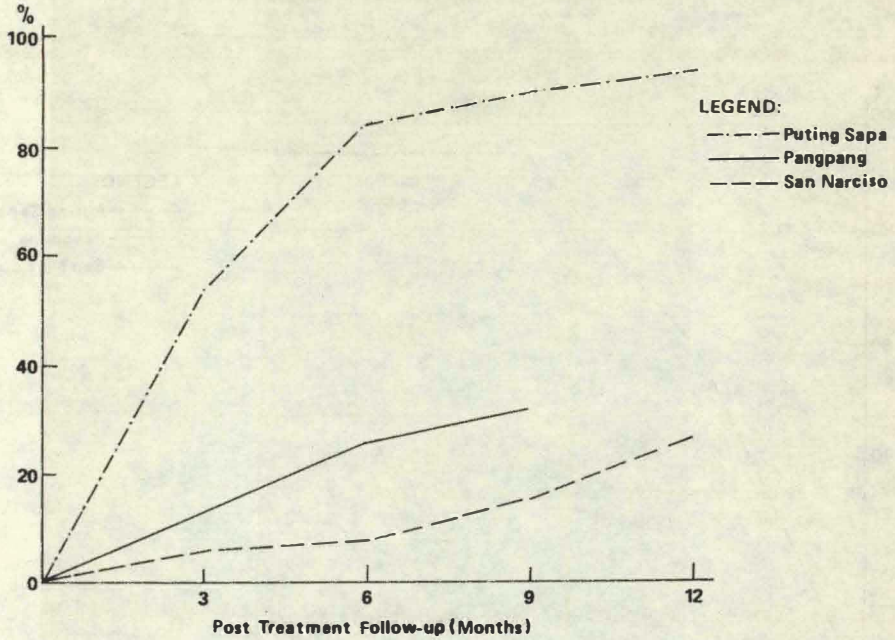

Figure 5. Comparison of Reinfection Rates of Trichuriasis Among Adults in Three Selected Areas.

group 1 was 84.7 percent as compared to 12.9 and 20.7 percent for groups 2 and 3 respectively. At the 12th month, group 1 had a reinfection rate of 95.7 percent compared to 28.7 percent for group 3. It is quite evident from these data that periodic treatment given 3 times a year for three years was much better than the single treatment regimen.

The reinfection rates of trichuriasis are shown in Table 5 and Figure 5. It can be seen here that the reinfection rates at the 3rd month were higher than those of ascariasis. Single treatment regimen (group 1) registered a 53 percent rate while the periodic treatment regimen for one year (group 2) and the periodic treatment for 3 years (group 3) were 12.4 and 5.2 percent respectively. At the 6th month observation, the single treatment regimen registered a 83.7 percent rate as compared to 25.8 and 6.9 percent for groups 2 and 3 respectively. At the 9th month, the reinfection rate for the single treatment gradually increased to 89 percent as compared to 32 and 15 percent for groups 2 and 3 respectively. At the 12th month, group 1 reached 93.2 percent while group 3 reinfection rate was only 26.6 percent. The reinfection rates for the three helminths at the 12th month were all over 93 percent.

The reinfection rates for hookworm infection are shown in Table 6 and Figure 6. With the exception of the single treatment regimen (group 1) which

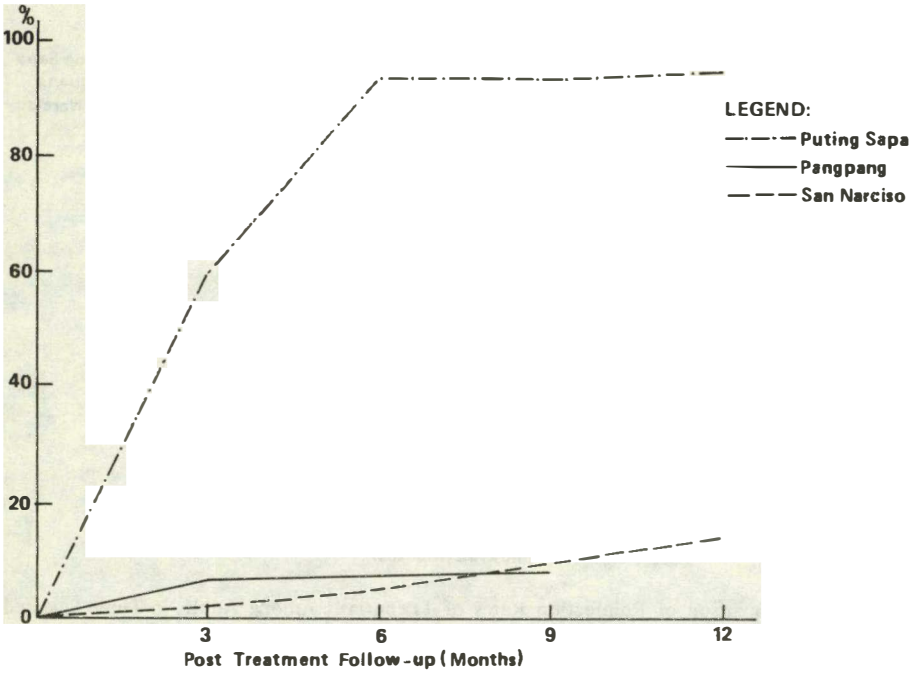

Figure 6. Comparison of Reinfection Rates of Hookworm Infection Among Adults in Three Selected Areas.

gave a reinfection rate of 60 percent at the 3rd month, the rates for groups 2 and 3 were quite low ranging from 1.6 to 7 percent respectively. At the 6th month, group 1 gave a 93.8 percent reinfection rate while groups 2 and 3 gave 8.5 and 5.6 percent respectively. While the single treatment regimen remained more or less stationary at 9th and 12th months observation, the periodic treatment regimen for one year and also for 3 years maintained a low level of reinfection rates ranging from 9 to 15.7 percent respectively.

Comparing the reinfection rates of ascariasis among children with those among adults for the 3 groups, we noticed that the adults showed consistently lower rates than children during all the periods of observation. The difference in rates were evident in groups 2 and 3 where the periodic treatment regimen was applied. In group 1, where single treatment regimen was applied, the reinfection rates for both children and adults were not much different.

In the case of trichuriasis reinfection rates, the adults showed lower rates than children among those given periodic treatment. There was no difference at all

between reinfection rates among children and adults where single treatment regimen was applied. In fact, adults showed slightly higher reinfection rates.

In hookworm, the reinfection rates among adults were higher than in children probably because farming was the principal occupation in Puting Sapa (group 1). In groups 2 and 3 where periodic treatment was applied, it was quite evident that the reinfection rates obtained among adults were much lower than those of children.

Summary and Conclusion

Reinfection rates of soil-transmitted helminthiases from 3 groups of subjects given broad spectrum anthelmintics and using different treatment regimen are hereby presented.

The data gathered showed that subjects given a single treatment regimen (group 1) had the highest and fastest reinfection rates, followed by those given periodic treatment of 3 times a year for one year (group 2). The lowest reinfection rates were obtained from those given periodic treatment every 4 months for 3 years (group 3). In general, adults showed lower reinfection rates when compared to children particularly on those subjects that were given periodic treatment regimen.

From this study, there seems to be justification in recommending the adoption of periodic treatment for 3 years in the control and/or eradication of soil-transmitted helminthiases in this country. This statement is based on the low reinfection rates of the 3 common intestinal helminths when subjects were given the above treatment regimen. The low reinfection rates may be explained by th death or non-infectivity of the eggs or larvae in soil within a 3-year period and hence transmission is minimized and eventually stopped.

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