

AN ATTEMPT TO STUDY THE ECONOMIC LOSS ARISING FROM *SCHISTOSOMA JAPONICUM* INFECTION AND THE BENEFITS DERIVED FROM TREATMENT

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Abstract. From the northern and southern portions of Leyte Province, which are endemic for schistosomiasis, a total of 801 infected individuals were interviewed, examined, and classified into mild, moderate, severe and very severe forms of disease with an assumed loss of working capacity for each category. The frequency rate or number of spells of illness for the past year under observation were correlated with the degree of incapacity to get the total days lost per person per year. Following a series of computations, of which the disability rate was considered as the most important, a total of 45.4 days lost per infected person per year was arrived at. Treatment of the disease with praziquantel was carried out and the patients were followed up one year after treatment, at which time the same methodology was applied. The results show that the 45.4 days lost prior to treatment went down to 4 days lost. There was an economic gain of 41.4 days as a result of treatment. This can be expressed in terms of financial value if we consider half of the infected cases as breadwinners receiving a minimum wage. It should be noted that a number of assumptions in this study were made. It is, however, hoped that this work will serve as a guide and a starting point for others to carry out related studies on economic loss and subsequent economic benefits to justify budgetary requests/allocations for the implementation of various preventive and control measures.

INTRODUCTION

Schistosomiasis imposes significant economic burdens on individuals, communities and nations. It is costly because of its effect on physical, economic and social health. Of the several ways in which the disease imposes an economic burden on society, the one which is least known in quantifiable terms is its direct impact on labor performance. Previous studies on this aspect have suffered from a lack of a more precise knowledge of how the infection and its treatment actually affect worker performance.

Since the advent of a safe, non-toxic and effective anti-schistosomal drug, praziquantel, selective mass chemotherapy of schistosomiasis cases has been carried out to a certain extent in

the province of Leyte for the past 3 years. Encouraging results have been obtained as shown by a reduction in the prevalence-incidence rates. The health improvement which will result can have important effects, since the benefits may "spill over" to persons or groups in the community other than the direct beneficiaries.

This study aims to provide future researchers with a way how to carry out a direct measurement of the effects of schistosomiasis on people and their economic lives, as well as on the morbidity changes which take place when an intervention is being undertaken. Their results can then be compared with our data on the progress of schistosomiasis control program in terms of economic loss as the disease control program goes on.

General objectives are to assess the changes in morbidity and economic impact with the treatment of schistosomiasis japonica in Leyte. Specific objectives are to determine the mandays lost arising from schistosomiasis infec-

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tion before treatment, determine the days lost arising from schistosomiasis one year after treatment, and relate any mandays gained as a result of treatment in terms of economic benefits from past and present endeavors.

MATERIALS AND METHODS

The study areas

The study includes some endemic barangays from the municipalities of Santa Fe and Alang-Alang in the North and Dagami and Dulag in the South. In order to better demonstrate any impact of the treatment program, municipalities with a relatively higher endemicity were selected, preferably one coastal and one interior town in each direction. In the North, since there was only one coastal town and this was the site of another study by researchers from the Research Institute of Tropical Medicine, we had no choice but to use two interior towns. The prevalence of schistosomiasis in these municipalities in 1983 ranged from 10.7 to 22.1%: 10.7% in Dagami, 13.1% in Dulag, 22.1% in Santa Fe and 15.2% in Alang-Alang.

The infected individuals

At least 300 infected individuals from the North and about the same number from the South were interviewed and examined. The severity of the disease was adapted as the main criterion, irrespective of the stage or the speed of the disease process. A simple classification dividing the disease attributable to schistosomiasis, which the patient could easily distinguish and which could be recorded during the course of a short interview, was used. In the classification of severity "incapacity" was included as an im-

portant element as shown below:

1. Mild - occasional abdominal pain, occasional diarrhea or dysentery and no absence from work.
2. Moderate - with anemia (less than 10 g/100 ml) or weakness, and the inability to do hard work.
3. Severe - with recurring attacks of diarrhea and dysentery, and frequent absence from work.
4. Very severe - with ascitis and/or emaciation, and total absence from work.

From the cross - section of the patients examined, the number of mild, moderate, severe and very severe cases of the disease was established.

Measurement of disability

In the absence of agreed upon criteria for which the degree of ill health could be identified and differentiated, the following classification was adopted and the number of days of sickness in each of the four categories with an assumed loss of working capacity for each are recorded in Table 1.

The frequency rate or the number of spells of illness for the past year per person under observation was correlated with the degree of incapacity to get the days lost per year.

The existence of a relationship between the 3 types of rates has been brought out by Dorn (1955 and 1956). If F represents the frequency rates, S the severity and D the disability rate.

$$D = F \times S \text{ or } F = D/S$$

The disability rate (D) is obviously the most important figure for purposes of computations

Table 1
Classification of sickness with assumed loss of working capacity.

Class	Description	Assumed loss of working capacity in %
Non-disabling sickness		
Class I	No absence from work	25
Disabling sickness		
Class II	Absence from work not classified under III or IV	50
Class III	Confined to house	75
Class IV	Confined to bed	100

before and one year after treatment with praziquantel.

RESULTS

The infected cases (Pre-treatment findings)

A total of 801 individuals from 22 barangays were included in the study. Of the 801 subjects, 523 were males, 278 females with a sex ratio of 188 males per 100 females. The ages of the patients ranged from 2.5 to 81 years. The highest peak of the disease occurred among the age group 10-19 years old, comprising about 40.6% of the total (Table 2). At least 67.7% were farmers and their families (Table 3).

Clinical findings

Physical examination revealed that 103 patients (12.9%) had hepatomegaly, 14 (1.7%) had hepatosplenomegaly, and 2 (0.51%) had splenomegaly without hepatomegaly (Table 4).

Anemia was moderately severe in 8.4%, mild to moderate in 49.8% while 41.8% had normal hemoglobin values of 13 g% or above (Table 5).

Clinical examination of the 801 patients showed that 16.5% were asymptomatic. Those presenting with definite signs and symptoms were further classified into mild, moderate and severe according to the degree of ill health and

Table 2
Age and sex distribution of the stool positive individuals for *S. japonicum* infection pre- and post-treatment in four municipalities of Leyte.

Age group	Initial examination				Follow-up examination			
	Male		Female		Male		Female	
	No.	%	No.	%	No.	%	No.	%
0-9	74	14.1	49	17.6	48	11.7	32	14.7
10-19	219	41.9	106	38.1	181	43.9	91	41.7
20-29	72	13.8	22	7.9	52	12.6	16	7.3
30-39	72	13.8	31	11.2	52	12.6	24	11.0
40-49	41	7.8	36	12.9	42	10.2	26	11.9
50-59	29	5.5	25	9.0	20	4.9	20	9.2
60 and over	16	3.1	9	3.2	17	4.1	9	4.1
Total	523	100.0	278	100.0	412	100.0	218	100.0

Table 3
Distribution of individuals positive for *S. japonicum* infection by occupation pre-and post treatment in four municipalities of Leyte.

Occupation	Initial examination (1983)		Follow-up examination (1984)	
	No.	%	No.	%
Pupils	296	37.0	202	32.1
Farmers	245	30.6	186	29.5
Unemployed	99	12.4	55	8.7
Students	46	5.7	70	11.1
House keepers	38	4.7	53	8.4
Pre-schoolers	33	4.1	24	3.8
Laborers	26	3.2	30	4.8
Professionals and other office workers	11	1.4	3	0.5
Market vendors and businessmen	5	0.6	4	0.6
Tuba gatherers	2	0.2	3	0.5
Total	801	100.0	630	100.0

Table 4
Prevalence of hepatomegaly and splenomegaly among *S. japonicum* cases before and after treatment with praziquantel.

Age group (year)	No. examined	Hepatomegaly		Splenomegaly	
		No.	%	No.	%
0-9	123	35	28.46	0	0.00
10-19	325	39	12.00	8	2.46
20-29	94	5	5.32	1	1.06
30-39	103	11	10.68	4	3.88
40-49	77	5	6.49	0	0.00
50-59	54	4	7.41	1	1.85
60 and over	25	4	16.00	0	0.00
Total	801	103	12.86	14	1.75

hemoglobin value. Ninety point one percent were considered mild (Class I), 9.7% were moderate (Class II), while only 1 (0.2%) was classified as severe (Class III) (Table 6).

Measurement of disability

A relationship between frequency (F), severity (S) and disability (D) rates has been demonstrated by Dorn (1956) as follows:

$$D = F \times S$$

The frequency, severity and disability rates of morbidity were thus obtained (Table 7). The disability rate of cases from the 4 endemic towns was 163.84 days, which is equivalent to the average number of sick days per person per year. It was noted that Class I sickness constituted 89.2% of the total sick days, Class II comprised 10.6%, and Class III was 0.2% (Table 8). No patient was encountered belonging to Class IV. Assuming that Class I, Class II and Class III had working capacity losses of 25, 50, and 75%, respectively, we obtained the following :

$$\text{Class I: } 163.84 \times 0.892 \times 0.25 = 36.5$$

$$\text{Class II: } 163.84 \times 0.106 \times 0.50 = 8.7$$

$$\text{Class III: } 163.84 \times 0.002 \times 0.75 = 0.2$$

$$\text{Total: } 45.4$$

Therefore, the average total days lost per infected person per year was equivalent to 45.4.

Follow-up of the treated cases

A one year post-treatment interview and examination were conducted. Out of 801 sub-

Table 5
Hemoglobin levels of 630 *S. japonicum* infected persons before and one year after treatment with praziquantel.

Hemoglobin level	Pre-treatment		One year after treatment	
	No.	%	No.	%
Less than 10g%	55	8.7	22	3.5
10-12 g%	314	49.5	236	37.5
13 g% and above	265	41.8	372	59.0
Total	634	100.0	630	100.0

Table 6
Clinical gradient of schistosomiasis cases in four municipalities of Leyte, 1983 and 1984.

Classification	schistosomiasis cases 1983		schistosomiasis cases one year after treatment	
	No.	%	No.	%
I. Asymptomatic	132	16.5	416	66.0
II. Symptomatic	669	83.5	214	34.0
Total	801	100.0	630	100.0
For symptomatic				
1. Mild	603	90.1	207	96.7
2. Moderate	65	9.7	7	3.3
3. Severe	1	0.1	0	0.0
4. Very severe	0	0.0	0	0.0
Total	669	100.0	214	100.0

jects, 630 were followed up. Of the 630, the ratio of males to females was 1.37:1. The ages ranged from 3 to 81 years. Two hundred seventy-five (43.7%) of those who followed up belonged to the age group 10-14 years (see Table 2 for age and sex distribution).

The proportion of unemployed significantly decreased from 12.3% to 8.7%. They became either laborers, students or housekeepers. Their improved state of well-being was the most common reason cited by the subjects for being productive or active again (Table 3).

Blood follow-up examinations showed a reduction in severe anemia (Hgb less than 10 g%) from 7.9% to 3.5%, and mild anemia decreased from 50.9% to 37.5%. This reduction with the subsequent increase in the number of subjects with normal hemoglobin (above 12.5 g%) from 41.1% to 59.1% was statistically significant (Table 5).

In general, a remarkable improvement in the nutritional status of the patients was observed one year after treatment with praziquantel.

Prior to treatment in 1983, 16.5% of the 801

Table 7
Frequency, severity and disability rates of illness among 801 *Schistosoma* infected individuals over a one year period by age, 1983.

Age group (In years)	Number examined	Number of spells of illness	Freq rates (No. spell per person)	Total duration in days	Severity rate (duration / spell in days)	Disability rate (No. of sick days per person)
0-9	123	5,898	47.95	21,205	3.60	172.62
10-19	325	16,438	50.58	56,194	3.42	172.98
20-29	94	3,230	34.36	13,347	4.13	141.91
30-39	103	3,545	34.42	15,670	4.42	152.14
40-49	77	2,825	36.69	12,303	4.36	159.97
50-59	54	1,977	36.61	8,984	4.54	166.21
60 and over	25	717	28.68	3,530	4.92	141.11
Total	801	34,630	43.23	131,233	3.79	163.84

Table 8
Number and duration of spells of illness classified according to the degree of ill-health (class I - IV) among 801 *Schistosoma* infected individuals over a one year period by age, 1983.

Age group (In years)	Total No. of spells	Total duration in days	I		II		III		IV	
			No.	Duration	No.	Duration	No.	Duration	No.	Duration
0-9	5,898	21,205	4,804	17,607	1,094	3,598	-	-	-	-
10-19	16,438	56,194	13,475	48,610	2,909	7,284	54	300	-	-
20-29	3,230	13,347	3,218	12,987	12	360	-	-	-	-
30-39	3,545	15,670	3,395	14,845	150	825	-	-	-	-
40-49	2,825	12,303	2,637	11,498	188	805	-	-	-	-
50-59	1,977	8,984	1,812	8,004	165	980	-	-	-	-
60 and over	717	3,530	717	3,530	-	-	-	-	-	-
Total	34,630	131,233	30,058	117,081	4,518	13,852	54	300	-	-

Percentage distribution of duration of spells by cases :
 Class I = $117,081 / 131,233 \times 100 = 89.22\%$
 Class II = $13,852 / 131,233 \times 100 = 10.56\%$
 Class III = $300 / 131,233 \times 100 = 0.23\%$

Computation for man-days lost :
 $163.84 \times 0.892 \times 0.25 = 36.5$
 $163.84 \times 0.106 \times 0.50 = 8.7$
 $163.84 \times 0.002 \times 0.75 = 0.2$
 Total man-days lost = 45.5

Table 9

Frequency, severity and disability rates of illness among 630 followed-up *Schistosoma* infected persons over a one year period by age, 1984.

Age group (In years)	Number examined	Number of spells of illness	Frequency rate (spells / person)	Total duration in days	Severity rate (duration / spell)	Disability rate (No. of sick days per person) F = E x C
	A	B	C = B/A	D	E = D/B	
0-9	80	141	1.76	411	2.91	5.12
10-19	272	1,373	5.05	2,825	2.06	10.40
20-29	68	349	5.13	962	2.76	14.16
30-39	76	615	8.09	1,337	2.17	17.56
40-49	68	400	5.88	2,650	6.63	38.98
50-59	40	237	5.93	924	3.90	23.13
60 and over	26	153	5.88	810	5.29	31.11
Total	630	3,268	5.19	9,919	3.04	15.78

Table 10

Number and duration of spells of sickness classified according to age and degree of ill-health among 630 followed-up *Schistosoma* infected persons over a one year period, 1984.

Age group (In years)	Total No. of spells	Total duration of spell in days	Class I		Class II		Class III		Class IV	
			No.	Duration	No.	Duration	No.	Duration	No.	Duration
0-9	141	411	110	374	31	37	-	-	-	-
10-19	1,373	2,825	1,359	2,774	14	51	-	-	-	-
20-29	349	962	264	882	85	80	-	-	-	-
30-39	615	1,337	615	1,337	-	-	-	-	-	-
40-49	400	2,650	400	2,650	-	-	-	-	-	-
50-59	237	924	237	924	-	-	-	-	-	-
60 and over	153	810	153	810	-	-	-	-	-	-
Total	3,268	9,919	3,138	9,751	130	168	-	-	-	-

Percentage distribution of duration of spells by cases :

Class I = $9,751 / 9,919 \times 100 = 98.31\%$

Class II = $168 / 9,919 \times 100 = 1.69\%$

Computation for man-days lost :

Class I = $15.78 \times 0.98 \times 0.25 = 3.9$

Class II = $15.78 \times 0.017 \times 0.50 = 0.1$

Working days lost for followed-up patients = 4.0

cases were asymptomatic, one year after therapy, 416 (66%) of the 630 that were followed-up were symptom-free. Although 34% of the treated group remained symptomatic, the degree of severity of their symptoms was significantly reduced (Table 6).

Physical examination showed that of the cases followed-up one year after treatment, hepatosplenomegaly was significantly reduced from 1.7% to 0.9% (Table 4).

Disability before and after treatment

Through careful interview and detailed his-

tory taking, the details of each treated individual were obtained, where the number of spells for each symptom, and the duration, were recorded. From these data, the frequency rate (number of spells per person), severity rate (duration per spell in days), and disability rate (number of sick days per person per year) were again obtained as in the pre-treatment study. The disability rate of the followed-up cases was 15.78, which when allocated to the different classes of ill health with their corresponding assumed loss of working capacity, resulted in 4.0 days lost of working capacity per treated person (Tables 9 and 10).

Comparative assessment of the economic benefits of treatment

The computed days lost prior to treatment in 1983 were 45.4. At follow-up one year after treatment, this went down to 4 days lost, a percent reduction of 91.2%.

DISCUSSION

Based on the clinical findings, it is quite apparent that one of the impact of chemotherapy was the reduction in morbidity and severity of the disease. The 41.4 (45.4 - 4 = 41.4) days gained from treatment of the disease mean more manpower. If this is multiplied by the total number of cases, the total days gained as a result of treatment can be obtained. This can be expressed in terms of a theoretical monetary value, if we consider half of the infected cases are breadwinners receiving minimum wage.

It is hoped that this study will provide present day researchers, a way of assessing progress of a schistosomiasis control program in terms of morbidity and severity of the disease and not just in terms of prevalence (Blas *et al*, 1989).

Both the impact of treatment, which started as a selective mass treatment to mass treatment

starting in 1997 to the present, has not yet been properly assessed. It may be worthwhile to mention here that, in a review of the schistosomiasis problem in the Philippines, the prevalence went down from an average of 10.4% in 1981-1985 to 4.1% in 1996 (Blas *et al*, 2004). The accompanying degree of reduction in morbidity would be very interesting to look into.

ACKNOWLEDGEMENTS

We are grateful for receiving financial support from the Philippine Council for Health Research and Development (PCHRD), Department of Science and Technology (DOST) and Pfizer Health Foundation.

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