

EVOLUTION OF SCHISTOSOMIASIS IN AN HYPERENDEMIC AREA OF THE MINAS GERAIS STATE: TWO CROSS-SECTIONAL STUDIES (*)

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S U M M A R Y

Two cross-sectional studies on schistosomiasis mansoni were done in Comercinho, Minas Gerais (Brazil), at an interval of 7 years. In 1974 and 1981 feces examinations (KATO-KATZ method) were done in 89 and 90% of the population (about 1,500 inhabitants) and clinical examinations were done in 78 and 92% of the patients who excreted *Schistosoma mansoni* eggs in the feces, respectively. The rate of infection by *S. mansoni* did not change (69.9% in 1974 and 70.4% in 1981), but the geometrical mean of eggs per gram of feces (431 ± 4 and 334 ± 4 , respectively) and the rate of splenomegaly (11 and 7%, respectively) decreased significantly in 1981, when compared to 1974. This reduction was observed only in the central zones of the town (zones 1-2) where the rate of dwellings with piped water increased from 17 to 44%. In the surroundings (zones 3-4), where the proportion of houses with piped water did not change significantly between 1974 (10%) and 1981 (7%), the geometrical mean of *S. mansoni* eggs and the rate of splenomegaly did not change either.

I N T R O D U C T I O N

A cross-sectional study on schistosomiasis mansoni was done in Comercinho, Minas Gerais State, Brazil. In this study the most interesting finding was the severity of the schistosomiasis (higher infection rate, higher egg count in the feces and higher rate of splenomegaly) in the environments (zones 3-4) compared to the one observed in the central areas in the town (zones 1-2). In zones 3 and 4 the heads of family were predominantly manual workers (73 and 94%, respectively), only 3 and 10% of the houses had piped water and less than 14% of the dwellings were of good quality, while in zones 1 and 2, the economical situation of the heads of family, the quality of the houses, and the water supply were better⁴.

In the present paper the results of the cross-sectional study done in 1981 will be compared to one done previously in Comercinho 7 years before. This comparison aims to: a) evaluate if the rate of infection, the counting of *S. mansoni* eggs in the feces and the rate of splenomegaly in zones 1-2 and 3-4 underwent modifications during the period of survey; b) if any change had occurred, identify the possible factors responsible for the modification.

M A T E R I A L S A N D M E T H O D S

Comercinho is a town in the northeast of the State of Minas Gerais (Brazil) situated at 701 kilometers from the capital (Belo Horizonte). The town is surrounded by three small

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streams that are used by the population chiefly for domestic activities (75% of the contact of the inhabitants of Comercinho with natural waters are for washing clothes and dishes, for body hygiene, and to obtain water from the streams for housekeeping⁵). There is no sewage drainage in the town and the intermediate host is *Biomphalaria glabrata*⁴.

Comercinho was divided into four geographical zones: two situated in the environs (zones 3 and 4) and two in the central area of the town (zones 1 and 2). Further details are in COSTA et al.⁴.

The people from Comercinho were examined in 1974 and in 1981: in both periods feces and clinical examination in patients who excreted *S. mansoni* eggs were done. No schistosomiasis control program was made in the area during the period of study.

A complete census in the town was done in May, 1974 and in May, 1981; forms were filled out with name, date of birth and sex of the inhabitants as well as the origin of the water supply in the house (whether with or without piped public water).

The feces examinations were done by the KATO-KATZ method¹⁰. Two slides from each sample of feces were prepared and the mean of the two egg counts was considered as the number of *S. mansoni* eggs per gram of feces of the patient.

The clinical examinations were done by one physician in 1974 and by another from the same staff in 1981. The individuals were examined in decubitus dorsales and in right lateral decubitus being considered palpable the liver and spleen detected immediately below the costal margin, breath held. The PESSOA & BARROS¹² clinical classification was used with slight modifications: **Type I** — liver and spleen not palpable, or palpable liver with normal consistency; **Type II** — hardened palpable liver; **Type III** — palpable spleen or splenectomized patients.

Statistic analysis

To evaluate the statistic significance of the differences between the means, STUDENT's *t* test was used, and for the differences between the frequencies, the X^2 test with YATES correc-

tion was used. The results from 1974 and 1981 were adjusted by the age, according to the weighted standard population (the statistic analysis of the differences between the adjusted rates were done through the method of the minimum variance). The minimum level of significance considered was 95%¹³.

RESULTS

The Fig. 1 shows the distribution of the population from Comercinho, according to sex and age, as well as the rate of patients that underwent clinical and/or feces examinations in 1974 and 1981. In 1974 and in 1981 there were respectively 1487 and 1474 persons living in the town; the feces examination was done in 88.8 and 90.2% of the whole population and the clinical examination was done in 78.2 and 92.2% of the positive patients, respectively.

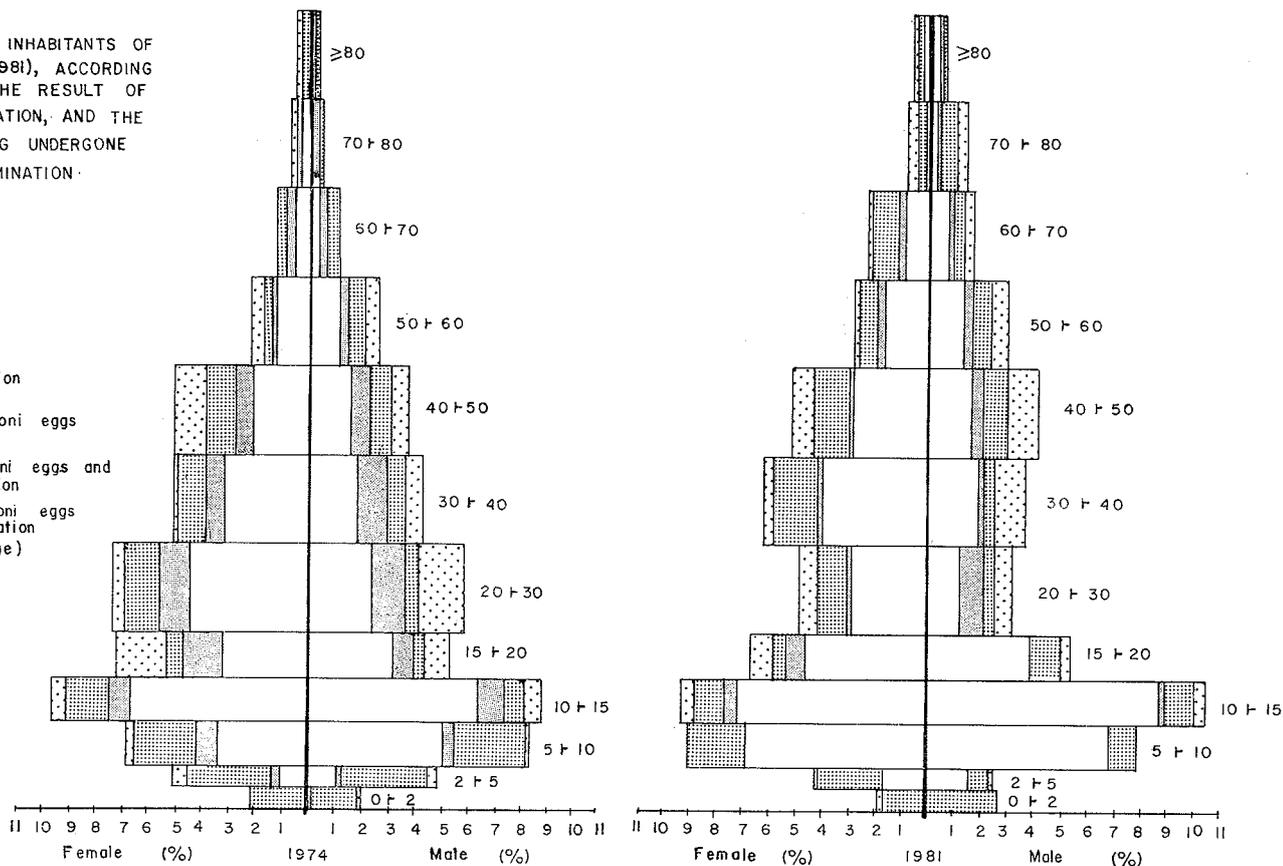
The rate of infection by *S. mansoni* did not change during the analysed period (69.9 and 70.4%), but the geometric mean of eggs in the feces and the rate of splenomegaly decreased significantly in 1981, when compared to 1974 (Table I). These similarities and differences remained when the results of both periods were adjusted by the age of the standard population (rate of infection = 70.3 and 70.2%; rate of patients with ≥ 1000 eggs per gram of feces = 31.7 and 24.0%, and rate of splenomegaly = 11.4 and 6.6% in 1974 and 1981, respectively).

Table II shows the rate of infection, the egg counting and the distribution of the clinical forms in zone 1-2 and 3-4. In regard to zones 1-2, the following results are remarkable: a) the rate of infection in children and adults did not change between 1974 and 1981; b) the geometric mean of eggs in children and in adults (treated or not) decreased significantly between 1974 and 1981; c) the proportion of children with splenomegaly decreased from 10.6% in 1974 to 2.5% in 1981; d) the rate of splenomegaly in adults was statistically similar in both periods (9.2% in 1974 and 5.1% in 1981). In zones 3-4, the only statistically significant difference between 1974 and 1981 was the increase of the rate of infection in children (from 68.0 to 80.8%).

Table III shows the water supply, electricity in the house, the pavement of streets, the po-

Fig. 1 - DISTRIBUTION OF THE INHABITANTS OF COMERCINHO (1974/1981), ACCORDING TO THE AGE, SEX, THE RESULT OF THE FECEs EXAMINATION, AND THE CONDITION OF HAVING UNDERGONE THE CLINICAL EXAMINATION.

- ◻ Without feces examination
 - ▨ Without *Schistosoma mansoni* eggs in the feces
 - ▧ With *Schistosoma mansoni* eggs and without clinical examination
 - ◻ With *Schistosoma mansoni* eggs and with clinical examination
- X-Y: Age group (years of age)



T A B L E I

Rate of infection, *Schistosoma mansoni* EGG count and schistosomiasis clinical forms (Comercinho, 1974/1981)

Variables	1974		1981	
	(n)	% or Mean \pm SD	(n)	% or Mean \pm SD
A. Rate of infection (positives/examined)	(923/1320)	69.9	(936/1329)	70.4
B. Geometric mean of eggs				
1. In all positives	(923)	431.0 \pm 4.2	(936)	333.6 \pm 4.4(*)
2. Only in the positives never treated	(909)	435.5 \pm 4.2	(879)	343.2 \pm 4.8(*)
C. Clinical forms				
Types I and II	(640)	88.6	(804)	93.2
Type III	(82)	11.4	(59)	6.8(*)
Total	(722)	100.0	(833)	100.0

(*) Statistically significant differences between 1974 and 1981 (X^2 or STUDENT's t test) — $p < 0.05$

T A B L E II

Rate of infection, *Schistosoma mansoni* EGG count and schistosomiasis clinical forms in children and adults, according to the geographical zone (Comercinho, 1974/1981)

Variables	Zones 1-2		Zones 3-4	
	1974	1981(*)	1974	1981(*)
I. CHILDREN				
Rate of infection (positives/examined)	(273/474)59.1	(271/449)59.4	(134/200)68.8	(196/238)80.8(*)
Geometric mean of eggs \pm SD				
— In all positives	(273)464.8 \pm 4.3	(271)283.3 \pm 4.2(*)	(134)676.8 \pm 4.5	(196)784.8 \pm 5.0
— Only in the never treated positives	(273)464.8 \pm 4.3	(268)282.2 \pm 4.2(*)	(133)676.8 \pm 4.5	(192)781.1 \pm 4.7
Clinical forms				
— Types I and II	(202) 89.4	(256) 97.5	(101) 82.0	(167) 86.7
— Type III	(24) 10.6	(6) 2.5(*)	(22) 18.0	(26) 13.3
II. ADULTS				
Rate of infection (positives/examined)	(350/451)76.2	(293/423)70.5	(166/195)85.2	(176/218)80.4
Geometric mean of eggs \pm SD				
— In all positives	(350)380.1 \pm 4.0	(293)208.6 \pm 3.7(*)	(166)385.9 \pm 4.3	(176)359.8 \pm 3.7
— Only in the never treated positives	(341)387.7 \pm 3.9	(259)229.8 \pm 3.6(*)	(162)386.4 \pm 4.3	(160)364.0 \pm 3.7
Clinical forms				
— Types I and II	(225) 90.8	(247) 94.9	(112) 89.6	(134) 91.6
— Type III	(23) 9.2	(14) 5.1	(13) 10.4	(13) 8.4

(n) % or Mean \pm SD

‰: Age standardized rates (Direct method)

(*) Statistically significant differences between 1974 and 1981 (method of the minimum variance or STUDENT's t test)

Children: 0-14 and Adults: \geq 15 years of age

pulation examined and the report of specific treatment according to the geographical zone. The following differences were observed between 1974 and 1981: a) the proportion of houses with piped water increased from 16.6 to 44.4% in zones 1-2; b) the proportion of houses with electricity increased significantly in zones 1-2 and in zones 3-4; c) two streets in zones 1-2 were paved in 1974 and in 1981 11 paved streets were found; d) in 1974 less children were clinically examined in zones 1-2 and 3-4, and less adults in zones 1-2 than in 1981. The proportion of patients who underwent feces

examinations and the proportion of treated children were statistically similar in 1974 and 1981 in zones 1-2 as well as in zones 3-4.

DISCUSSION

Periodic cross-sectional studies in endemic areas permit an evaluation of whether schistosomiasis is increasing or decreasing. BARBOSA & VOSS¹ made two cross-sectional studies on schistosomiasis in Agua Preta (northeast of Brazil) and found that the rate of infection by *S. mansoni* had not been changed 7 years after

T A B L E III

Water supply and electricity in the houses, paved streets, examined population and report of treatment with schistosomes, according to the geographical zones (Comercinho, 1974/1981)

Variables	Zones 1-2		Zones 3-4	
	1974 (n)5	1981(*) (n)%	1974 (n)%	1981(*) (n)%
Piped-water(1)				
Yes	(33) 16.6	(87)44.4(*)	(7) 10.1	(7) 7.4
No	(166) 83.4	(98)50.0	(2) 89.9	(87) 92.6
Not-surveyed	(0) 0.0	(11) 5.6	(0) 0.0	(0) 0.0
Electricity(2)				
Yes	(69) 34.7	(158)80.6(*)	(6) 8.7	(25) 26.6(*)
No	(130) 65.3	(38)19.4	(63) 91.3	(69) 73.4
Paved streets(2,3)				
Yes	(2) 11.8	(11)61.1	(0) 0.0	(0) 0.0
No	(15) 88.2	(7)38.9	(3)100.0	(3)100.0
Individuals with feces examination				
Yes	(925) 87.3	(875)88.5	(395) 92.5	(454) 93.6
No	(135) 12.7	(114)11.5	(32) 7.5	(31) 6.4
Positives with clinical examination				
— CHILDREN				
Yes	(226) 82.8	(262) 96.7(*)	(123) 91.8	(193) 98.5(*)
No	(47) 17.2	(9) 3.3	(11) 8.2	(3) 1.5
— ADULTS				
Yes	(248) 70.9	(261) 89.1(*)	(125) 75.3	(147) 83.5
No	(102) 29.1	(32) 10.9	(41) 24.7	(29) 16.5
Positives with report of treatment				
— CHILDREN				
Yes	(0) 0.0	(3) 1.1	(0) 0.0	(4) 2.0
No	(273)100.0	(268) 98.9	(134)100.0	(192) 98.0
— ADULTS				
Yes	(9) 2.6	(34) 11.6(*)	(4) 2.4	(16) 9.1(*)
No	(341) 97.4	(259) 88.4	(162) 97.6	(160) 90.0

(*) Statistically significant differences between 1974 and 1981 (X² test)

1: The not-surveyed cases were excluded of the statistic analysis

2: Source — FUNDAÇÃO IBGE (1981)

3: The statistic analysis was not made

the first feces examination took place. During this period, no schistosomiasis control program was implemented and no socio-economic changes took place in that area. JORDAN et al.^{8,9} in St. Lucia developed a project of control of schistosomiasis in 5 places, which consisted of providing all the houses with piped water. After 2-5 years the rate of infection and the *S. mansoni* egg counts had decreased significantly. In the control areas, the rate of infection and the egg counts increased. BHAJAN et al.² found that the infection by *S. mansoni* had decreased in school children from different endemic areas in Puerto Rico ten years after the first examination. These Authors used multiple regression analysis to verify that the decrease was strongly related to the improvement of water supply. HIATT et al.⁷ accomplished a program of control of schistosomiasis in Boqueron (Puerto Rico), that consisted of the use of molluscicide, marsh draining, cleaning of the streams and sa-

nitary education. After 5 years they concluded that the rate of infection and the mean of *S. mansoni* eggs had not undergone important alterations.

In the present investigation, the rate of infection did not change during the period analysed, but the counting of eggs in the feces and the rate of splenomegaly decreased significantly in 1981, when compared to that observed in 1974 (Table I). These changes occurred exclusively in the central zones of Comercinho (zones 1-2) while in the environs (zones 3-4) the egg count and the rate of splenomegaly did not change (Table II).

The egg counts decreased in adults and children from the central zones suggesting that in both groups the contact with natural waters had decreased. The reduction of splenomegaly was significant in the children from zones 1-2

(10.6 to 2.6%) while in the adults the difference between 1974 and 1981 (from 9.2 to 5.1%) was not statistically significant. The adults in endemic areas often show a splenomegaly that started years ago. In this way, the decreasing of the rate of splenomegaly in the children suggests that the changes responsible for the decreasing occurred recently.

Several points should be discussed to try to explain the differences between the data obtained in 1974 and 1981 in the central zones of Comercinho. The proportion of children from zones 1-2 that had been clinically examined was lower in 1974 than in 1981. In spite of this, the number of splenomegaly found in 1974 (24 cases in 226 positive individuals) was three times higher than the one found in 1981 (6 cases in 262). This shows that there was a real decrease in the number of children with splenomegaly, since the number found in 1974 would not be reached in 1981 even if all the positive children in zones 1-2 were clinically examined (in the last year, only 9 children were not examined — Table III). Another aspect to be considered is that in 1974 the patients without *S. mansoni* eggs in the feces were not clinically examined. Nevertheless the inclusion of the negative patients in the cross-sectional study done in 1981 did not alter the differences in the rates of splenomegaly between the central zones and the surroundings of Comercinho⁴. KLOETZEL¹¹ and BINA³ found that specific treatment might decrease the incidence of splenomegaly in schistosomiasis endemic areas. In the present investigation, the rate of children which had been treated was small (0% in 1974 and 1.5% in 1981) and did not differ between zones 1-2 and 3-4 (Table III). Regarding the urban infrastructure of Comercinho, an increased number of houses with electricity was found in zones 1-2 as well as in 3-4. 9 Streets, all in the central zones were paved between 1974 and 1981; the pavement of these streets did not lead to the canalization of any stream. In zones 1-2 the proportion of houses with piped water increased from 16.6 to 44.4%, while in zones 3-4 no significant change was found (10.1 and 7.4%, respectively in 1974 and 1981) (Table III).

These data lead to the following conclusions: a) the increased water supply seems to be the most obvious explanation for the changes in the *S. mansoni* pattern in the central zones of Comercinho; b) although the rate of

infection was the same, there was a simultaneous decrease in the rate of splenomegaly and in the *S. mansoni* egg count in children. This is a strong sign that the decrease of the egg count in endemic zones may be a useful indicator of a decrease of the severe forms of schistosomiasis in the age group 0-14 years.

RESUMO

Evolução da esquistossomose em uma zona hiperendêmica do Estado de Minas Gerais: dois estudos seccionais

Dois estudos seccionais da esquistossomose mansoni foram desenvolvidos na cidade de Comercinho, Estado de Minas Gerais (Brasil), com intervalo de sete anos. Em 1974 e em 1981 foram feitos exames de fezes em, respectivamente, 89 e 90% da população da cidade (cerca de 1.500 habitantes) e exame clínico em, respectivamente, 78 e 92% dos pacientes que apresentavam ovos de *S. mansoni* nas fezes. O índice de infecção pelo *S. mansoni* não se modificou durante o período analisado (69,9% em 1974 e 70,4% em 1981), mas a média geométrica de ovos por grama de fezes (431 ± 4 e 334 ± 4 , respectivamente) e o índice de esplenomegalia (11 e 7%, respectivamente) diminuíram significativamente em 1981, quando comparado ao observado em 1974. Esta redução ocorreu exclusivamente nas zonas centrais da cidade (zonas 1-2), onde a percentagem de domicílios com água encanada aumentou de 17 para 44%. Na periferia (zonas 3-4), onde a percentagem de domicílios com água encanada não mudou significativamente entre 1974 (10%) e 1981 (7%), a contagem de ovos de *S. mansoni* e o índice de esplenomegalia também não sofreram modificações.

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REFERENCES

1. BARBOSA, F. S. & VOSS, H. — Evolution of the clinical-gradient of *Schistosoma mansoni* infection in a small town in north-eastern Brazil. *Bull. Wld. Hlth. Org.* 40: 966-969, 1969.
2. BHAJAN, M. M.; MARTINEZ, V.; RUIZ-TIBEN, E. & JOBIN, W. R. — Socioeconomic changes and reduc-

- tion in prevalence of schistosomiasis in Puerto Rico. *Bol. Asoc. Méd. P. Rico* 70: 106-112, 1978.
3. BINA, J. C. — Influência da terapêutica específica na evolução da esquistossomose mansoni. *Rev. Pat. Trop.* 10: 221-267, 1981.
 4. COSTA, M. F. F. L.; ROCHA, R. S.; MAGALHÃES, M. H. A. & KATZ, N. — A clinical-epidemiologic survey of schistosomiasis mansoni in a hyperendemic area in Minas Gerais State (Comercinho, Brazil). I. Differences in the manifestations of schistosomiasis in the town centre and in the environs. *Trans. R. Soc. Trop. Med. Hyg.* 79: 539-545, 1985.
 5. COSTA, M. F. F. L.; MAGALHÃES, M. H. A.; ROCHA, R. S. & KATZ, N. — Water contact and socio-economic variables in the epidemiology of schistosomiasis in a Brazilian hyperendemic area: a case-control study. (In preparation).
 6. FUNDAÇÃO INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA. *Dados sobre os domicílios de Comercinho, Medina*, 1981.
 7. HIATT, R. A.; CLINE, B. L.; RUIZ-TIBEN, E.; KNIGHT, W. B. & BERRIOS-DURAN, L. A. — The Boqueron project after 5 years: a prospective community-based study of infection with *Schistosoma mansoni* in Puerto Rico. *Am J. Trop. Med. Hyg.* 29: 1223-1240, 1980.
 8. JORDAN, P.; WOODSTOCK, L.; UNRAU, G. O. & COOK, J. A. — Control of *Schistosoma mansoni* transmission by provision of domestic water supplies. *Bull. Wild. Hith. Org.* 52: 9-20, 1975.
 9. JORDAN, P.; CHRISTIE, J. D. & UNRAU, G. O. — Schistosomiasis transmission with particular reference to possible ecological and biological methods of control. *Acta Trop.* 37: 95-135, 1980.
 10. KATZ, N.; CHAVES, A. & PELLEGRINO, J. — A simple device for quantitative stool thick-smear technique in schistosomiasis mansoni. *Rev. Inst. Med. trop. São Paulo* 14: 397-400, 1972.
 11. KLOETZEL, K. — A rationale for the treatment of schistosomiasis mansoni, even when re-infection is expected. *Trans. R. Soc. Trop. Med. Hyg.* 1: 609-610, 1967.
 12. PESSÓA, S. B. & BARROS, P. R. — Notas sobre a epidemiologia da esquistossomose mansônica no Estado de Sergipe. *Rev. Med. Cir. São Paulo* 13: 17-24, 1953.
 13. SNEDECOR, G. W. & COCHRAN, W. G. — *Statistical Methods*. 6th edit., Yowa, The Yowa State University Press., 1977.

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