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ALTERNATIVE APPROACHES IN SCHISTOSOMIASIS CONTROL

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Measures for the control of schistosomiasis were implemented in Egypt begining 1922. This shows that developing endemic countries are facing this problem for near 70 years. However, results in the control of this infection have not been satisfactorily obtained in spite of the technologies and strategies recently developed.

The idea that social and economic components are relevant in the control of schistosomiasis is not new although its extension and profundity have not usually been well understood. More recently, most of the workers have recognized that the focal distribution of the prevalence rates of schistosomiasis should not be neglected in the control of the infection.

At present, field work projects on the control of schistosomiasis are being developed in rural areas of two Brazilian states (Espírito Santo and Pernambuco). The adopted strategy aims to interfere in the complex relationships between man and his bio-social-cultural environment, without forgeting that the unequal distribution of the space is a consequence of the political and economic organization of the Society.

Key words: schistosomiasis control – alternative approaches for control – Brazil

Endemic diseases comprise a poorly defined group of infectious and parasitic diseases having in common the complexity of parasite life cycles in nature and its close relationship with the living conditions of human populations. Since these diseases are mostly prevalent in tropical and/or sub-tropical regions of the world, they have been referred to as *tropical diseases,* even though it is well established that the determinant factor for its distribution is not the climate "per se" but the political, socioeconomic, and cultural contexts characteristic of most Third World nations.

Classically, control efforts have concentrated enormous budgets, comprising manpower and technologies, organized into control programs targeted to specific parasitic diseases. It is not our aim here to critically review the controversies over the advantages and drawbacks of control programs, but rather to discuss the potential of alternative approaches to control in which the complexities of human societies and cultures, as well as of their immediate environments, are considered as focal points for the planning of interventions.

Our discussion will be centered on schistosomiasis mansoni, reflecting the long-term experience of the senior author in particular on schistosomiasis control programs in Latin America and Africa. Notwithstanding, many of the points raised and proposals are potentially applicable to other forms of schistosomiasis and even to other endemic diseases.

Schistosomiasis is a major health threat in a number of Third World countries, affecting over 200 million persons. In Brazil, schistosomiasis is considered a typical rural disease, even though it has made its way into the outskirts of various towns. With the advent of large scale development programs (e.g. hydroelectric power plants and agropastoral projects), especially since the mid 60's a rapid spread in the geographical distribution of schistosomiasis has been observed in many regions of Brazil, such as in the Amazon, facilitated by the migration of large human contingents and the characteristic pattern of poor housing and overall lack of adequate sanitary conditions of these areas (Coimbra & Santos, 1986; Coimbra et al., 1984; Moraes, 1972; Paraense, 1983).

MAN, ENVIRONMENT, AND SCHISTOSOMIASIS

In the life-cycle of the schistosomes man is an active participant. As final host and vector of the parasite (Wright 1969), man not only harbors its sexual form but also disseminates its eggs through his excreta. The diagram shown in Fig. 1 represents a simplified life-cycle of the schistosomes highlighting the well known phases (1 to 4) and interfaces (a to d) through which the parasite has to go through.

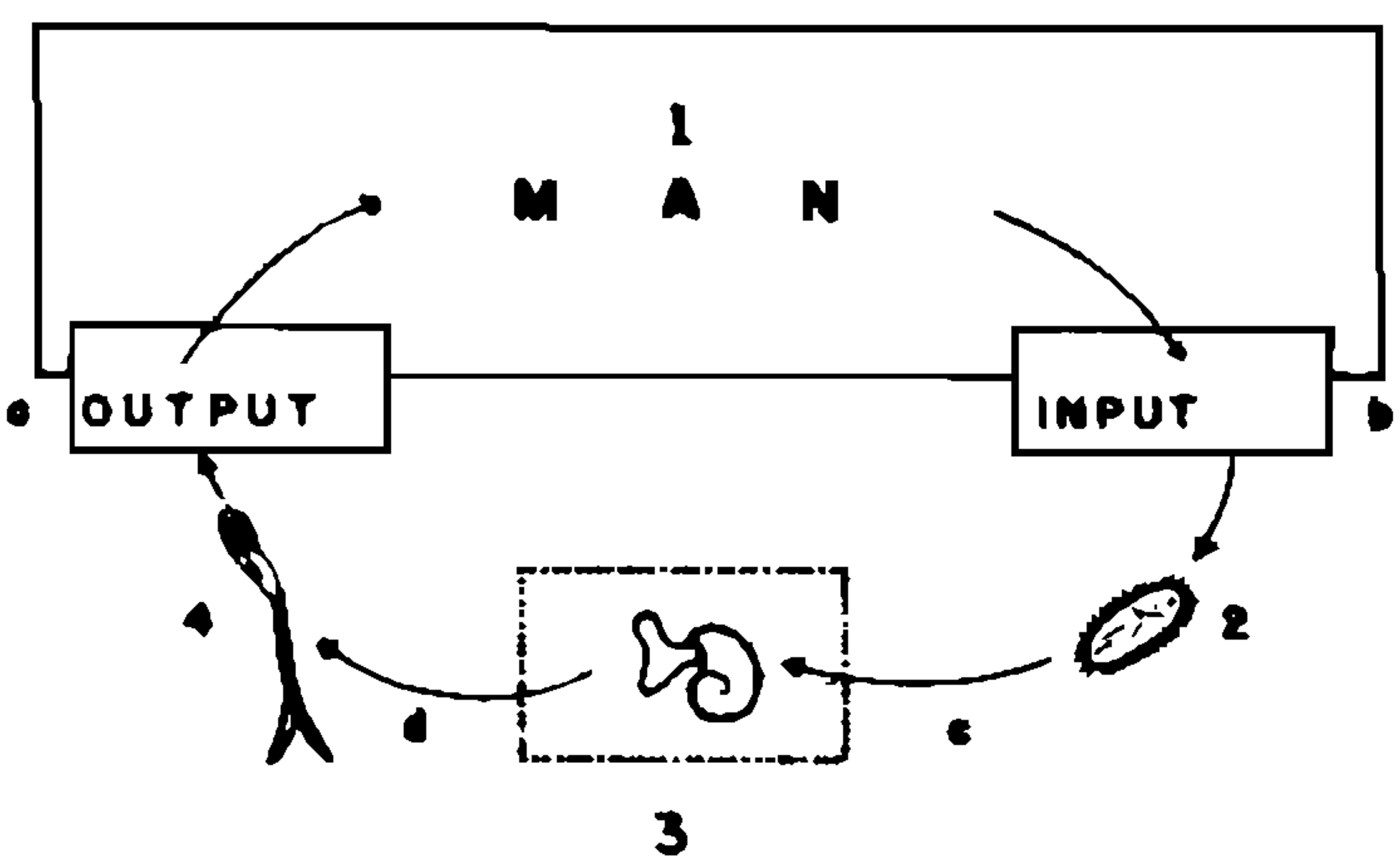

Fig. 1: phases (1 to 4) and interfaces (a to d) of the lifecycle of the schistosomes: a simplified view to show the snail "feeding" mechanism.

The relationship between human populations living under favoring conditions for transmission and snail populations can be depicted in the form of a diagram (Fig. 2). In this diagram, the life-cycles of human and mollusk populations are represented by intersectional circles. The bigger the overlapping surface of the two circles, the greater the chance of acquiring the infection (cf. Barbosa, 1972). The shaded areas in the circles represent three hypothetical situations (1 to 3) illustrating different grades of contact between humans and infective stages of schistosomes, i.e., cercariae. The success of these relations depend mostly upon one of the partners _ man _ whose activity pattern influences the population dynamics of snails and determines the degree of exposure to the parasite. In this sense, snails play a passive role in transmission.

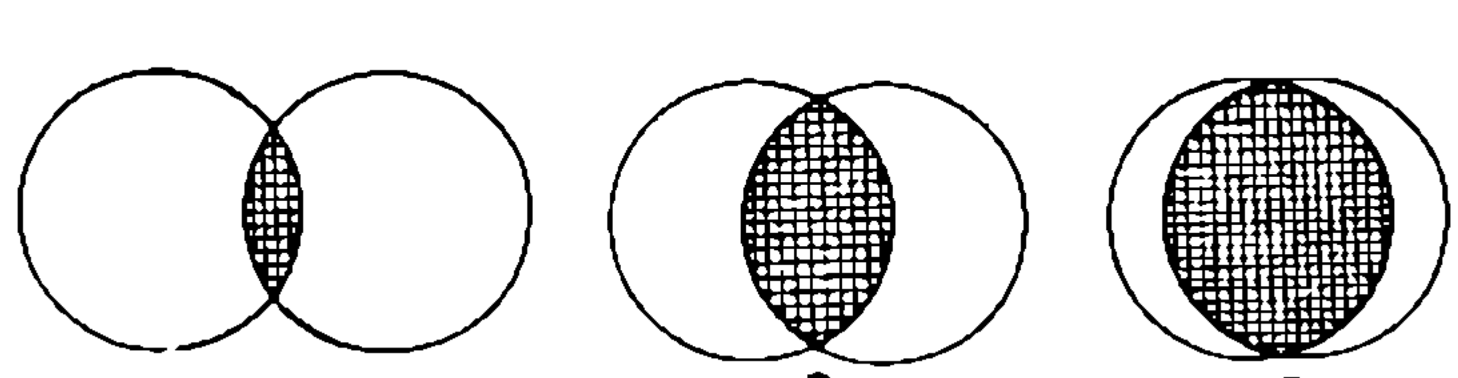

Fig. 2: diagramatic view of the man/mollusk relationships.

The various pathways through which schistosomes have to go through at different phases and interfaces of their life-cycle are not completely understood from a quantitative standpoint, despite the several attempts in mathematical modeling in schistosomiasis. In other words, it is not yet known the relative weight played by the various biological, environmental, and human factors in producing the disease.

Snails can be seen as *machines* for cercarial production. They are *fed* with miracidia and, after a pre-patent period of variable length, cercariae are shed. Of course it is understood that these relationships are not linear functions but vary according to a number of factors pertaining the environment, the particular strain of the schistosome and the genetic make-up of the local snail strain. Under certain circumstances the *machine* can attain high levels of productivity such as in the case of *Biomphalaria glabrata* in northeastern Brazil, where up to 20.0% of snails can be naturally infected with *Schistosoma mansoni* (Gonçalves et al., 1991). In other cases, the *machine* attains much lower levels of productivity but, even so, still can play an important role in the epidemiology of the disease in a given region. A case in point is *B. straminea*, also from northeast Brazil, a species that, even in highly endemic areas, only a small fraction of it is found naturally infected, approximately 0.04 to 1.35% (Barbosa & Costa, 1981). To the present, the relationships between infection in snails and cercariae production on one hand, and levels of endemicity among human populations on the other, are not completely understood.

Available empirical data show that man is, in fact, the most active participant in the cycle of schistosomiasis (Wright, 1969). When established in a certain area, and living under precarious conditions, man creates favorable situations for the transmission of the parasite.

In regions yet not altered by human activities, such as Amazonia, the natural population of planorbid snails is usually low (Moraes, 1972; Coimbra Jr. & Santos, 1986). Deforestation and moderate pollution of water collections lead to the development of high density snail populations. As it has been noted elsewhere, *Biomphalaria* snails can be attracted to various kinds of detritus and have been found feeding upon human feces (Barbosa, 1983a).

Mathematical models help elucidate important aspects of the dynamics of schistosomiasis transmission. However, a model to account for the complex man/snails/schistosomes relationship and how schistosomiasis is maintained at endemic levels among human populations was derived from empirical observations such as: (a) schistosome egg production is so large that only a small residuary percentage of eggs are enough to keep transmission at considerable level (Davis, 1981), and (b) under natural conditions, very low rates of planorbid infection are enough to maintain schistosomiasis at high endemic levels (Barbosa, 1983a).

APPROACHES TO CONTROL: A REVIEW

The control of schistosomiasis dates back to 1922 (Mousa & Ayad, 1972) when the Egyptian government established specialized units for the treatment of the disease, particularly among school children. The application of molluscicides, along with other control measures, was introduced in Egypt beginning 1940 with the use of copper sulfate. In 1955 sodium pentachlorophenate, a more efficient drug, was first used in Central Egypt.

Since than it was generally agreed that effective control of schistosomiasis should lay on three lines of attack: (a) mass treatment, (b) snail control, and (c) sanitation. New molluscicides and chemotherapeutic drugs were made available and different strategies for the implementation of control methods were proposed, as it will be discussed in the next section of the paper.

At present, the vast majority of health workers agree on the general concept that the broader social-economic system of any country plays a major role in the determination of the disease profile, both at the individual and at the collective levels. These relationships are not linear but subject to a complex network encompassing various political, social, economic, and public health problems that can be analyzed at several levels. There are enough evidences to show that improvements in the human environment, particularly in what regards sanitation, can influence infection rates in schistosomiasis. This is known since the 1950s, thanks to the works of Annecke et al. (1955) and Pitchford (1958). Twenty years latter, the second author presented an account of the situation of schistosomiasis control in Africa (Pitchford, 1972). According to this account, in areas where piped water was supplied for domestic purposes and other simple and relatively cheap measures were enforced aiming at reducing human/water contacts, infection rates were being progressively reduced. In Brazil, a seven-year experimental program out in northeastern Brazil showed that schistosomiasis could be effectively controlled in the project area by limiting intervention to sanitation implemented through a community organization program (Barbosa et al., 1971). Finally, the example from Saint Lucia (Jordan et al., 1973) was impressive as it showed that through the sole introduction of household water, a significant reduction in man/water contact was achieved, leading to reductions in prevalence and incidence rates of schistosomiasis in the area.

It should be remembered that the above evidences were obtained when powerful drugs and molluscicides had not yet been developed. Important steps toward the effective control of schistosomiasis were achieved in countries which attained basic social and economic improvements, along with the enforcement of public health services, such as in Puerto Rico and Venezuela (cf. Barbosa, 1970, 1972).

With the introduction of new technologies (mostly chemicals), the old recognized conceptual macro-model was discharged, being replaced by direct actions targeted against the parasite and/or the snails, as described in the following section.

For instance, the results reported by Farooq and co-authors (see Farooq & Haiston, 1966 for references) after a two-year period of application of niclosamide (Bayluscide*) at the Nile's delta resulted in widespread optimism. Since than, the elimination of the snail host by chemical products has been considered to be the most efficient measure for the control of schistosomiasis (WHO, 1973). This led to the spending of large sums by Third World countries in control programs, even though in many cases, results were never evaluated properly. In addition, a major disadvantage is that niclosamide requires repeated applications and has a number of environmental side effects since it is lethal to other species of snails and fish.

Despite all optimism, Farooq's work was seriously questioned by other investigators (cf. Gilles et al., 1973). In Brazil, a long-term schistosomiasis control project carried out in a rural setting pointed to a number of limitations in the sole use of Bayluscide (Barbosa & Costa, 1981).

Toward the end of the 1970s, new drugs were being tested (mainly oxamniquine and praziquantel). With these drugs, medical treatment was made easier since they were not only very effective against the schistosomes, but were well tolerated by the patient and could be given in a single oral dose. Undoubtly, "these drugs play a crucial role in all control programs" (Mott, 1986).

In spite of the use of effective chemicals in the control of schistosomiasis, rural populations over the world still pay a heavy tool to this disease. It is now recognized that the application of a single method is of limited effectiveness in achieving long-term control over schistosomiasis. Within this context, several alternatives have been proposed, all pointing to the need of integrating different specific measures in control programs.

The first approach may fall under the framework of "integral fight against schistosomiasis". It attempts to place all strategies at the same level of importance, highlighting the need for continuous work in the fields of health education and socioeconomic development. There is little left to comment from such compliant and utopic view, but to say that the causes of diseases are not situated at the same levels and that they are located outside the health field of action (Barbosa, 1983b; SUCAM, 1983). In this regard, McKeown (1979) points out that ". . . there was and there is still a large amount of unjustifiable indulgence over the range of understanding of the disease and the capacity to control it. As for example in the assumption that malaria and schistosomiasis will soon be eradicated, or that there is very little to fear about the infections transmitted by air".

The second approach attempts to associate schistosomiasis control to community health programs. The same indulgence is observed in this case, i.e., the inefficiency of this approach collides with the principle that development is a global process that involves all society (Barbosa, 1983a; Mott, 1986). Terms such as community development, health community programs, socioeconomic improvements, community organization and participation, among others, have been frequently used to indicate a "modern" view in coping with the non-confessed failures of the classical methods in controlling schistosomiasis.

Thirdly, the other approach to the issue of control is focused at high-risk groups, attempting to prevent the prevalence of the hepatosplenic clinical form of the disease (Katz, 1982). Embedded in this view is the recognition that schistosomiasis cannot be controlled. In fact, this is the first message found in Warren's (1982) work directed to the "developing world". This author points out that the eradication of schistosomiasis through regular methods can only be achieved in "unusual situations, such as in the case of rapid developing countries like Japan and Puerto Rico".

Along those lines, the Brazilian Special Program for the Control of Schistosomiasis (PECE), sponsored by the Ministry of Health, has changed its initial objectives, now limiting its goal to reducing prevalence rates of the hepatosplenic form of the disease (Kloetzel & Schuster, 1987). By doing so, PECE gave up its initial formulation of "integrated program". Notwithstanding all internal criticism to the Brazilian program, it is recognized that PECE achieved reduction in the overall prevalence rates of the disease throughout the country. Data made available form the Ministry of Health indicates that prevalence rates tended to go down after the first evaluation, although staying at a stable level in later evaluations. The Brazilian experience demonstrates that residual prevalences remains unchanged despite efforts in reducing through mass treatment. Another important point is that, despite low rates observed, the prevalence can return to its original levels of infection in a few years after curtailing the program (Warren, 1982; Barbosa & Silva, 1992). It should also be mentioned that, despite the maintenance of prevalence, the reduction of hepatoesplenic form has significantly diminished in treated areas (cf. Kloetzel & Schuster, 1987). However, more field research conducted in areas where schistosomiasis is endemic, and under more rigid protocols are needed to demonstrate this trend.

As it can be depicted from the above review, there are no specific or combined method that can keep schistosomiasis under control at the extensive endemic areas of the Third World for indefinite time.

ALTERNATIVES TO SCHISTOSOMIASIS CONTROL

Without excluding the other levels of analysis, our attention is focused on alternatives for the control of schistosomiasis through actions directed to the immediate environment in which man – the main vector of the disease – lives and works.

An important factor to be pointed out is that prevalence rates of schistosomiasis is not homogeneously distributed in a given area. Although the idea of focal transmission sites is well known, Kloetzel & Schuster (1987), Kloetzel & Vergetti (1988) and Kloetzel et al. (1990) had the merit to have developed the concept that schistosomiasis control should be targeted towards selected areas at higher risk. This means to give emphasis to the micro-level for control purposes.

In the above direction, Kloetzel (1989), analyzing data from the PECE program in the state of Alagoas believe that "... satisfactory control (perhaps even interruption of the bulk of transmission) can be attained by means of modest endeavors, especially designed to micro-level conditions. This will mean that, instead of a sweeping attack on all fronts, a selective policy will have to be adopted, targeted upon clusters of highly infected individuals, which in their turn will point directly towards the remaining foci of active transmission".

The shift toward a micro-level approach to schistosomiasis control puts more emphasis on the importance of small groups of persons, families and individual risk behaviors, thus calling for the need of creating more culturally sensitive strategies for control. By looking at people's perceptions about health and disease one can retrieve important informations about health-related attitudes and behaviors relevant to schistosomiasis transmission and control. This constitutes key informations to ensure the planning of a sustained schistosomiasis control program in which community participation can be fully attained.

Along those lines, a long-term (4 1/2 years) schistosomiasis experimental control program was designed in Brazil. This program, supported by several institutions, is being implemented in the rural areas of the counties of Conceição do Castelo (state od Espírito Santo) and Vitória de Santo Antão (state of Pernambuco). These localities were selected on the account of their special ecological, political, socioeconomic and epidemiological parameters, in order to allow for comparisons between the two sites.

The main objective of the program is to control schistosomiasis (and other intestinal helminthiasis) by means of a community oriented health model at the level of primary care.

The communities are being mobilized and pre-existing organizations reinforced in an attempt to ensure local participation in the planning, management, and evaluation of the program. The use of molluscicide and mass treatment are not considered. Control measures will be limited to the use of individual medical treatment and improvements of home sanitation devices. All these measures, implemented through the participation of the local population, should minimize human contact with contaminated water and encourage positive changes in the habits and attitudes with regards to prevention of schistosomiasis transmission. To cut down areas of contact between humans and the infective stages of the schistosomes is the key to success of the program.

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