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The Global Epidemiological Situation of Schistosomiasis and New Approaches to Control and Research

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Abstract

While the distribution of schistosomiasis has changed over the last fifty years and there have been successful control programmes, the number of people estimated to be infected or at risk of infection has not been reduced. Today, 85% of the number of infected people are estimated to be on the African continent where few control efforts are made. In terms of disease burden, there is therefore a growing discrepancy between sub-Saharan Africa and the rest of the world. WHO has now developed a dual strategy for the control of schistosomiasis: a strategy for morbidity control adapted to the public health context in high burden areas, and a strategy to consolidate control in areas where a low endemic level has been reached and elimination may be feasible. Related to this new vision, some research needs are pointed out.

Keywords

Schistosomiasis; control; elimination; research

Introduction

Schistosomiasis remains one of the most prevalent parasitic infections in the world. It is endemic in 76 countries and territories, and continues to be a global public health concern in the developing world. Because it is a chronic insidious disease, it is poorly recognised at early stages, and becomes a threat to development as the disease disables men and women during their most productive years. It is particularly linked to agricultural and water development schemes. It is typically a disease of the poor who live in conditions which favour transmission and have no access to proper care or effective prevention measures.

The 1984 WHO Expert Committee on the Control of Schistosomiasis introduced a strategy for morbidity control, which had become feasible because of the availability of effective and safe single dose drugs (WHO, 1985). This created high hopes for success, not only in terms of a reduction in the burden of this disease, but also in terms of possible elimination of the

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infection through a presumed effect of regular treatment on transmission. Community wide treatment campaigns were initiated in numerous endemic areas. Because of the high drug prices, active diagnosis and treatment was the most cost-effective and thus preferred strategy. After an initial "attack phase" involving substantial, often external funds, it was expected that the endemic level would have decreased to an extent that national health authorities would be able to take over implementation during a maintenance phase.

Whereas a number of countries have managed to sustain schistosomiasis control over the last two decades, most donor-funded vertical control initiatives set up in Africa during the 1980's have shown to be unsustainable. Despite the fact that the 1991 WHO Expert Committee on the Control of Schistosomiasis called for greater flexibility and a more prominent role for Primary Health Care services (PHC) and other sectors in sustainable implementation (WHO, 1993), most of the schistosomiasis control activities in sub-Saharan Africa have been stopped since.

The current status of schistosomiasis and its control

While the distribution of schistosomiasis has changed over the last fifty years and there have been successful control programmes, the number of people estimated to be infected or at risk of infection has not been reduced. Where control has been successful, the number of people infected and at risk of infection is very small. This is the situation in most formerly endemic countries in Asia and the Americas (Figure 1). On the other hand, in sub-Saharan Africa where the population has increased by approximately 70% over the last 25 years, a greater number of people are infected or at risk of infection.

As there is little accurate data on country specific prevalence, global estimates for the number of people infected and number at risk of infection must still be made based on extrapolations of limited prevalence survey data to country level. The most accurate data may be those provided by national control programmes or from national surveys. National surveys have been conducted in a few countries in Africa with estimates of national prevalence given. When prevalence data were extrapolated and applied to the 1995 population estimates, it was calculated that about 652 million people are at risk of infection from the five human schistosome species and that 193 million are infected. Based on these calculations, 85% of the estimated number of infected people are currently on the African continent (Chitsulo *et al.*, 2000).

The burden due to schistosomiasis: a growing discrepancy between sub-Saharan Africa and the rest of the world

It has to be acknowledged that some progress has been made in schistosomiasis control. A number of countries have appreciated the public health importance of schistosomiasis and have initiated control before or during the 1980's. In China and Japan, the high morbidity and mortality due to *S. japonicum* leading to the disintegration of communities and consequent reduction in agricultural production justified control (Chen and Zheng, 1999; Tanaka and Tsuji, 1998). In Brazil schistosomiasis was one of the leading public health problems (Katz, 1998). Control was initiated in Egypt because irrigation is the mainstay of

agriculture and it was felt that morbidity due to schistosomiasis would hamper production (Mobarak, 1982). Also in Morocco, the intensive development of irrigated agriculture and the associated threat of an extension of the schistosomiasis problem, were the incentive to initiate national control (Laamrani et al., 2000). Some of these endemic countries, such as Brazil, China, the Philippines and Egypt, have been able to sustain national control programmes for a prolonged period and have succeeded in reducing morbidity to very low levels. Others, such as the smaller Caribbean Islands, the Islamic Republic of Iran, Mauritius, Morocco, Puerto Rico, Tunisia and Venezuela, are nearing elimination or have already achieved this goal (WHO, 2001a).

Despite these encouraging results, schistosomiasis control is currently almost non-existent in sub-Saharan Africa. Most control initiatives have been abandoned, and national health authorities in sub-Saharan Africa today show little commitment towards schistosomiasis control. They often feel that the resources required to control the disease are disproportionate within their public health context.

It has been argued that, compared to Brazil, Egypt and Sudan, sub-Saharan Africa had less schistosomiasis related morbidity (Gryseels, 1989). However, numerous reports of substantial late-stage morbidity have been published in the international literature prior to 1970. Also, a recent review study has quantified the clinical morbidity associated with schistosome infection in sub-Saharan Africa and came up with substantial numbers of ill or seriously ill cases (Van der Werf, in press). The same study also suggested that the number of deaths involving schistosomiasis in sub-Saharan Africa may be as high as 200,000 per year.

The deteriorating socio-economic situation, a progressive loss of diagnostic potential in peripheral health facilities, and the appearance or re-emergence of more visible health problems, may have contributed to the downgrading of schistosomiasis on the public health agenda. The fact that schistosomiasis is a focal problem, of which the public health importance is "diluted" at the national level, may have further been responsible for the decreasing commitment towards its control by national health authorities. This has now led, in many parts of sub-Saharan Africa and in a few countries elsewhere, such as Irak or Yemen, to deplorable situations in which pockets of high morbidity exist and essential anti-schistosomal drugs are hardly available.

Schistosomiasis control in high burden areas

The main principles of schistosomiasis control, such as the concept of morbidity control and the recommendation that it should be implemented through the primary health care system, have not changed since the second meeting of the WHO Expert Committee in 1991 (WHO, 1993). Nevertheless, some elements in schistosomiasis control have changed during the last decade.

Praziquantel – the drug of choice for all forms of schistosomiasis – has become significantly less costly. Several brands of good quality, generic praziquantel are on the market today (Doenhoff et al., 2000; Appleton and Mbaye, 2001). The cost of an average treatment with

this drug has come down to less than 0.30 US\$ - less than a customary user fee in health services. This clearly opens up perspectives for a more generalised access to the drug. It also implies that presumptive treatment, on the basis of early clinical symptoms, or universal treatment on the basis of epidemiological criteria, have become cost-effective in an increasing number of endemic situations (Guyatt et al., 1994; Carabin et al., 2000). As praziquantel is a safe drug, it can be delivered at the most peripheral levels of the drug delivery system, also by non-medical personnel.

There is also a growing consensus that morbidity control, infection control, and transmission control are different objectives and should be recognised as distinct and consecutive steps on the road from morbidity control in the strict sense towards elimination (Fig. 2). In high burden areas, the first step to take in control is indeed to deal with morbidity in the strict sense. The World Health Organization has recently reviewed the strategy for the implementation of morbidity control in high burden areas (WHO, in press), with emphasis on better targeting of control interventions, and a more cost-effective and sustainable implementation of control strategies. The WHO Expert Committees for the Prevention and Control of Schistosomiasis and Soil-transmitted Helminthiases, in their recent first joint meeting held in Geneva from 8 to 14 October 2001, have defined a simple, easy and affordable control package adapted to the prevailing public health context in high burden countries. Integration of control in existing structures and decentralisation of decision-making and delivery are key elements for sustainable control in this package. Minimal implementation targets have been laid down in a recent WHO resolution (WHO, 2001b).

The provision of adequate clinical care is a first essential component of control within the existing health system. Good access to praziquantel is indeed the strict basis for morbidity control. Yet, very few high burden countries have managed so far to provide access to this 30 US cents' drug in their peripheral health system. Health services could even ensure a more active role in morbidity control and implement systematic treatment of high risk individuals where this is justified by the epidemiological situation.

Community-based treatment should first be targeted to school-age children. There is indeed evidence that the impact of treatment on morbidity decreases with age, and that repeated treatment in the early stages of life has a long-lasting effect on morbidity at a later age. In this perspective, focusing the delivery of regular chemotherapy on the younger age groups will produce maximum benefits, and prevent chronic sequelae in adulthood (King *et al.*, 1992; Hatz *et al.*, 1998; Frenzel *et al.*, 1999). School-age children can be reached through the primary school system, in collaboration with the educational sector. Even in areas where school enrolment rates are low, outreach activities can be designed to ensure good coverage (Montresor *et al.*, 2000). WHO estimates that it is feasible to provide regular treatment to at least 75% of school-age children at risk of morbidity by the year 2010. In school-based delivery systems, integration with other public health interventions such as geohelminth control, feeding, micronutrient supplementation and/or other interventions as a package, should be aimed for.

Communities with high prevalence rates and special occupational groups such as fishermen and irrigation workers, should also have easy access to regular treatment for schistosomiasis.

Praziquantel can be made available to them as part of broader community based drug delivery programmes or outreach services, or simply on demand through the most peripheral levels of the primary health care system (community health workers or drug distributors). The current low cost of praziquantel opens up real perspectives for cost-recovery and sustainable access.

The practical tools for epidemiological assessment and the delivery of regular treatment to high risk groups are constantly being refined in order to meet the requirements for an easy and reliable implementation by peripheral actors. Some, such as the questionnaire approach for rapid assessment of urinary schistosomiasis (Lengeler et al., in press) or the dose pole which is currently being developed for praziquantel (Montresor et al., 2001), have great potential for facilitating the implementation of control in the field. Current best practice in this regard has recently been defined by the WHO Expert Committees for the Prevention and Control of Schistosomiasis and Soil-transmitted Helminthiases, and practical guidelines are being issued (WHO, in press).

In order to enhance the effect of regular chemotherapy, long-lasting improvement in hygiene and sanitation should not be forgotten. This includes provision of safe water and sanitation, and appropriate health education. In addition, complementary integrated control activities, such as environmental management measures, should be planned with other sectors such as agriculture and water resource development programmes. It is also important to ensure that any development activity likely to favour the emergence or spread of schistosomiasis and other parasitic diseases is preceded by a proper health impact assessment and accompanied by preventive measures to limit their impact.

Consolidation of schistosomiasis control in areas where a low endemic level has been reached, and prospects for elimination

It has been demonstrated, in a number of formerly heavy burden countries, that sustained schistosomiasis control efforts have resulted in significant reductions in morbidity and mortality. Where disease is no longer a public health issue, sustainable transmission control focusing on hygiene and sanitation improvement, and environmental management, should become the major operational components. These will decrease the risk of resurgence of schistosomiasis and strengthen and continue improvements to other public health goals as well. As the endemic level decreases, new objectives need to be defined, in view of possible elimination. This, in turn, leads to new approaches and algorithms defined according to local situations. Cost-effectiveness and decentralised decision making are also crucial issues in low transmission areas. Optimal use of resources is indeed necessary to maintain sufficient control pressure to avoid resurgence.

Schistosomiasis is currently not considered as a disease targeted for eradication¹ or elimination². In the absence of a global effort to eradicate or eliminate schistosomiasis,

¹permanent reduction to zero of the world-wide incidence of a disease as a result of deliberate efforts - continued intervention measures are no longer required

²reduction to zero of the incidence of a specific disease in a defined geographic area as a result of deliberate efforts; continued intervention measures required

WHO has not established a standardised Certification Process which would involve the setting up of an international commission, and the definition of standardised criteria to certify that schistosomiasis is not endemic any more in a country or area. Moreover, the fact that schistosomiasis has a complex transmission cycle, that the asymptomatic carrier state is common, and that for certain parasite species an animal reservoir exists, would make the definition of criteria for elimination a complex issue. Also, interruption of transmission may be reached in different ways: by the "sterilisation" of the parasite reservoir, by the elimination of the snail intermediate host (e.g. through the use of competitor snails), by an improvement in socio-economic status and hygiene so that contamination and infective water contact does not occur any more, or by a combination of these scenarios. The issue is further complicated by the risk of re-introduction of the disease in an area where it was previously eliminated, particularly where water resource development and/or migration occurs.

However, a possible way for individual countries to demonstrate that schistosomiasis has been eliminated from their territory, is to document that no new, locally contracted infections were observed over a sufficient period of time. The observation period, during which no cases should be detected to confidently declare that transmission has been interrupted, depends very much on the risk of re-emergence or re-introduction in a particular context. The degree of certainty that no new cases were detected also depends very much on the performance of the surveillance system, in terms of sensitivity of the diagnostic method used, and the operational performance of the reporting system. Ideally, close surveillance should be implemented through existing, permanent channels and procedures, complemented by surveys in populations at high risk. Even in low transmission areas, upper grade primary school children and special occupation groups appear to be the best populations among which to conduct surveillance surveys. Surveillance should only be eased as the risk of resurgence is demonstrated to have clearly diminished (WHO, 2001a).

Research for control: some further needs

Although tools are currently available to make major progress in schistosomiasis control in high burden areas in the coming years, some aspects of knowledge and implementation may be further improved. Better knowledge about the subtle and clinical disease burden, including mortality and neglected aspects of morbidity such as genital/reproductive consequences, neurological complications and associations with other diseases, would help to raise the profile of the disease in national and international public health agendas. This is also the case for better knowledge of the economic impact of schistosomiasis and the "cost of no control".

Concerning intervention methods, improved rapid epidemiological assessment methods for intestinal schistosomiasis would be most useful. The usage and formulations of praziquantel may be subject to improvement, and the safety of its use in pregnancy will have to be documented. As control interventions unfold, appropriate methods for post-intervention assessment and evaluation, including the effect on morbidity, will have to be defined. The main new tool to be sought for is probably a new schistosomicidal drug – preferably one which is active on all stages of the parasite.

Thorough documentation of control interventions in different settings will provide useful information on optimal delivery strategies and cost-effectiveness, including in areas where schistosomiasis is co-endemic with other diseases. Some operational issues which will become more and more important as morbidity decreases are the use of environmental management methods in African schistosomiasis, environment-friendly focal transmission control and improved communication strategies for behavioural change.

In areas where a low endemic level has been reached as a result of sustained control interventions, the main challenge appears to be the adoption of new or improved field applicable diagnostic methods for infection control. In areas where elimination is aimed for, better knowledge about the importance of an animal reservoir, and better methods and formulations to treat infected animals, may help to speed up the process. Further improvement of environmental management strategies, and methods for surveillance in different settings and for different sub-species is also needed here.

Although expected to have a less immediate practical role in schistosomiasis control or elimination, vaccine research and development may prove to be useful in the long term.

Conclusions

The control of schistosomiasis, a disease which is still affecting a large number of poor people in the developing world, deserves more and renewed attention and commitment, particularly in sub-Saharan Africa. Simple, but sustained control measures, can relieve an underestimated and surely unnecessary disease burden in high transmission areas. This has been demonstrated by a number of countries, which have implemented control for a sustained period, and which today are able to even contemplate elimination of the disease on their territory or part of it.

Schistosomiasis control is not an "all-or-nothing" phenomenon. A few basic measures can easily be implemented in all circumstances. Essential anti-schistosomal drugs must be accessible at all levels of the health system, and appropriate treatment strategies must be established in accordance with the endemic level. Protecting their younger age groups from subtle morbidity and late-stage complications is within the reach of most nations, with or without the help of international donor agencies, particularly if the regular delivery of anthelmintic treatment is integrated in a comprehensive public health package. The integration of schistosomiasis control in existing health care delivery structures and public health interventions, such as health packages delivered through schools, is essential in high transmission areas in order to ensure health policy commitment and sustainability. Health authorities must be able to recognise schistosomiasis control as an integral part of the basic health package delivered to the populations they are responsible for.

Many diseases are intimately related to poverty and poor living conditions. This is particularly true for parasitic diseases. Poor people are therefore likely to have more than one parasitic disease. For many of these diseases, regular chemotherapy is the major operational component for immediate relief of the disease burden, while improved living

conditions and economic development are the permanent solutions. This offers possibilities for integrated advocacy and interventions.

More substantial and costly control measures may be adopted by individual countries if they want to extend schistosomiasis control objectives beyond morbidity control, provided the technical and financial efforts can be sustained over sufficiently long periods.

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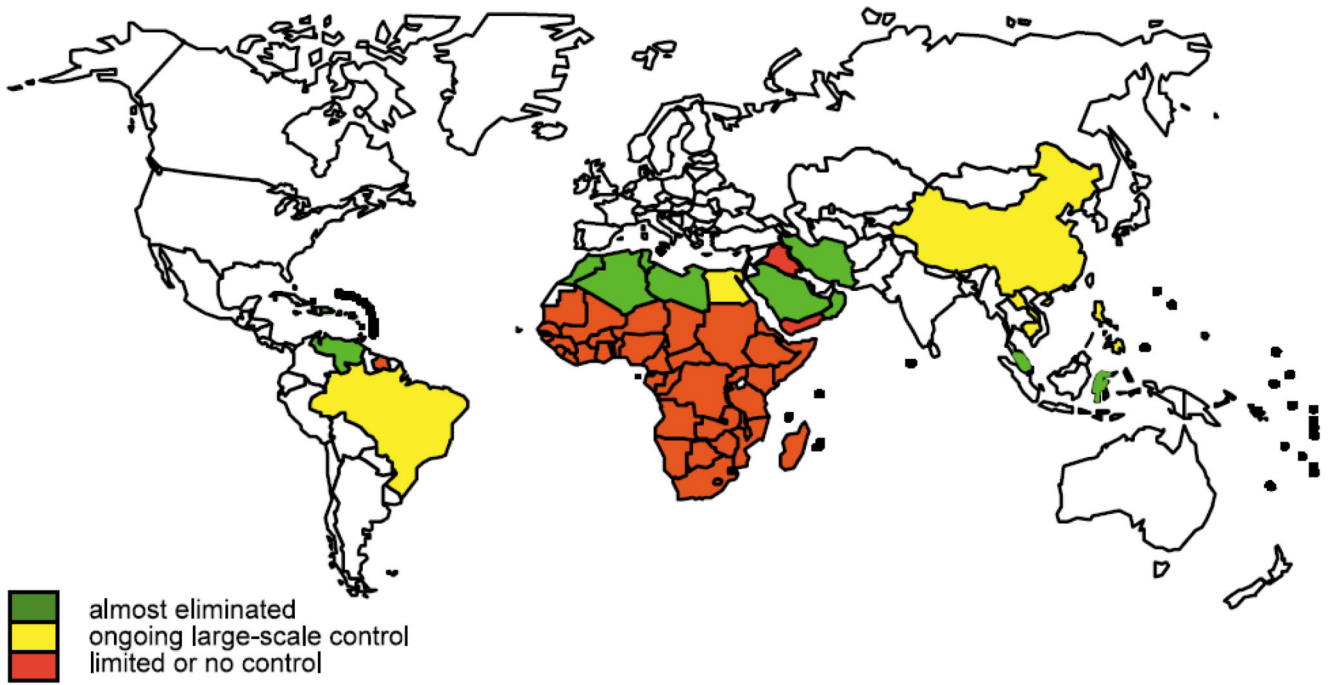


Fig. 1.
The current status of schistosomiasis control in the world.

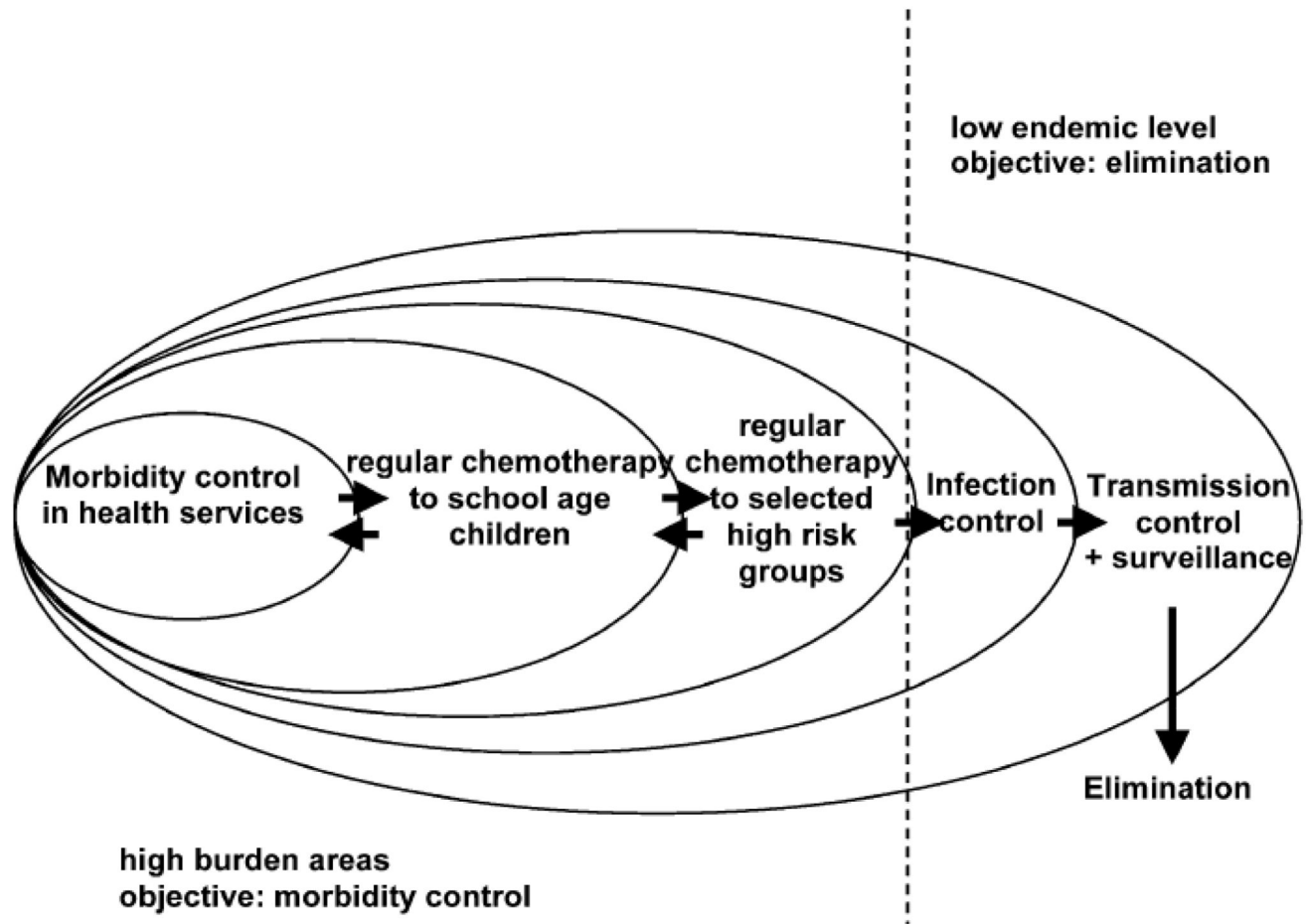


Fig. 2.
The consecutive steps on the road from morbidity control in the strictest sense towards elimination (concept of “staged control”)