Indian J Med Res 139, January 2014, pp 7-9

Commentary

India can do more about intestinal worm infections

In this issue Kattula *et al*[1] presented the results of a survey of soil-transmitted helminth (STH) infections (roundworm, whipworm and hookworm) among school children in two districts of Tamil Nadu, along with an analysis of risk factors for infection, identified through a case-control analysis. The authors found the overall prevalence of STH infections to be 7.8 per cent among 3,706 children screened in the two districts. This could be an underestimate of the true prevalence, given the laboratory techniques used to diagnose infection, but nevertheless it is well below previous estimates of STH prevalence in Tamil Nadu. In the 1980s, prevalence rates of over 90 per cent had been reported in villages in Chingleput district and as well as in Madras[2-4]. A decade later, another study from a village in Vellore, Tamil Nadu, found 22.8 per cent of all stool samples examined to be positive for hookworm[5].

Historically, two broad reasons have accounted for declining prevalence of STH infections: widespread use of anthelmintics and improvements in sanitation and education. In countries such as Japan and South Korea, mass deworming campaigns which coincided with an era of strong economic development, resulted in rapid decline in STH infections. Kattula *et al*[1] suggest that the declining prevalence in their study area may be partly attributed to the mass drug administration programmes with diethylcarbamazine citrate (DEC) and albendazole, which target elimination of lymphatic filariasis. In addition to its action against filarial worms, albendazole is also very effective against all three STH infections, and is primarily marketed for this indication[6].

Improved living conditions almost inevitably lead to declining prevalence of STH infections. These are basically transmitted through the contamination of surface soil with human faeces. Economic development, which is usually accompanied by improved housing and the adoption of better sanitation, will reduce the kind of risk factors identified in this study[1], such as living in field huts, and defaecation in open fields. However, this kind of widespread improvement in sanitation frequently takes many years, if not decades, to result in reduced transmission because helminth eggs remain viable in the soil for many years after environmental contamination has occurred. Because of this, WHO recommends preventive chemotherapy as a primary means of controlling STH infections when prevalence rates are high[7].

STH infections are part of a group of 17 diseases categorized by the WHO as Neglected Tropical Diseases. Despite their diversity, it is a group characterized by its association with poverty and proliferation in tropical environments. Multiple infections in a single individual are common. In May 2013, the World Health Assembly passed a resolution (WHA 66.12) which calls on Member States, *inter alia*, to expand and implement, as appropriate, interventions against neglected tropical diseases to reach the targets agreed in the Global Plan to Combat Neglected Tropical Diseases 2008-2015, as set out in the WHO's Roadmap for accelerating work to overcome the global impact of neglected tropical diseases[8]. In the case of STH infections, the targets set out in the Roadmap are that by 2015, 50 per cent of pre-school and school-aged children in need of treatment are regularly treated and 100 per cent of endemic countries have a plan of action for control programmes; and by 2020, 75 per cent of pre-school and school-aged children in need of treatment are regularly treated, with at least 75 per cent coverage in all endemic countries.

Identifying who is in need of treatment can be somewhat difficult. Conducting parasitological surveys is costly and time-consuming. The Global Atlas of Helminth Infections (GAHI) is an online open-access information resource on the distribution

of STH, schistosomiasis and lymphatic filariasis[9]. GAHI aims to provide reliable and updated maps of helminth infection distribution that are essential to target treatment to populations in greatest need. For India, GAHI maps data from 127 surveys conducted over the period 1999 to 2007. Although some parts of India are too hot or dry to permit transmission of STH, the combined prevalence rates reported in many of these surveys are well over the 20% threshold recommended by the WHO for introduction of preventive chemotherapy programmes[7]. The strategy recommended by the WHO for control of the STH infections aims to eliminate morbidity rather than the infections *per se*[9]. This is because morbidity from STH becomes prominent only when worm burdens are relatively high and eliminating moderate and heavy intensity infections is achievable through preventive chemotherapy. Preventive chemotherapy for STH infections, as recommended by WHO, involves the periodic administration of single dose albendazole or mebendazole to populations at high risk of morbidity. Many national control programmes target school age children because they harbour the highest worm burdens and are the main source of environmental contamination. Moreover, the school system offers an ideal setting for deworming and provision of health education messages to children.

While it is undisputed that anthelmintics are effective in deworming infected persons, there is an ongoing debate in the scientific literature regarding other benefits of mass deworming programmes. A Cochrane Library review of the effects of deworming drugs on nutritional indicators, haemoglobin and school performance, last updated in 2012, concluded that a single dose of deworming increases weight and haemoglobin in children known to be infected with worms[10]. However, the review also found that most studies on routine deworming drugs given to school children (deworming all children without screening) have not shown benefit on weight; and that community deworming had little or no effect on haemoglobin and cognition, while the evidence in relation to school attendance and school performance was generally poor, with no obvious or consistent effect. The authors conclude that "it is probably misleading to justify contemporary deworming programmes based on evidence of consistent benefit on nutrition, haemoglobin, school attendance or school performance because there is insufficient reliable information to know if this is so"[10].

On the other hand, it has been argued that "a paucity of randomized trial data suggesting benefit does not equate to a lack of benefit..."[11]. It has also been highlighted that the rationale for community deworming (where everyone is treated, infected or not) is based, not on the expected benefit of the intervention in those who are uninfected, but on the fact that such deworming programmes are more cost-effective and pragmatic than screening and treating[11]. The conclusions of the Cochrane review have been questioned on the grounds that although the Cochrane approach is well suited to analyse traditional medical trials, there are important limitations in pooling randomized trial data for the evaluation of large empiric deworming programmes, and that the included studies were not designed or powered to be able to answer the questions asked.

The only randomized controlled trial that has been adequately powered to examine the impact of deworming was conducted in Lucknow, north India, over a 5-year period in a lightly infected pre-school population. The results showed little effect on mortality; nor were weight, height and haemoglobin levels significantly improved by albendazole[12]. A recent cluster-randomized trial on the impact of school-based deworming with mebendazole and weekly iron supplementation on the cognitive abilities of school children in Sri Lanka's plantation sector, also found no impact on haemoglobin, concentration levels, or educational test scores, despite reduction of infection over a 6-month period[13].

All STH infections are chronic, with infection and re-infection occurring throughout the development of a child. Even in endemic communities with high prevalence, many individuals may be uninfected, and among those who are infected, worm burden is highly variable. The magnitude of benefit from deworming is affected by worm burden as well as other factors such as overall nutritional status, socio-economic conditions etc. Because of this, the benefits of deworming are most apparent in the long-term studies that assess outcomes in terms of accumulated impacts on broad measures of human development, such as those published in the social sciences literature[11].

One such study draws on the work of the Rockefeller Sanitary Commission which led a successful effort to eradicate hookworm disease from the American South, starting in about 1910. At that time, hookworm infected about 40 per cent of Southern American school children. Bleakley has assessed the economic consequences of the large scale population-based treatment and hygiene

education programmes initiated by the Commission[14]. The campaign substantially reduced hookworm disease almost immediately. Areas with higher levels of hookworm infection prior to the campaign experienced greater increases in school enrolment, attendance, and literacy after the intervention. A long-term follow up indicated a substantial gain in income that coincided with exposure to hookworm eradication. Another study has evaluated a Kenyan project in which school-based mass deworming was randomly phased into schools rather than to individuals[15]. The programme was found to reduce school absenteeism in treatment schools by 25 per cent, and to be far cheaper than alternative ways of boosting school participation. Deworming also substantially improved health and school participation among untreated children in both treatment schools and neighbouring schools. However, the researchers did not find evidence that deworming improved academic test scores.

As there has been an improvement in sanitation, nutrition and education in India, transmission of STH infections will be gradually interrupted. However, until that happens, school-based mass deworming programmes should be continued.

Nilanthi de Silva
Department of Parasitology
Faculty of Medicine
University of Kelaniya
Sri Lanka
nrdesilva@gmail.com

References

1. Kattula D, Sarkar R, Ajjampur SSR, Minz S, Levecke B, Muliyil J, *et al*. Prevalence & risk factors for soil transmitted helminth infection among school children in south India. *Indian J Med Res* 2014; *139* : 76-82.
2. Elkins DB. A survey of intestinal helminths among children of different social communities in Madras, India. *Trans R Soc Trop Med Hyg* 1984; *78* : 132-3.
3. Elkins DB, Haswell-Elkins M, Anderson RM. Epidemiology and control of intestinal helminths in the Pulicat Lake region of Southern India. I. Study design and pre- and post-treatment observations on *Ascaris lumbricoides* infection. *Trans R Soc Trop Med Hyg* 1986; *80* : 774-92.
4. Srinivasan V, Radhakrishna S, Ramanathan AM, Jabbar S. Hookworm infection in a rural community in South India and its association with haemoglobin levels. *Trans R Soc Trop Med Hyg* 1987; *81* : 973-7.
5. Kang G, Mathew MS, Rajan DP, Daniel JD, Mathan MM, Mathan VI, *et al*. Prevalence of intestinal parasites in rural Southern Indians. *Trop Med Int Health* 1998; *3* : 70-5.
6. Keiser J, Utzinger J. Efficacy of current drugs against soil-transmitted helminth infection: systematic review and meta-analysis. *JAMA* 2008; *299* : 1937-48.
7. World Health Organization. *Eliminating soil-transmitted helminthiases as a public health problem in children: progress report 2001-2010 and strategic plan 2011-2020*. Geneva: WHO; 2012.
8. World Health Organization. *Accelerating work to overcome the global impact of neglected tropical diseases: a roadmap for implementation*. Geneva, WHO, 2012. Available from: *http://www.who.int/neglected_diseases/NTD_RoadMap_2012 Fullversion.pdf*, accessed on June 12, 2013.
9. The Global Atlas of Helminth Infections. Available from: *http://www.thiswormyworld.org/*, accessed on May 1, 2013.
10. Taylor-Robinson DC, Maayan N, Soares-Weiser K, Donegan S, Garner P. Deworming drugs for soil-transmitted intestinal worms in children: effects on nutritional indicators, haemoglobin and school performance. *Cochrane Database Syst Rev* 2012; *11* : CD000371.
11. Bundy DA, Walson JL, Watkins KL. Worms, wisdom, and wealth: why deworming can make economic sense. *Trends Parasitol* 2013; *29* : 142-8.
12. Awasthi S, Peto R, Read S, Richards SM, Pande V, Bundy D: DEVTA (Deworming and Enhanced Vitamin A) team. Population deworming every 6 months with albendazole in 1 million pre-school children in north India: DEVTA, a cluster-randomised trial. *Lancet* 2013; *381* : 1478-86.
13. Ebenezer R, Gunawardena K, Kumarendran B, Pathmeswaran A, Jukes MCH, Drake LJ, *et al*. Cluster-randomised trial of the impact of school-based deworming and iron supplementation on the cognitive abilities of schoolchildren in Sri Lanka's plantation sector. *Trop Med Int Health* 2013; *18* : 942-51.
14. Bleakley H. Disease and development: evidence from hookworm eradication in the American South. *Q J Econ* 2007; *122* : 73-117.
15. Miguel E, Kremer M. Worms: identifying impacts on education and health in the presence of treatment externalities. *Econometrica* 2004; *72* : 159-217.