Deworming and Development: Asking the Right Questions, Asking the Questions Right

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Two billion people are infected with intestinal worms [1]. In many areas, the majority of schoolchildren are infected, and the World Health Organization (WHO) has called for school-based mass deworming. The key area for debate is not whether deworming medicine works—in fact, the medical literature finds that treatment is highly effective [2], and thus the standard of care calls for treating any patient known to harbor an infection. As the authors of the Cochrane systematic review point out, a critical issue in evaluating current soil-transmitted helminth policies is whether the benefits of deworming exceed the costs or whether it would be more prudent to use the money for other purposes [3].

While in general we think the Cochrane approach is very valuable, we argue below that many of the underlying studies of deworming suffer from three critical methodological problems: treatment externalities in dynamic infection systems, inadequate measurement of cognitive outcomes and school attendance, and sample attrition. We then argue that the currently available evidence from studies that address these issues is consistent with the consensus view expressed by other reviews and by policymakers that deworming is a very cost-effective way to increase school participation and has a high benefit to cost ratio.

**Treatment Externalities**

Most of the studies included in David Taylor-Robinson and colleagues' systematic review do not adequately address the population dynamics of helminth infection. These studies follow standard practice in clinical trials and consider untreated people as a control group. But geohelminth transmission is a dynamic process, and both theoretical and community studies have shown that treatment of some individuals leads to a reduction in transmission in the community as a whole [4,5]. Thus, in a trial randomized at the level of the individual, the expected difference between treatment and control children within the same area will be less than the actual treatment effect. If, for example, school attendance increases by 8 percentage points among treated children and by 4 percentage points among the untreated due to externalities, the estimated impact using this technique will only be 4 percentage points, rather than the true effect of 8 percentage points. These concerns are not merely hypothetical: a study in Kenya found large health and educational spillovers to untreated students within treated schools and even to students in nearby schools [6]. In light of this finding, the primary focus of a review should be studies that use a cluster design and correct standard errors for intra-cluster correlation [6–8], if indeed the purpose of such a review is to evaluate the desirability of mass deworming as a policy. The three studies cited which used this approach, some of which were excluded from the Cochrane review, did find positive effects of deworming.

**Measuring Cognitive Outcomes and School Attendance**

The summary of the Cochrane review [3] published in this issue of *PLoS Neglected Tropical Diseases* focuses on biomedical outcomes while only touching on cognitive and educational issues in a single paragraph.

Measuring the impact of a health intervention on cognitive outcomes requires careful consideration based on an understanding of the nature of cognitive development, and at least three issues need to be addressed [9]. First, impaired cognition rarely results from a single cause [10]. Worm infections are likely to affect children’s cognitive development differently according to their levels of poverty, psychosocial stimulation, and general health status. Reporting of these other environmental risk factors is essential for interpreting studies on cognitive impacts, yet such reporting is rarely used as an inclusion criterion in systematic reviews. Second, the cumulative and interacting impacts of multiple threats to cognitive development typically means a range of functions could be affected, requiring a comprehensive battery of cognitive assessments. However, Taylor-Robinson and colleagues did not give the design of these cognitive assessments the same weight as other methodological considerations when selecting studies for their systematic review. Finally, recovery of cognitive impairments may depend on remedial education or psychosocial simulation in addition to treatment of the disease leading to the impairment [11]. Consequently, null results with cognitive outcomes are difficult to interpret unless trial designs address the above issues.

When measuring the quantity of schooling, it is also critical to directly verify attendance through independent checks on site rather than relying on reported data, which is often influenced by incentives for teachers to exaggerate enrollment and attendance to increase funding. One study found large discrepancies between school attendance measured by registers versus spot checks in a sample of Kenyan primary schools, with average attendance over 10 percentage points higher in the
References


3. Taylor-Robinson D, Jones A, Garner P (2007) School participation benefits of deworming are similarly large and statistically significant in the study subregion, consisting of 50 primary schools, where schwistosomiasis was largely absent and where the protocol thus called for praziquantel not to be provided.)


