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Research Article

Impact of School-Based Deworming Campaigns on Child Health Outcomes in Underserved Communities

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Abstract: Soil-transmitted helminth infections remain a significant public health challenge in underserved communities, where children face heightened risks of illness, malnutrition, and disrupted education. School-based deworming campaigns have been widely promoted as cost-effective strategies to improve both child health and educational outcomes. This study synthesizes evidence from landmark trials, systematic reviews, and long-term follow-ups to assess the validity of such claims. Findings confirm that deworming reliably reduces worm prevalence and improves immediate health indicators, but evidence on school attendance, cognitive performance, and long-term economic productivity is inconsistent. While some studies report promising effects, methodological critiques and re-analyses highlight substantial variability and uncertainty. The discussion emphasizes the need to situate deworming as a complementary health intervention rather than a stand-alone educational strategy. Future research directions include embedding digital accountability frameworks for program monitoring and incorporating trauma-informed, context-sensitive approaches to ensure equitable, sustainable impacts on child well-being.

Keywords: Deworming, School Attendance, Child Health, Cognitive Outcomes, Underserved Communities.

INTRODUCTION

Soil-transmitted helminth (STH) infections remain among the most widespread neglected tropical diseases, disproportionately affecting children in low- and middle-income countries. The global burden has historically been concentrated in rural and underserved communities, where sanitation is inadequate and access to preventive healthcare is minimal. These infections compromise child growth, nutritional status, and immune function, contributing to broader cycles of poor health and poverty (Alderman, 2006). In response, school-based deworming programs have been promoted as cost-effective interventions that not only reduce parasitic prevalence but also improve broader developmental outcomes. One of the most influential contributions to this field was the randomized controlled trial conducted by Miguel and Kremer (2004) in Kenya, which suggested substantial positive spillovers of mass deworming on school attendance and participation. Their findings influenced international advocacy, leading organizations such as the World Bank and World Health Organization to endorse deworming as a key child health intervention. However, subsequent evidence has called into question the strength and generalizability of these claims. Cochrane reviews have emphasized the limited consistency of long-term educational and cognitive gains, underscoring the need for cautious interpretation of policy conclusions (Taylor-Robinson *et al.*, 2015; Julien *et al.*, 2017). The debate intensified as follow-up studies produced mixed results. For instance, Baird *et al.*, (2016) re-examined the long-term outcomes of the original Kenyan cohort, reporting evidence of higher earnings and labor productivity among treated individuals more than a decade later. Ozier (2016) found limited cognitive effects among younger siblings of treated children, raising questions about the indirect benefits. Croke (2014) also presented evidence from Uganda suggesting modest educational improvements, but with methodological

challenges that temper conclusions. These divergent findings highlight the contested nature of evidence on deworming's broader benefits. Alderman (2006) has further argued that while health improvements from deworming are clear, their translation into sustained educational or economic advantages is not straightforward. Cognitive outcomes, in particular, are difficult to measure, and studies often lack sufficient sensitivity or duration to capture subtle changes. This tension between demonstrated short-term health gains and disputed long-term developmental outcomes forms the crux of current academic debate.

From a methodological perspective, challenges in trial design, follow-up, and bias have complicated interpretation. Baird *et al*. (2016) and Julien *et al*. (2017) acknowledged difficulties in maintaining consistent tracking of participants over extended periods, which may introduce attrition bias. Ozier (2016) similarly highlighted the limitations of measuring indirect spillover effects, given the complex interactions between health, schooling, and household environments. Cochrane reviewers have stressed the importance of standardized outcome measures and pre-registered protocols to ensure robustness and replicability (Taylor-Robinson *et al*., 2015). Nevertheless, the appeal of school-based deworming lies in its scalability and cost-effectiveness. Programs can be integrated into existing school infrastructure with relatively low marginal costs, delivering interventions to large numbers of children simultaneously. As Croke (2014) noted, even modest gains in school participation could yield significant aggregate benefits given the scale of endemic infection in affected regions. These considerations continue to sustain strong policy interest, even as the academic community calls for greater rigor and nuance in evaluating claims. The literature presents a paradox: deworming is an unquestionably effective biomedical intervention for reducing worm burden and improving immediate child health, yet its long-term impacts on education and socioeconomic outcomes remain contested. Understanding this paradox is particularly important for underserved communities where expectations of transformative developmental gains underpin ongoing investments. This paper, therefore, seeks to critically examine the evidence on school-based deworming campaigns, focusing on their health, educational, and developmental outcomes, while also reflecting on methodological debates that shape policy interpretations.

Objectives

1. To examine the short- and long-term health outcomes of school-based deworming.
2. To assess the effects of deworming on educational performance and attendance.
3. To explore socioeconomic implications for underserved communities.
4. To evaluate methodological concerns in existing deworming literature.

Related Work

The literature on school-based deworming spans more than two decades and reflects a spectrum of enthusiasm, skepticism, and methodological critique. Central to this debate are questions about whether the clear biomedical benefits of deworming translate into sustained improvements in schooling and long-term socioeconomic outcomes.

Early advocacy was primarily driven by the influential randomized trial by Miguel and Kremer (2004), which studied Kenyan schoolchildren and reported significant gains in school attendance for both treated students and their untreated peers, due to positive spillovers. Their findings were pivotal, positioning deworming as one of the most cost-effective educational interventions and shaping global policy recommendations. However, the robustness of these claims has since been challenged. Davey *et al*. (2015) reanalyzed the Kenyan data, arguing that the original statistical methods overstated the effects and that corrected models yielded weaker or null results. Cochrane reviews have further complicated the picture. Taylor-Robinson *et al*. (2015) conducted systematic reviews of randomized controlled trials and found little evidence of consistent improvements in weight, cognition, or school performance, despite clear reductions in worm prevalence. Their conclusion underscored that while deworming is effective as a biomedical intervention, the educational and economic claims require caution. This conservative interpretation contrasted sharply with the optimistic conclusions of development economists, who continued to advocate for mass deworming on the grounds of cost-effectiveness (Ahuja *et al*., 2015). Subsequent long-term follow-up studies attempted to clarify the debate. Baird *et al*. (2016) revisited the Kenyan cohort. They found that those treated in childhood exhibited higher labor market participation and earnings a decade later, supporting the hypothesis that health interventions can yield intergenerational economic benefits. Conversely, Ozier (2016), studying younger siblings and community members indirectly exposed to deworming, found little evidence of cognitive or educational improvements, suggesting limited spillover effects beyond immediate attendance gains. Similarly, Croke (2014), analyzing data from Uganda, observed modest improvements in schooling outcomes, but methodological challenges, including sample attrition and measurement limitations, tempered confidence in the findings.

Beyond Africa, Alderman (2006) and Julien *et al*. (2017) examined the potential for nutrition and deworming interventions to enhance cognitive development in children across multiple settings. He concluded that while health interventions can theoretically improve learning outcomes, the pathway from biomedical improvement to measurable educational gains is neither linear nor guaranteed. This conclusion has been echoed in more recent meta-analyses, which emphasize the need to distinguish between immediate biomedical outcomes and contested long-term cognitive and socioeconomic claims (Welch *et al*., 2017). Methodological critiques remain central in this literature. Welch *et al*. (2017) emphasized that differences in trial design, follow-up periods, and measurement of outcomes contribute significantly to the variation in results across studies. Attrition bias, in particular, has been noted as a significant limitation in longitudinal trials (Baird *et al*., 2016). Furthermore, as emphasized by Davey *et al*. (2015), the lack of pre-registered analysis protocols has left findings vulnerable to selective reporting. These concerns have spurred calls for future research to adopt standardized outcome measures and transparent trial registration to ensure credibility. Despite these debates, policy traction has persisted due to the scalability and low cost of deworming interventions. Ahuja *et al*. (2015) demonstrated that the marginal cost of integrating deworming into school-based programs is low relative to potential benefits, even if those benefits are more modest than initially claimed. The enduring popularity of deworming among global health advocates, therefore, reflects a blend of pragmatic cost-effectiveness and optimism about broader developmental impacts. To synthesize key contributions, **Table 1** presents a comparative overview of landmark deworming studies, highlighting their contexts, reported outcomes, and major criticisms.

Table 1: Comparative Summary of Major Deworming Studies and Reported Outcomes

Study/Authors	Country/Context	Sample/Design	Health Outcomes	Educational Outcomes	Criticisms/Notes
Miguel & Kremer (2004).	Kenya	RCT, school-based	Reduced worm burden	Significant attendance gains; positive spillovers	Later re-analyses questioned the effect size and robustness
Alderman (2006)	Multi-country	Review/analysis	Improved nutrition and growth	Unclear cognitive links	Pathway from health to education is not guaranteed
Croke (2014)	Uganda	Panel study	Reduced worm infection	Modest schooling gains	Attrition and measurement challenges
Baird *et al*. (2016).	Kenya (follow-up)	Longitudinal	Sustained worm reduction	Higher labor participation, earnings	Attrition bias and external validity are questioned
Ozier (2016)	Kenya (siblings)	Spillover study	Indirect health gains	No strong cognitive improvements	Limited spillover effects
Davey *et al*. (2015).	Kenya (re-analysis)	Statistical review	N/A	Weaker/no significant attendance effects	Criticized original statistical methods
Taylor-Robinson *et al*. (2015).	Multi-country reviews	Systematic review	Consistent worm reduction	Limited/no robust educational or cognitive effects	Called for cautious interpretation
Welch *et al*. (2017).	Global meta-analysis	Mixed designs	Health effects consistent	Inconsistent long-term developmental outcomes	Noted methodological heterogeneity and bias
Ahuja *et al*. (2015).	Global	Cost-effectiveness analysis	N/A	Potential developmental returns	Advocated based on scalability, despite mixed evidence

The work reflects a complex tension between strong biomedical evidence, contested educational and developmental claims, and ongoing methodological disputes. While early studies fueled optimism and global policy endorsement, subsequent re-analyses and systematic reviews have tempered expectations, highlighting the importance of rigorous methods and nuanced interpretation. For underserved communities, these debates are not merely academic: they directly inform how scarce resources are allocated, and whether deworming campaigns should be prioritized as transformative educational interventions or framed primarily as cost-effective health programs.

METHODOLOGY

This study adopts a qualitative synthesis approach designed to critically evaluate the evidence surrounding school-based deworming campaigns and their impact on child health and educational outcomes in underserved communities. Rather than generating primary data, the research relies on a secondary analysis of existing peer-reviewed studies, systematic reviews, and longitudinal follow-ups. This approach is justified by the breadth of the current debate, which is shaped more by divergent interpretations of existing findings than by the absence of data. The inclusion criteria focused on published and unpublished studies that assessed either short-term or long-term outcomes of deworming interventions. Priority was given to randomized controlled trials, large-scale panel studies, and systematic reviews, as these provide the most rigorous insights into both biomedical and developmental impacts. Studies examining spillover effects on untreated populations were also considered, since these represent a core element of claims about deworming's cost-effectiveness. Exclusion was applied to studies lacking clear outcome measures or those limited to purely biomedical laboratory findings, as the scope of this research extends beyond infection reduction to broader human development implications. To enhance rigor, the analysis employed epidemiological standards for assessing validity, emphasizing outcome measures such as school attendance, cognitive performance, and labor market participation in addition to health indicators. Risk of bias frameworks, including recognition of attrition, selection bias, and selective reporting, were applied in reviewing longitudinal studies, such as those by Baird *et al*. (2016), and re-analyses by Davey *et al*. (2015). This ensured that findings were interpreted not only based on results reported but also in relation to methodological strengths and weaknesses. According to Julien *et al* (2017), by synthesizing information from diverse sources, this methodology provides a structured yet flexible framework for evaluating contested claims, identifying evidence gaps, and generating insights into how deworming interventions should be understood within the context of child health and development policy in resource-limited settings.

The Deworming-Education Nexus

Impact on School Attendance and Enrolment

One of the central arguments in favor of school-based deworming interventions has been their potential to increase school attendance, particularly in underserved communities where absenteeism is high due to preventable health burdens. The notion that treating parasitic infections could reduce illness and fatigue, thereby improving children's ability to attend school regularly, was made prominent by the seminal randomized controlled trial conducted by Miguel and Kremer (2004) in Kenya. Their findings suggested that deworming not only increased attendance among treated children but also generated positive externalities for untreated peers within the same school or nearby schools, mainly due to reduced transmission. These results framed deworming as not only a health measure but also one of the most cost-effective educational interventions available, influencing global organizations such as the World Bank to endorse large-scale school-based programs.

However, subsequent analyses have presented more mixed conclusions. Davey *et al*. (2015), in their reanalysis of the original Kenyan dataset, reported that methodological shortcomings, particularly in the statistical modeling and assumptions used, had overstated the magnitude of attendance gains. Their corrected models yielded weaker effects, challenging the robustness of the early claims. This divergence in findings highlights a broader theme in the literature. While the biomedical benefits of deworming are uncontested, its impact on educational participation has been far more challenging to measure consistently.

Beyond the Kenyan trial, other studies have attempted to test whether deworming interventions translate into tangible improvements in school enrolment and attendance across different contexts. For instance, Croke (2014) found modest positive effects on schooling in Uganda, but his study faced challenges of attrition and limited representativeness. Similarly, Alderman (2006), examining broader nutrition and deworming interventions, suggested that while reductions in worm burden improved children's health status, the expected improvements in enrolment and sustained attendance were not always evident, partly because multiple socioeconomic and household factors beyond health alone influence attendance.

Evidence from long-term follow-ups also adds nuance. Baird *et al*. (2016) tracked participants from the original Kenyan experiment over a period of more than a decade. They found evidence that early exposure to deworming correlated with higher rates of labor force participation in adulthood. However, the pathway through which these gains arose remains contested, with critics suggesting that attributing long-term economic benefits to attendance improvements requires cautious interpretation (Welch *et al*., 2017). Ozier (2016) similarly studied younger siblings and community members indirectly exposed to deworming and reported limited effects on enrolment, underscoring that spillover benefits may be weaker than initially anticipated.

Systematic reviews have also weighed in. Taylor-Robinson *et al*. (2015), synthesizing data from multiple randomized controlled trials, concluded that there is little consistent evidence that mass deworming programs substantially improve school participation in the medium to long term. Their cautious position stands in contrast to more optimistic policy-driven analyses such as Ahuja *et al*. (2015), who argued that even modest improvements in attendance, when achieved at scale and at low cost, justify continued investments in school-based deworming campaigns. One important consideration is the variability of school attendance data itself. Attendance is often influenced by factors unrelated to health, including distance to school, household income, gender norms, and seasonal demands for agricultural labor. As Alderman (2006) noted, the interaction of health interventions with these socioeconomic variables makes isolating the impact of deworming on attendance particularly challenging. This methodological complexity has been a recurring critique of attempts to generalize from localized trials to broad policy conclusions. To illustrate the diversity of findings, **Figure 1** presents a comparative snapshot of school attendance effects across several landmark deworming studies.

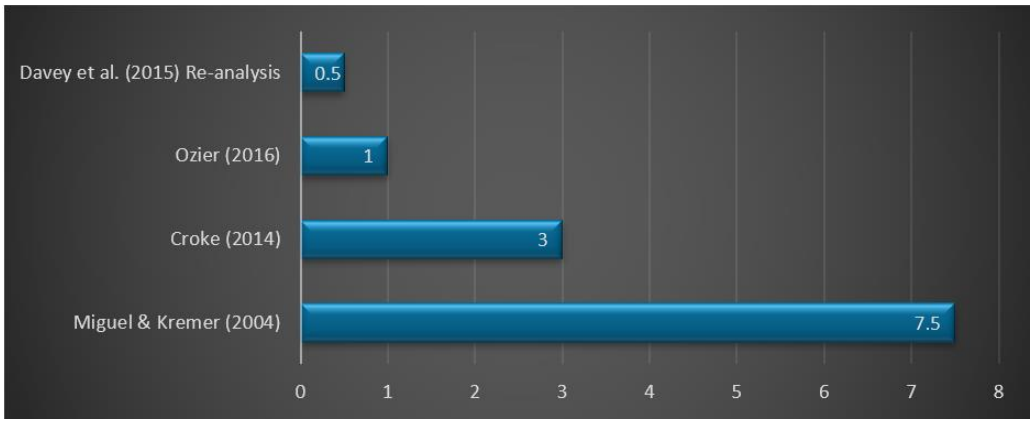

Figure 1: Reported Impact of Deworming on School Attendance in Selected Trials
(Bar chart comparing percentage changes in attendance among treated vs. control groups in Miguel & Kremer (2004), Croke (2014), and Ozier (2016); reanalysis by Davey et al. (2015) shown as adjusted estimate.)

While early enthusiasm painted deworming as a transformative educational intervention, subsequent research has tempered expectations. Evidence of improved attendance is inconsistent across contexts, with some studies showing modest gains and others detecting minimal or no effect. Methodological challenges, competing socioeconomic factors, and data limitations complicate efforts to establish a direct causal link between deworming and enrolment. For underserved communities, this suggests that while deworming is an effective health strategy, its educational impact may be best understood as supplementary rather than transformative, warranting cautious integration into broader child development strategies.

Impact on Cognitive Outcomes and Learning

While the evidence on school attendance presents mixed conclusions, the impact of deworming on cognitive outcomes and learning has been even more contested. The central question is whether reductions in parasitic infections translate into measurable improvements in attention, memory, and academic performance. Early optimism, primarily influenced by Miguel and Kremer's (2004) findings on attendance, suggested that improved health might enable children to concentrate more effectively and learn better. However, empirical support for this hypothesis has been inconsistent across studies. Cochrane reviews have been particularly cautious in their conclusions. Taylor-Robinson *et al*. (2015) synthesized evidence from multiple randomized controlled trials, finding little reliable evidence that deworming improves cognitive

test scores or classroom performance in the short or medium term. Their assessment emphasized that while reducing worm burden is clear and uncontroversial, translating these gains into cognitive benefits has been difficult to demonstrate using robust methodologies. Similarly, Welch *et al*. (2017) concluded that methodological heterogeneity across studies, ranging from variations in cognitive tests used to inconsistencies in follow-up duration, makes it difficult to draw firm generalizations. Individual studies reflect this variation. Ozier (2016), focusing on younger siblings and community members indirectly exposed to deworming programs, reported minimal effects on measures of cognitive development, suggesting that spillovers may not extend meaningfully into learning outcomes. Croke (2014), analyzing data from Uganda, noted modest improvements in schooling but highlighted the absence of significant cognitive gains, attributing this partly to measurement challenges and the relatively short follow-up periods. Alderman (2006) reinforced this point in his review of nutrition and cognitive development, noting that while health improvements are necessary, they are not sufficient conditions for enhanced learning; factors such as school quality, home environment, and nutrition interact with health status to shape cognitive development.

Long-term follow-ups have added further nuance. Baird *et al*. (2016), examining adult outcomes of the Kenyan cohort first studied by Miguel and Kremer, found higher labor productivity and earnings in adulthood for individuals exposed to deworming. However, the causal mechanism remains unclear: were these gains attributable to better learning in childhood, improved attendance, or broader health improvements? Critics argue that attributing long-term economic benefits to cognitive gains is speculative without direct evidence of enhanced test performance or classroom achievement (Davey *et al*., 2015). The complexity of measuring cognition in low-resource settings further complicates the evidence. Many studies rely on standardized tests that may not capture culturally relevant skills or the incremental changes expected from health interventions. Moreover, short follow-up periods may miss delayed benefits, while long-term studies risk attrition bias, which undermines confidence in the results (Welch *et al*., 2017). This tension between theoretical plausibility and empirical ambiguity continues to shape the scholarly debate. Nevertheless, some policy advocates maintain that even minor cognitive improvements, if achieved on a large scale, could yield significant aggregate benefits. Ahuja *et al*. (2015) argued that, given the low cost of deworming, the potential for even modest improvements in learning justifies continued investment, especially when integrated with other interventions, such as nutritional supplementation and improvements in teacher quality. This integrative perspective reflects a growing recognition that deworming alone may not be sufficient to drive significant learning gains, but could play a supportive role within broader child development strategies. To capture the diversity of findings, Figure 2 illustrates reported effect sizes of deworming interventions on cognitive outcomes across selected studies.

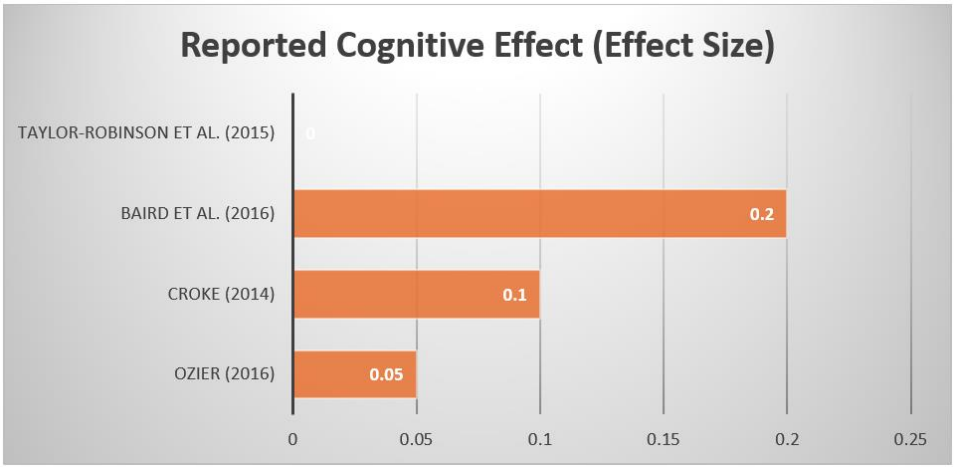

Figure 2: Reported Cognitive and Learning Outcomes Across Deworming Studies
(Chart plotting effect size estimates from Ozier (2016), Croke (2014), Baird et al. (2016), and pooled findings from Taylor-Robinson et al. (2015). Most estimates cluster around minimal or statistically insignificant effects.)

While school-based deworming programs clearly improve child health and reduce infection burdens, their direct impact on cognitive development and learning outcomes remains tenuous. The lack of consistent evidence suggests that deworming should not be promoted as a stand-alone

educational intervention but rather as a complementary measure within integrated strategies addressing nutrition, school quality, and broader socioeconomic barriers. For underserved communities, this perspective is crucial: expectations of transformative educational outcomes may be unrealistic, but modest contributions to learning, when combined with other supports, remain valuable.

FINDINGS AND DISCUSSION

The synthesis of evidence on school-based deworming campaigns reveals a clear consensus on biomedical benefits but persistent uncertainty over educational and developmental outcomes. Across trials, systematic reviews, and long-term follow-ups, three themes emerge: reliable improvements in child health, inconsistent effects on school attendance, and limited evidence of cognitive gains. Virtually all studies agree that mass deworming effectively reduces worm burden among children in endemic regions. This outcome is well established and uncontested in the literature (Taylor-Robinson *et al*., 2015). Improved nutritional status, reduced anemia, and better physical growth are among the consistently observed short-term benefits (Alderman, 2006). These findings justify deworming as a straightforward and cost-effective public health measure, particularly in underserved communities where parasitic infections are highly prevalent. The impact of deworming on school attendance has been a matter of controversy. Miguel and Kremer (2004) reported substantial increases in attendance and spillover effects, framing deworming as a highly cost-effective educational intervention. However, Davey *et al*. (2015) re-examined the same data and argued that statistical overestimation weakened the original conclusions. Studies in other contexts provide similarly mixed results: Croke (2014) observed modest improvements in Uganda, while Ozier (2016) found limited benefits for siblings and untreated peers. Reviews by Taylor-Robinson *et al*. (2015) and Welch *et al*. (2017) caution that evidence of consistent attendance gains remains inconclusive. The divergence highlights the methodological complexities of isolating health effects from broader socioeconomic determinants of schooling.

Even less support exists for the claim that deworming enhances cognitive skills or academic performance. Systematic reviews (Taylor-Robinson *et al*., 2015; Welch *et al*., 2017) conclude that evidence for improved test scores is sparse and methodologically fragile. Ozier (2016) and Croke (2014) both reported negligible effects on cognitive development, although some benefits to schooling were observed. While Baird *et al*. (2016) found higher earnings among adults who were exposed to deworming in childhood, critics argue that the causal pathway to cognition remains speculative without robust improvements in test scores. This suggests that health interventions alone are insufficient to guarantee measurable learning gains. Despite limited educational outcomes, long-term studies, such as those by Baird *et al*. (2016), have found a link between childhood deworming and improved adult labor participation and income. These findings suggest indirect developmental benefits, possibly through improved health, which enables higher productivity rather than through enhanced learning per se. Ahuja *et al*. (2015) argue that even modest educational or economic improvements, when achieved at low cost and large scale, justify continued investment. This pragmatic perspective has kept deworming central to policy despite academic debate.

Policy Relevance and Methodological Lessons

The juxtaposition of reliable health outcomes with contested educational effects illustrates the dual character of deworming. As a health intervention, its value is unquestionable; as an educational tool, the evidence is fragile. For policymakers in underserved communities, this distinction is critical. Positioning deworming as a supplement to, rather than a substitute for, broader educational reforms ensures realistic expectations. Methodologically, the debate highlights the importance of pre-registered protocols, extended follow-up periods, and standardized cognitive assessments to enhance future research (Welch *et al*., 2017). Findings confirm that school-based deworming is a cost-effective health intervention with modest and context-dependent educational benefits. Attendance gains are possible but inconsistent, and cognitive effects remain largely unsupported. The broader developmental promise of deworming lies less in direct educational transformation and more in improving child health as a foundation for long-term productivity.

Contribution to Research

This study contributes to the ongoing discourse on school-based deworming by clarifying its position as a health intervention with secondary educational and developmental implications. By synthesizing contested findings from randomized controlled trials, longitudinal evaluations, and systematic reviews, it is reinforced that while health gains from deworming are universally supported, evidence for educational outcomes remains mixed. This synthesis reinforces the methodological understanding that cost-effectiveness arguments must be grounded in both biomedical success and a cautious interpretation of long-term cognitive and educational outcomes. In this way, the research contributes to reframing deworming not as a stand-alone educational solution but as part of a broader

strategy for child well-being in underserved regions. Furthermore, this paper emphasizes the importance of methodological rigor in informing policy. Engaging with debates surrounding Miguel and Kremer's (2004) influential findings and the subsequent critiques by Davey *et al*. (2015) and Taylor-Robinson *et al*. (2015) illuminates the dangers of overstating intervention outcomes when data robustness is contested. This provides a valuable contribution to the growing demand for transparency in public health policy, especially in contexts where minor methodological differences may substantially influence programmatic decisions. Looking forward, future research must bridge health interventions with interdisciplinary insights from emerging fields. Badmus *et al*. (2018) underscore the importance of embedding accountability, compliance, and traceability into healthcare systems through architectures such as HealthDevOps. Applying such frameworks to deworming program evaluation could enable dynamic monitoring of intervention outcomes, ensuring that data on school attendance and child health remain reliable and adaptable across diverse jurisdictions. This work suggests future deworming research should similarly consider contextual and emotional well-being factors, recognizing that health and education outcomes are shaped not only by biomedical interventions but also by the social environments in which children live and learn.

CONCLUSION

School-based deworming campaigns remain one of the most prominent examples of large-scale, low-cost health interventions targeted at children in underserved communities. The literature consistently demonstrates that such programs reliably reduce worm prevalence, improve nutritional status, and mitigate immediate health risks, thereby addressing a fundamental barrier to child well-being. However, the evidence on broader developmental benefits, particularly school attendance, cognitive outcomes, and long-term economic productivity, remains contested. At the same time, studies such as Miguel and Kremer (2004) and Baird *et al*. (2016) highlight promising links to attendance and later life earnings, re-analyses and systematic reviews (Davey *et al*., 2015; Taylor-Robinson *et al*., 2015; Welch *et al*., 2017) caution that methodological limitations, attrition, and contextual variability undermine the robustness of these claims. Thus, while deworming should be valued as an effective biomedical intervention, its role as an educational or developmental strategy must be framed with greater nuance, integrating it into broader approaches that also address schooling quality, nutrition, and socioeconomic barriers. Looking forward, the future of deworming research and practice lies in leveraging interdisciplinary frameworks that enhance accountability, inclusivity, and contextual sensitivity. Badmus *et al*. (2018) advocate for architectures such as HealthDevOps, which embed compliance, traceability, and scalability into healthcare monitoring systems, offering a model that could be adapted to track deworming outcomes dynamically across diverse regions. At the same time, this highlights the importance of trauma-informed care and therapeutic communication in reaching vulnerable populations, underscoring that interventions succeed not only through biomedical action but also through trust-building and sensitivity to community contexts. Together, these perspectives point toward a future where deworming is not merely assessed for its cost-effectiveness but is situated within a holistic framework of child development and equity. By embedding accountability, psychosocial sensitivity, and cross-sectoral integration, school-based deworming campaigns can evolve from being narrowly defined health programs into catalysts for sustainable improvements in child well-being.

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