

# Interventions for Health and Well-Being in School-Aged Children and Adolescents: A Way Forward

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The health and well-being of school-aged children has received little attention compared with younger children aged < 5 years and adolescents. In this final article in a supplement of reviews that have assessed the effectiveness of interventions for school-aged children across a variety of health-related domains (including infectious diseases, noncommunicable diseases, healthy lifestyle, mental health, unintentional injuries, and sexual and reproductive health), we summarize the main findings and offer a way forward for future research, policy, and implementation. We complement this evidence base on interventions with a summary of the literature related to enabling policies and intersectoral actions supporting school-aged child health. The school represents an important platform for both the delivery of preventive interventions and the collection of data related to child health and academic achievement, and several frameworks exist that help to facilitate the creation of a health-promoting environment at school.

abstract

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The health, development, and well-being of school-aged children and adolescents aged 5 to 14 years worldwide has been given relatively little attention compared with children aged < 5 years partly because of their lower risk of morbidity and mortality. There remain substantial gaps in data for health indicators, mortality, and causes of death for this “missing middle” that are only beginning to be addressed.<sup>1</sup> Given recent successes in reducing rates of under-5 child mortality in low- and middle-income countries (LMICs), school-aged children and adolescents represent a large proportion of the global population. Many routine interventions and services already exist in high-income country (HIC) settings, and preventive and promotive interventions that support a healthy lifestyle, positive development, and well-being in this age group have the potential for significant effects both short term and over the life course, including reducing the burden of mortality and morbidity due to infections, noncommunicable diseases, mental illness, substance abuse, and unintentional injuries. Infrequent contacts with the health system and increasing autonomy and independence in this age group present opportunities wherein health interventions can be delivered through a variety of integrated strategies, including school-based, community-based, and digital platforms.

In this article, we provide a summary and conclusions for a series of reviews on the effectiveness of interventions for school-aged child health published together in this supplement of *Pediatrics*. The authors of the articles included in this supplement and referred to in this summary describe the background and review methodology<sup>2</sup> and review interventions in school-aged children to address high-burden infectious diseases<sup>3</sup> and

neglected tropical diseases (NTDs),<sup>4</sup> improve immunization coverage,<sup>5</sup> address noncommunicable diseases,<sup>6</sup> support mental health and positive development,<sup>7</sup> promote the healthy use of digital media,<sup>8</sup> promote health through digital platforms,<sup>9</sup> prevent unintentional injuries,<sup>10</sup> promote sexual and reproductive health and rights,<sup>11</sup> and assess key delivery platforms, strategies, and enabling policies.<sup>12</sup>

By collating this body of evidence syntheses, we highlight in this article existing evidence gaps and describe a way forward for research prioritization and the scaling up of evidence-based interventions. We propose a recommended set of packages of care for school-aged children, including both a core set of interventions that can be feasibly implemented in all LMICs and an expanded package as opportunity and context allow.

## SUMMARY OF THE EVIDENCE

In this section, we summarize the key findings of each of the 10 reviews included in this supplement. Table 1 lists the main effect estimates for interventions with significant impacts on child health outcomes. Table 2 lists key interventions recommended for school-aged children.

### Infectious Diseases

In a review of interventions for improving vaccination coverage in school-aged children,<sup>5</sup> the authors found that effective interventions to increase coverage of common vaccines in the 4- to 10-year age group, such as human papilloma virus and diphtheria-tetanus toxoids-pertussis boosters, can involve vaccine education, reminders, school-based programs, and provider-based interventions. Effect sizes were generally larger for children aged ≤10 years compared with adolescents aged 11 to 18 years. There was a large gap in the evidence for studies conducted in LMICs.

Evidence from a review of interventions to address high-burden infectious diseases<sup>3</sup> revealed that point-of-use water treatment and filtration and zinc supplementation can reduce diarrhea risk in school-aged children and adolescents. There was also some evidence to suggest that peer counseling and training of health care workers can improve tuberculosis detection and completion of treatment regimens. The authors concluded that an overall dearth of data exist on the effectiveness of interventions for high-burden infections in school-aged children and adolescents compared with the evidence base for children aged < 5 years.

In a review of interventions for addressing NTDs in school-aged children and adolescents,<sup>4</sup> the authors identified several effective interventions for NTDs with high burdens. Mass drug administration for deworming was effective at reducing the prevalence of infection with several species of soil-transmitted helminths (STH). Mass drug administration approaches using azithromycin and health education were effective in reducing the prevalence of trachoma infection. Health education was also found to be promising in reducing the prevalence of schistosomiasis infection. Sparse evidence supports the effectiveness of vector control approaches. Overall, the evidence was of low quality, and more robust evaluations are needed to determine the effectiveness of NTD control measures in school-aged children.

### Noncommunicable Diseases

Key findings from an overview of reviews across multiple domains of noncommunicable diseases and environmental toxicants revealed several effective interventions for their prevention and management in school-aged children.<sup>6</sup> These interventions include community-based asthma management for reducing

**TABLE 1** Summary of Pooled Effects of Key Interventions Across Domains of School-Aged Child Health

Intervention	Key Outcomes (Significant Effects)
<b>Health promotion</b>	
Digital-based interventions to improve health and healthy lifestyle choices <sup>9</sup>	Body fat percentage: MD, −0.35% (−0.64% to −0.06%); fruits and vegetables intake: MD, 0.63 (0.21 to 1.04) servings/d
Interventions for screen time and sedentary behavior reduction <sup>8</sup>	Screen time—general (min/d): MD, −11.45 (−19.18 to −3.73); screen time—television (min/d): MD, −12.46 (−20.82 to −4.10); sedentary behavior (min/d by accelerometry): MD, −3.86 (−6.30 to −1.41)
School-based social-emotional learning interventions <sup>13</sup>	Positive social behavior: ES (Hedges' <i>g</i> ), 0.13 (0.05 to 0.21); academic performance: ES, 0.33 (0.17 to 0.49); conduct problems: ES, 0.14 (0.07 to 0.21); emotional distress: ES, 0.16 (0.08 to 0.23); drug use: ES, 0.16 (0.09 to 0.24)
School-based universal resilience-focused interventions <sup>14</sup>	Depression: SMD, −0.08 (−0.14 to −0.01); externalizing behaviors, SMD, −0.18 (−0.34 to −0.01)
School-based multicomponent positive psychology interventions <sup>15</sup>	Depression: ES, 0.28 (0.13 to 0.43); anxiety, ES, 0.14 (0.04 to 0.24)
Mindfulness-based interventions <sup>16</sup>	Depression: ES (Cohen's <i>d</i> ), 0.27 (0.06 to 0.49); anxiety: ES, 0.16 (0.04 to 0.27)
<b>Prevention</b>	
Vaccination education <sup>5</sup>	Vaccination coverage: RR, 2.10 (1.03 to 4.31)
Vaccination reminders <sup>5</sup>	Vaccination coverage: RR, 1.57 (1.20 to 2.06)
Provider-based vaccine intervention <sup>5</sup>	Vaccination coverage: RR, 1.22 (1.10 to 1.35)
School-based vaccine intervention <sup>5</sup>	Vaccination coverage: RR, 1.22 (1.12 to 1.33)
Multilevel vaccine intervention <sup>5</sup>	Vaccination coverage: RR, 1.08 (1.06 to 1.09)
Health education for trachoma <sup>4</sup>	Mean prevalence of active trachoma: MD, −4.00 (−7.80 to −0.20)
Health education for schistosomiasis <sup>4</sup>	Prevalence of <i>Schistosoma mansoni</i> : RR, 0.10 (0.05 to 0.19)
Point-of-use water treatment of diarrhea prevention <sup>3</sup>	Diarrhea: RR, 0.61 (0.49 to 0.75)
Improved cookstove intervention (plancha, justa, and patsari stoves) <sup>17</sup>	Improvement in personal particulate matter exposure in children: SMD, 1.26 (0.91 to 1.75)
School-based psychosocial interventions <sup>18</sup>	Internalizing disorders: ES (Hedges' <i>g</i> ), 0.133 (0.002 to 0.263)
School-based universal mindfulness and relaxation-based interventions <sup>19</sup>	Anxiety: SMD, −0.65 (−1.14 to −0.19)
<b>Treatment or care</b>	
Mass drug administration for STH infection <sup>4</sup>	Prevalence of <i>Ascaris lumbricoides</i> : RR, 0.42 (0.35 to 0.52); prevalence of <i>Trichuris trichiura</i> : RR, 0.64 (0.53 to 0.77); prevalence of hookworm: RR, 0.44 (0.29 to 0.66); height: MD, 0.35 (0.01 to 0.68)
Micronutrient (iron) for STH <sup>4</sup>	Anemia prevalence: RR, 0.34 (0.14 to 0.81); hemoglobin: MD, 2.29 (0.48 to 4.09)
Mass drug administration for trachoma <sup>4</sup>	Ocular chlamydial infection prevalence: RR, 0.19 (0.04 to 0.94)
School- or community-based treatment of streptococcal pharyngitis for rheumatic heart disease prevention <sup>20</sup>	Rheumatic fever: RR, 0.41 (0.23 to 0.70)
Cognitive-behavioral interventions for prevention and treatment of anxiety <sup>21</sup>	Anxiety score: SMD, −0.81 (−1.00 to −0.63)
<b>Aftercare or ongoing care</b>	
Community-based intervention for asthma management <sup>22</sup>	Asthma-related hospitalizations: OR, 0.24 (0.15 to 0.38)
Classic ketogenic diet for epilepsy <sup>23</sup>	≥50% seizure reduction in patients with intractable epilepsy: pooled efficacy rate, 0.52 (0.46 to 0.57)
Long-term red cell transfusions for sickle cell disease <sup>24</sup>	Incidence clinical stroke: RR, 0.12 (0.03 to 0.49); incidence of vaso-occlusive crises: RR, 0.24 (0.12 to 0.48)
Physical activity and/or sedentary behavior intervention for type 1 diabetes <sup>25</sup>	Change in HbA <sub>1c</sub> : −0.85% (−1.45 to −0.25)

Values in parentheses are 95% confidence intervals. ES, effect size; MD, mean difference; OR, odds ratio; RR, risk ratio; SMD, standardized mean difference; STH, soil-transmitted helminth.

hospitalization, red cell transfusions for reducing stroke and vaso-occlusive crises in sickle cell disease, adherence to a ketogenic diet for seizure reduction in epilepsy, and physical activity intervention for type 1 diabetes. School- and community-based treatment of streptococcal pharyngitis

reduced the risk of developing rheumatic fever, and the use of improved cookstoves reduced children's exposure to particulate matter. There is some evidence from LMICs that health care provider training and public awareness campaigns for early detection may

improve childhood cancer outcomes and treatment adherence, but evidence is sparse.

### Healthy Lifestyle, Nutrition, and Physical Activity

In a review of interventions to reduce sedentary behavior and

**TABLE 2** Key Interventions for School-Aged Children, Organized by Child Health Domain

Child Health Domain	Core Package	Expanded Package	Contextual Interventions
Infectious diseases	Routine age-appropriate vaccinations, boosters, and catch-up Promotion of improved water, sanitation, and hygiene conditions Oral rehydration salts for diarrhea treatment Antibiotics for treatment of severe infections and sepsis	—	Provision and promotion of insecticide-treated bed nets Mass drug administration, health education, and vector control for NTDs
Nutrition and healthy lifestyle	Education and media messaging on healthy eating, physical activity education, and reducing sedentary behavior Micronutrient supplements and school feeding programs Health education for oral health	Lifestyle modification for obesity prevention and management	—
Noncommunicable disease	Prompt diagnosis and management of chronic noncommunicable diseases and disability (eg, asthma, sickle cell disease, epilepsy, cancer, diabetes) Treatment of streptococcal pharyngitis for rheumatic fever and heart disease prevention	Support for education, community-based care, and ongoing self-management of chronic disease	Promotion of improved cookstoves for reducing indoor air pollution
Mental health and positive development	Universal promotion of mental health, and targeted interventions for prevention and management of mental illness (eg, depression, anxiety, self-harm) and substance use Prevention of bullying, violence, and abuse and addressing conduct and behavioral concerns	School-based universal promotion of resilience, mindfulness, relaxation, social and emotional learning, and multicomponent positive psychology interventions to support positive development and well-being	—
Unintentional injuries	Swimming lessons for drowning prevention General physical safety education through school-based and digital platforms for the prevention of unintentional injury from burns, poisoning, and falls	Cycling courses, helmet use promotion, infrastructure development, and programs and policies supporting bicycle and road safety	—
Sexual and reproductive health and rights	Early educational interventions supporting sexual and reproductive health and rights, including prevention of sexually transmitted infections Programs for the prevention of female genital mutilation, early marriage, adolescent pregnancy, and gender-based violence	—	—

—, not applicable.

screen time in school-aged children and adolescents,<sup>8</sup> the authors identified mainly educational interventions for parents and children that were sometimes paired with physical activities and parental support at home. Meta-analysis of intervention effects from randomized controlled trials revealed small, significant reductions in measures of

screen time and sedentary behavior. Most studies were conducted in HICs.

The authors of a review of digital-based interventions for the universal promotion of healthy lifestyle behaviors<sup>9</sup> found a variety of interventions mainly focused on increasing indicators of physical activity, healthy eating habits, and

limiting screen time. The interventions assessed most often involved educational components for the promotion of healthy behaviors and were delivered through platforms such as social media, messaging, Internet media, and video games involving physical activity. Meta-analysis identified some beneficial effects of digital-based interventions

on reducing body fat percentage and increasing fruit and vegetable consumption. The participants in the included studies were mainly adolescents, and there was relatively little data pertaining to children aged <10 years.

### **Mental Health and Positive Development**

In an overview of systematic reviews across multiple domains of child mental health and positive development,<sup>7</sup> the authors found evidence supporting the positive effects of universal prevention interventions on children's mental health outcomes. School-based universal multicomponent interventions that promote resilience, positive psychology, mindfulness, and relaxation had generally beneficial effects on measures of depression, anxiety, and externalizing behaviors. School-based social and emotional learning interventions also improved measures of positive social behavior, academic performance, emotional distress, drug use, and conduct problems to varying degrees. School-based antibullying programs led to reductions in victimization and perpetration, and both community- and school-based interventions can contribute to preventing substance use initiation. The authors highlighted the importance of implementing multicomponent interventions delivered at multiple levels (ie, school, community). Overall, there was a relative dearth of robust evidence from LMICs compared with HICs.

### **Unintentional Injuries**

Evidence from a review of interventions for the prevention of unintentional injuries in school-aged children and adolescents<sup>10</sup> revealed several types of effective interventions targeting some of the highest-burden causes of unintentional injury morbidity and mortality in this age group, such as

road traffic and cycling injuries and drowning. These interventions included introducing legislation requiring helmet use, building or modifying infrastructure to protect cyclists and pedestrians, and educational interventions, such as cycling courses and swimming lessons, using digital and school platforms. Although there was evidence for beneficial effects on knowledge and practice of safe behaviors, outcomes associated with injury-related morbidity, disability, and mortality were insufficiently reported, and thus, additional research is required to confirm the downstream effects of the interventions assessed. There was a paucity of evidence from low-income countries, as the studies identified were almost exclusively conducted in HICs and upper-middle-income countries.

### **Sexual and Reproductive Health and Rights**

In a review of interventions supporting sexual and reproductive health and rights in children aged 5 to 10 years living in LMICs,<sup>11</sup> the authors identified educational interventions for sexual abuse prevention, which included strong evidence of benefits on improving knowledge of sexual abuse prevention concepts and strategies, and lower-certainty evidence for effects on skills, behaviors, and attitudes protective against sexual abuse and gender-based violence. They also uncovered evidence for an effect of educational interventions on improving skills and protective behaviors for reducing HIV infection. The importance of recognizing the cultural context, engaging parents and communities, and leveraging the school platform for delivering early educational interventions was highlighted, as was the beneficial effects of multiactivity programs involving interactivity on child engagement with the educational

material. Meta-analysis was not possible because the majority of included studies were not randomized and did not effectively quantify the magnitude of intervention effects. Future research is required to determine if knowledge is retained in the longer term.

### **Key Delivery Platforms and Strategies**

The authors of an overview of reviews synthesized the evidence base for key delivery strategies used to implement school-aged child health interventions and compared their relative effectiveness.<sup>12</sup> Interventions leveraging community-based, school-based, and financial strategies had promising effects on child health outcomes. Community- and school-based interventions were particularly effective for improving infectious disease outcomes compared with facility-based care alone. School-based interventions were also effective for improving indicators of child development, helmet wearing, delayed marriage, and reduction of body mass index in overweight children. The use of financial strategies was associated with improved outcomes related to food security, dietary diversity, and school enrollment. The evidence base for digital-based strategies was sparse and focused mainly on HICs. Future research is needed to address methodologic issues and assess intervention effectiveness in LMICs.

### **THE SCHOOL AS A PLATFORM FOR HEALTH PROMOTION**

The school platform represents one of the most effective strategies through which preventive health and nutrition interventions can be delivered to school-aged children living in LMICs. Many school-based health interventions can be delivered at very low cost, with annual costs per child



estimated to be  $\leq 3$  US dollars each for micronutrient supplementation, refractive error screening, toothbrush provision, malaria prevention education, and human papilloma virus vaccination.<sup>26</sup> The burden of malaria in school-aged children has been recognized as particularly neglected, and incorporating malaria prevention into school-based intervention packages is likely more cost effective than separate malaria-specific programs.<sup>27</sup> Delivering these interventions through schools, which children are attending on a daily basis, reduces some of the barriers to health service utilization that are inherent in families needing to visit primary care providers. Because participation and success in school are key determinants of child health, development, and well-being, health professionals can act as advocates for school-aged child health by pushing for structural change and policy reforms that support intersectoral cooperation between the education and health sectors.<sup>28</sup>

Diverse evidence for programs involving the school platform also exists outside of the systematic reviews of randomized controlled trials that have been the major focus of this supplement. Evidence from a prospective matched control study assessing the implementation of comprehensive school-based health programs for child and adolescent health in Zambia (including a school health worker teacher training program and biannual health screenings) revealed significant reductions in the odds of self-reported illness and stunting and increases in health knowledge,<sup>29</sup> suggesting that this low-cost program could be effectively implemented in other LMIC settings. The Enhanced School Health Initiative is another promising program that has helped in operationalizing the integrated implementation of school-based

deworming, school feeding, and water, sanitation, and hygiene interventions.<sup>30</sup> A qualitative study using the Consolidated Framework for Implementation Research to evaluate the implementation of a school-based universal mindfulness program in the United Kingdom revealed that school leadership was the most essential construct to implementation success.<sup>31</sup>

### ENABLING POLICIES AND INTERSECTORAL ACTIONS

As part of a systematic review<sup>12</sup> of delivery platforms for school-aged child health interventions, 20 reviews were identified that discussed the impact of the enabling policies and intersectoral actions on the successful implementation of key interventions. Seven reviews reported evidence from LMICs, whereas 13 reviews exclusively reported HIC evidence (Supplemental Information). The key findings from the reviews identified in this exercise are described in this section.

### Integrated Child Health Policies and Services

Among reviews that assessed the effects of enabling policies on the integration of multiple child health domains, combining regional and local interventions encouraged physical activity and reduced private motor vehicle use, and multisectoral planning improved health outcomes across several domains, although age-specific effects were difficult to determine.<sup>32</sup> Evaluations of the World Health Organization's (WHO's) Health Promoting Schools (HPS) framework<sup>33,34</sup> have led researchers to suggest that its implementation is associated with improvements in measures of physical activity and fitness, body mass index, fruits and vegetables consumption, tobacco use, and bullying outcomes.<sup>33</sup> Factors identified as essential for success include programs tailored to local

needs, interventions aligned with schools' aims, collaboration with school staff during program development, and ongoing training and support.<sup>34</sup> To inform an equity-focused approach to health and nutrition programming, Chopra et al<sup>35</sup> identified 3 strategies to alleviate bottlenecks that hinder child health intervention implementation in LMICs: (1) shift interventions from one delivery channel to another, (2) shift the way interventions are delivered within a channel, and (3) improve the delivery channel to address challenges.

### Policies Targeted at Specific Child Health Issues and Risks

System-wide, trauma-informed care models in out-of-home care settings were associated with significantly improved mental health outcomes in traumatized children, including reduced externalizing and internalizing behaviors.<sup>36</sup> National smoking bans are associated with improved cardiovascular and asthma health outcomes and reduced mortality rates for nonsmokers.<sup>37</sup> Changing norms and behaviors around sexual and reproductive health requires policy change, including reforming the legal minimum age of marriage, enforcing child marriage laws, and raising awareness about the harms of child marriage and the laws that prohibit it.<sup>38</sup> Community acceptance and support were essential to the success of physical safety legislation, and increased funding from the public or private sectors was imperative to develop and sustain the infrastructure necessary to implement effective physical safety initiatives.<sup>39</sup>

Policies focused on mitigating environmental risks and promoting improved water and sanitation infrastructure and hygiene conditions affect entire populations and, can also lead to health benefits

in school-aged children. Legislation to improve air quality and minimize the industrial use of toxins, such as lead, can lead to significant benefits in the health and development of children and reductions of their future risk of developing respiratory-related noncommunicable diseases.

### **Nutrition and Healthy Lifestyle Policies**

Authors of several reviews examined enabling policies that support the implementation of healthy lifestyle and nutrition interventions. In one mixed-methods review,<sup>40</sup> the authors proposed a framework to evaluate scale-up efforts and highlighted the importance of environmental policies, urban planning and transportation, and collaboration with nonhealth sectors. There is mixed evidence on whether local or statewide policies are more effective for supporting the implementation of physical activity and healthy diet interventions.<sup>41</sup> Regarding the effect of regulations on children's advertising, there is evidence to support the use of statutory actions, such as total bans on all advertising, bans during specific hours, bans on the length of advertising, advertisement of healthy foods, and voluntary codes not to advertise directly to children or during children's programming.<sup>42</sup> The Obesity Policy Action framework can be helpful to countries in designing a comprehensive approach to obesity prevention by identifying areas for policy action and how that action can be translated into health and nonhealth outcomes. Ultimately, a highlight of the framework is the need and opportunity for coordinated action across multiple sectors and levels of governance.<sup>43</sup>

The results of evaluations of school organization policies and frameworks for nutrition and

healthy lifestyles are supportive of the use of multicomponent interventions that include policy components. These interventions include nutritional standards, improvements in physical education, additional opportunities for physical activity, self-assessments, and nutrition and physical activity education. Government policies are also successful if they include both information provision and fruits and vegetables subsidies, and most study authors recommended joint school and governmental policies.<sup>44</sup> Data from interventions including both diet and physical activity policy components revealed significant reductions in weight-related outcomes, whereas those of diet-only and physical activity-only policies revealed nonsignificant reductions.<sup>45</sup> School policy interventions that include teacher training, activities that form eating and exercise habits, and multicomponent workbooks for physical activity outcomes are also supported by the evidence. Additionally, school food and nutrition policies are associated with improved dietary behaviors.<sup>46</sup>

Among reviews where authors assessed the effects of policies targeting food and beverage availability, taxes and subsidies were associated with changes to diet that may lead to improved health outcomes, though evidence was mainly derived from modeling studies, and data from randomized trials were scarce.<sup>47</sup> Policies and national strategies for providing healthy food directly (eg, in classrooms) or indirectly (eg, through vending machines) also have led to increased fruit and vegetable intake,<sup>48–50</sup> and competitive food and beverage policies (eg, product-specific restrictions) have led to reductions in habitual sugar-sweetened beverage and unhealthy snack

consumption. School meal standard policies are associated with increased habitual fruit intake and reduced habitual total fat and sodium intake,<sup>48</sup> and nutrition guidelines are associated with reduced total and saturated fat intake, increased availability of fruits and vegetables in school food provision, and improvements in dietary intake.<sup>51</sup> Multicomponent interventions that include  $\geq 2$  program elements in their designs are effective in increasing fruits and vegetables consumption and reducing obesity, though review authors emphasized that long-term funding is essential.<sup>50</sup>

### **MONITORING AND EVALUATION FOR SCHOOL-AGED CHILD HEALTH**

Currently, a need exists for a comprehensive monitoring and evaluation framework to track key indicators related to both health and academic achievement in school-aged children. There exist opportunities to incorporate monitoring and evaluation systems into school-based intervention programs for children, which require an integrated reporting strategy that involves intersectoral collaboration that links schools to health systems. Regular assessment of the health and well-being of school children is required to tailor health promotion programs to the individual needs and unique contexts of individual school environments.<sup>52</sup> Reporting systems already involve periodic school surveys and should additionally incorporate health indicators alongside data on academic performance and gender equity.

The WHO and United Nations Educational, Scientific and Cultural Organization recently published a set of global standards and indicators,<sup>53</sup> implementation guidance,<sup>54</sup> and 8 country case studies<sup>55</sup> in the pursuit of making every school a HPS.

The HPS implementation cycle consists of 5 steps: (1) consulting the global HPS standards and establishing a team; (2) conducting a situation analysis; (3) selecting appropriate implementation strategies and indicators; (4) implementing the HPS plan at multiple levels, including national, subnational, and school; and (5) monitoring implementation and progress toward goals.<sup>54</sup>

Global indicators can help to guide government priorities and actions, identify those components of a school system that require additional attention, and support a data-driven approach that promotes accountability. As a school system analog to the WHO Health System Building Blocks framework, indicators representing the following 8 global standards for supporting HPS status have been proposed<sup>53</sup>:

1. Government policies and resources
2. School policies and resources
3. School governance and leadership
4. School and community partnerships
5. School curriculum
6. School social-emotional environment
7. School physical environment
8. School health services

## EVIDENCE GAPS

For the domains of vaccination coverage, noncommunicable diseases, healthy lifestyle promotion, mental health, and unintentional injuries, there is a general lack of evidence derived from intervention trials conducted in LMICs. Given the high mortality rates in school-aged children and adolescents attributed to diarrhea, lower respiratory infections, malaria, meningitis, and typhoid, there is a particular lack of evidence for interventions specifically designed to target intervention uptake in this age group compared with the evidence base for children aged >5 years.

In many of the studies identified in the various articles of this supplement of reviews, researchers reported on outcomes, such as knowledge and behavior, and did not sufficiently report on key end points, such as illness, disability, or mortality. Furthermore, little evidence was reported for longer-term follow-up on the effects of interventions in school-aged children to examine impacts in adolescence and adulthood.

The evidence available for the effectiveness of interventions targeting mental health and the promotion of healthy lifestyle behaviors was relatively sparse for children aged 5 to 10 years compared with the literature available for adolescents. The authors of the systematic reviews on interventions supporting unintentional injury prevention and sexual and reproductive health and rights were unable to conduct meta-analyses because of the heterogeneity in interventions and outcome measures used across the studies they examined.

## IMPLICATIONS FOR RESEARCH AND POLICY

- Better data are needed to understand the main causes of morbidity and mortality in school-aged children and adolescents.<sup>1</sup>
- More research is required with an explicit aim to identify the key opportunities for early intervention available in school-aged children and adolescents to prevent morbidity and mortality across the life course.
- Future research could incorporate longer-term follow-up or longitudinal cohort designs to determine which protective factors and preventive interventions for school-aged children can have the greatest sustained effect on health and well-being.

- To complement improvements in access to high-quality health care, additional research is needed in LMICs to identify effective strategies to increase awareness, screening, and prompt diagnosis and treatment to reduce preventable deaths from noncommunicable diseases, such as childhood cancer, asthma, sickle cell disease, and epilepsy.
- Although there is some evidence from a recent systematic review that combining diet and exercise for obesity prevention may reduce body mass index,<sup>56</sup> there is a need for additional trials using robust methods to determine their effectiveness in LMICs.
- The school platform represents one of the most direct opportunities to deliver promotive and preventive interventions to school-aged children, and although effective interventions have been identified through trials in HICs, more high-quality research is required to determine their effectiveness and sustainability in LMIC settings.
- More high-quality research is required to examine how best to leverage digital platforms to reach school-aged children and adolescents in LMICs, which is especially pertinent given the rising rates of digital technology and Internet usage.

## ABBREVIATIONS

HIC: high-income country  
HPS: Health Promoting Schools  
LMIC: low- and middle-income country  
NTD: neglected tropical disease  
STH: soil-transmitted helminths  
WHO: World Health Organization

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