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Issue: *Integrating Nutrition and Early Childhood Development Interventions***Promoting equity through integrated early child development and nutrition interventions**Maureen M. Black<sup>1</sup> and Kathryn G. Dewey<sup>2</sup><sup>1</sup>Department of Pediatrics, University of Maryland School of Medicine, Baltimore, Maryland and <sup>2</sup>Department of Nutrition, University of California, Davis, Davis, California

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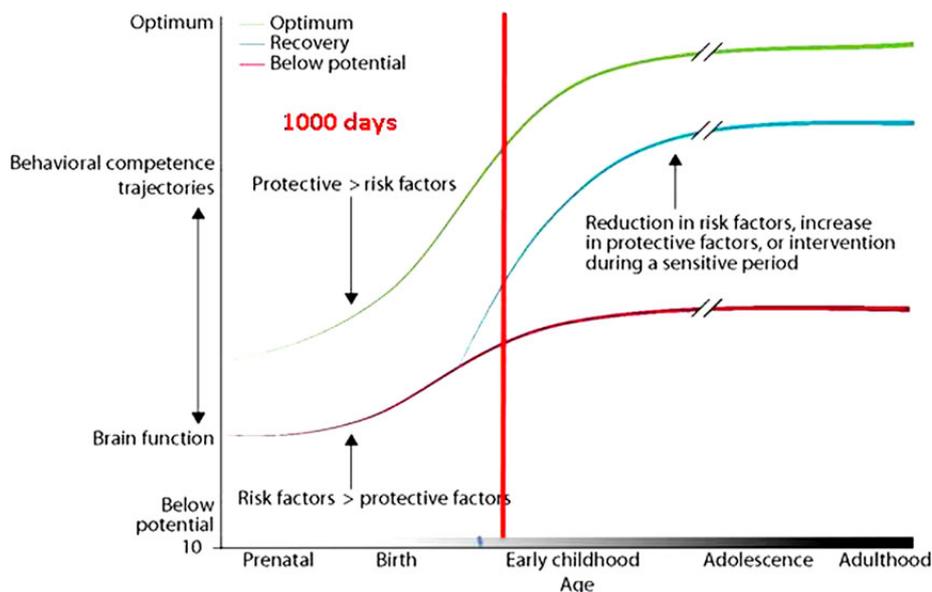
Sustainable development, a foundation of the post-2015 global agenda, depends on healthy and productive citizens. The origins of adult health begin early in life, stemming from genetic–environmental interactions that include adequate nutrition and opportunities for responsive learning. Inequities associated with inadequate nutrition and early learning opportunities can undermine children’s health and development, thereby compromising their productivity and societal contributions. Transactional theory serves as a useful framework for examining the associations that link early child development and nutrition because it emphasizes the interplay that occurs between children and the environment, mediated through caregiver interactions. Although single interventions targeting early child development or nutrition can be effective, there is limited evidence on the development, implementation, evaluation, and scaling up of integrated interventions. This manuscript introduces a special edition of papers on six topics central to integrated child development/nutrition interventions: (1) review of integrated interventions; (2) methods and topics in designing integrated interventions; (3) economic considerations related to integrated interventions; (4) capacity-building considerations; (5) examples of integrated interventions; and (6) policy implications of integrated interventions. Ensuring the health and development of infants and young children through integrated child development/nutrition interventions promotes equity, a critical component of sustainable development.

**Keywords:** integrated interventions; early child development; nutrition; equity

Sustainable development, the focus of the United Nations Sustainable Development Solutions Network for the post-2015 global agenda, depends on healthy, productive citizens with the intellectual skills, creativity, and motivation to lead, govern, and implement the policies and programs of the future. The preparation of such citizens begins before birth and continues through childhood, with the well-accepted recognition that the origins of adult health and well-being stem from the genetic–environmental interactions that begin in the first 1000 days (from conception through 24 months).<sup>1,2</sup> Thus, sustainable development depends on ensuring the health and development of young children, beginning prenatally and continuing at least through school entry.<sup>3</sup>

The health and development of infants and young children is also central to promoting equity. The

development of the human brain begins prenatally and continues through adolescence. Time-sensitive genetic–environmental interactions establish the basis for the formation and pruning of neuronal connections that facilitate the development of culture-specific skills, such as language.<sup>4</sup> Environmental interactions and conditions can foster equity by ensuring that children are exposed to responsive and enriching opportunities for exploration and learning, or can foster inequity through the denial of opportunities and basic needs, such as inadequate quantity or quality of food. Nutrition plays a critical role in children’s development, particularly early in life as neurodevelopmental building blocks are being formed and nutritional needs are high.<sup>5</sup> The combination of nutritional deficiencies and lack of responsive caregiving and opportunities to learn undermines the development of individual children,



**Figure 1.** Life-span development of equity/inequality may be modified by early intervention. Modified from Ref. 26.

increases inequities, and threatens the well-being of entire societies and countries.<sup>6</sup> Interventions that integrate nutrition and early child development offer promise for reducing inequities.<sup>7,8</sup> Although there is evidence of effective single interventions targeting early child development<sup>9,10</sup> and nutrition,<sup>11</sup> there is a need for critical evidence on the development, implementation, and evaluation of integrated early child development/nutrition interventions in preparation for scaling up interventions.<sup>9</sup> This volume examines the evidence regarding integrated child development and nutrition interventions and addresses strategies to promote equity through integrated interventions.

### Early child development

Child development is conceptualized from a life-span perspective. Early in life, children acquire an orderly progression of skills that form the blueprint for subsequent development. As children mature and adapt to their specific caregiving settings, individual and cultural differences emerge, and early disparities become more pronounced.<sup>12</sup> Risks, such as poverty, nutritional deficiencies, and lack of responsive caregiving and learning opportunities, contribute to inequities in children's development, resulting in over 200 million children under 5 years of age in low- and middle-income countries (LMIC) not reaching their developmental potential.<sup>6</sup>

The protective effects of sensitive/responsive caregiving on children's behavior and development can

prevent early inequities and promote development in multiple areas, including cognitive and socio-emotional development.<sup>13,14</sup> Early intervention that promotes protective factors can reduce inequities, thus increasing the likelihood that children reach their developmental potential (Fig. 1).

Early in life, infants and caregivers establish a reciprocal partnership in which they recognize and interpret both verbal and nonverbal communication signals from one another. This reciprocal process forms a basis for the emotional bonding or attachment between infants and caregivers that is essential to healthy social functioning.<sup>15</sup> Caregiver responsiveness provides the emotional support that children need to develop internal regulatory skills, thereby leading to advances in behavioral and developmental competence. Thus, the caregiving context plays a critical role in protecting and socializing children throughout their development.<sup>16</sup>

A wide range of programs for young children have been developed in LMIC, including maternal employment programs that provide custodial child care, home/community programs, and center-based preschools. Program coverage and quality vary, based on curricula, resources and materials, teacher training and supervision, and parent and community involvement. Effective interventions that focus on responsive caregiving and early learning opportunities are available<sup>10,17</sup> and investments in intervention programs early in life are more cost effective than investments during later years.<sup>18</sup> However,

intervention implementation is limited and often least available to children in the greatest need.<sup>10,19</sup> A recent meta-analysis of 30 early-childhood programs provided outside of North America found larger effects on cognition gains and behavior change among educational and mixed programs (stimulation or care, combined with nutrition) than among nutrition-only programs.<sup>20</sup> An unexpected finding was that programs in LMIC had lower effect sizes than programs in higher-income countries. Others have found that children with the most disadvantages often experience the greatest benefits,<sup>10</sup> emphasizing the importance of considering the specific context in which interventions occur.<sup>20</sup>

## Nutrition

The development of many organs, including the brain, is dependent upon adequate nutrients. Deficiencies in micronutrients that have been associated with brain development are common in children under age 5, with the prevalence of iodine deficiency (40% in Africa and 31.6% in Asia), zinc deficiency (23.9% in Africa and 19.4% in Asia), and anemia (hemoglobin < 110g/L, mostly due to iron deficiency: 20.2% in Africa and 19.0% in Asia).<sup>21</sup> Deficiencies in macronutrients (energy, protein, and fat) can lead to poor weight gain followed by stunting,<sup>22</sup> and certain macronutrients (e.g., essential fatty acids) are also associated with brain development.<sup>23</sup> Although the number of stunted children under 5 years of age has decreased from 253 million in 1990 to 165 million in 2011,<sup>24</sup> there are striking inequities in the prevalence of stunting between the poorest and richest quintiles within countries.<sup>21</sup> Stunting early in life has been associated with consequences that threaten equity throughout the life span, including delayed school entry, early school termination, and poor school performance, resulting in reduced work capacity and human capital.<sup>25–27</sup> Early stunting has been used as an indicator, along with poverty, to estimate the number of children worldwide who do not reach their developmental potential.<sup>6</sup> The reduction of nutritional deficiencies and the prevention of stunting during the first 1000 days are major priorities in promoting children's development and preventing inequalities.

In addition to growth faltering, overweight and obesity have emerged as serious problems among

young children throughout the world. In LMIC, rates of childhood overweight and obesity have increased from 4.2% in 1990 to 6.7% in 2010 (representing over 35 million children), with an expected increase to 9.1% in 2020 (12.7% in Africa).<sup>28</sup> Unlike other health and nutritional conditions that differentially affect children in the lowest wealth quintile, in LMIC obesity often occurs in the highest wealth quintiles, illustrating the complexities of the nutrition transition.<sup>29</sup> The consequences of childhood obesity often begin with psychosocial problems and extend to health-related problems.<sup>30</sup> Although the strategies that help families promote healthy growth among their young children (to prevent underweight and stunting) often apply to the prevention of obesity, this issue focuses primarily on the prevention of undernutrition and stunting.

Nutritional guidelines often focus on *nutrition-specific* interventions regarding the availability, accessibility, and acceptability of food and nutrients, beginning before conception and extending to breastfeeding promotion, the timing of complementary feeding, and dietary adequacy during childhood.<sup>11</sup>

*Nutrition-sensitive* interventions have emerged from the recognition that nutritional status is affected by factors that extend from societal conditions, such as poverty alleviation and women's empowerment, to household considerations, such as mealtime organization and family feeding interactions.<sup>31</sup> Since many of these nutrition-sensitive factors affect not only nutritional status, but also children's development,<sup>26,27</sup> they could be incorporated into integrated interventions,<sup>32</sup> thereby potentially strengthening both nutritional status and child development.

## Early child development as a context for nutritional recommendations

The transactional system, the theoretical basis for responsive parenting and responsive feeding, emphasizes the interplay that occurs between children and the environment and provides a useful framework for examining the associations that link early child-development and nutrition.<sup>16,33,34</sup> Through responsive interactions, caregivers provide structure and encouragement, while adapting their reactions to signals from the child. In a transactional system, children determine how much to eat (often

feeding themselves), as caregivers provide nurturance and support without forcing children to eat. Specific care is necessary in cases where children have limited ability to signal their needs, which may be attributed to the fussiness or anorexia that may accompany severe malnutrition, illness, or prematurity.

Caregivers model eating themselves and learn to respond appropriately to challenges, such as children's food refusal. Children explore and learn in a nurturant, respectful context with feeding and mealtime behavior that is driven by internal regulatory processes of hunger and satiety accompanying healthy growth.<sup>34,35</sup> Unresponsive feeding interactions, characterized by negative, coercive strategies to encourage children to eat or by permissive, overindulgent strategies, such as providing frequent snack foods with low nutritional quality, may compromise children's feeding behavior, leading to either underweight or overweight.<sup>36</sup>

Feeding interactions are an integral part of both breastfeeding and complementary feeding and illustrate how principles from the transactional system that inform early child development can be integrated into nutritional interventions. For example, breastfeeding promotion is a primary objective of nutrition-specific interventions, with low rates of exclusive breastfeeding and breastfeeding duration in many LMIC.<sup>37</sup> However, breastfeeding success is dependent on reciprocal mother–infant interactions and low rates of pressuring.<sup>38</sup> These behavioral considerations are central to transactional theory, and may be beneficial to breastfeeding success if they are included in breastfeeding promotion interventions. The period of complementary feeding, generally 6–24 months,<sup>39</sup> is a vulnerable period for growth faltering and excessive weight gain.<sup>22</sup> This period coincides with the child's acquisition of the oral motor, physical, digestive, and social skills necessary to advance to the family diet, along with the communication skills to signal hunger and satiety. Responsive feeding interactions can promote acceptance of complementary food.<sup>40</sup> However, caregivers who misinterpret their children's signals as food refusal or feeding problems are at risk for using unresponsive feeding strategies (i.e., either coercive or permissive).<sup>41</sup> Feeding problems are a major concern among caregivers of infants and toddlers throughout the world,<sup>42</sup> with prevalence estimates that range up to 45%.<sup>43</sup>

Although many policies from international agencies and high-income countries include responsive feeding recommendations,<sup>17</sup> there have been few trials in LMIC, and responsive feeding recommendations have not been routinely operationalized into nutritional interventions.<sup>44</sup> Their inclusion in policies in the absence of effectiveness trials to guide intervention strategies has been attributed to the presence of a strong theoretical basis for responsive feeding, global concerns regarding the nutritional problems of stunting and obesity, and emerging evidence that controlling and indulgent feeding behaviors undermine children's regulatory processes and can contribute to both underweight and obesity.<sup>44,45</sup>

These examples illustrate how principles from child development and transactional theory can inform nutritional interventions and the central roles that caregiver interpretations of children's behavior, caregiver beliefs, and local customs play in feeding behavior and children's acceptance of food. Intervention trials are needed in low- and middle-income populations that examine (1) how feeding patterns relate to children's growth, (2) whether responsive feeding interventions promote dietary diversity and healthy growth, (3) whether responsive feeding interventions translate to nonfeeding situations and promote children's cognitive and socioemotional development, and (4) whether interventions that promote responsive parenting<sup>46</sup> translate to feeding situations and growth.

Nutrition-specific and nutrition-sensitive recommendations have also been incorporated into early child development programs, often through providing food to children and nutrition education to caregivers. The addition of nutrition to early child development programs has been effective in promoting children's cognition and behavior in comparison to nutrition-only programs, although available evidence has not shown a beneficial effect beyond education-only programs.<sup>20</sup>

### **Integrated interventions**

Two strategies have been used to design integrated interventions. First, a factorial design has been used in which the two interventions (nutrition and promotion of child development) are introduced independently and the effect of each intervention is evaluated independently and in combination. This strategy enables comparisons of interventions as well as the additive and synergistic effects of the

combined interventions. Synergistic effects occur when the impact of one intervention is enhanced by the presence of the other. For example, in an integrated trial in Jamaica, the impact of zinc supplementation was greater among the children who received psychosocial stimulation.<sup>47</sup> Most integrated interventions have not formally evaluated the synergistic effects. Second, interventions can be completely integrated such that the two components cannot be separated and evaluated independently. In this strategy, both the intervention team and the participating families perceive a single intervention that incorporates both nutrition and child development, rather than two interventions. For example, ProPAN (Process for the Promotion of Child Feeding) is an integrated procedure developed and distributed by the Pan American Health Organization and UNICEF to develop, implement, and evaluate interventions and programs to improve infant and young child diet and feeding that include both food and responsive feeding.

### **This volume**

The papers in this volume dedicated to integrated interventions represent six areas: review of integrated interventions; methods and topics in designing integrated interventions; economic considerations related to integrated interventions; capacity-building considerations; examples of integrated interventions; and policy implications of integrated interventions.

#### *Review of integrated interventions*

The first paper in this section is a review of studies that integrated nutrition or health interventions with child development interventions. Grantham-McGregor *et al.* found efficacy trials (primarily home-visiting programs) and program evaluations (primarily center-based programs), but no integrated programs implemented at scale.<sup>48</sup> Although most efficacy trials showed beneficial effects of combined interventions and none reported negative effects, only one study reported synergistic effects (few tested for synergistic effects). Among program evaluations, most showed beneficial effects on children's development, but two showed negative effects and one showed no effect. Duration of follow-up varied and the authors provided recommendations regarding subsequent evaluations of integrated efficacy trials, programs, and programs at scale. The one study

that followed children into adulthood showed beneficial effects of early psychosocial stimulation on educational achievement and psychological functioning, but no sustained effects of early nutritional supplementation on growth.<sup>49,50</sup>

The second paper is a review of the implementation processes used in integrated interventions. Yousafzai and Aboud summarized 31 papers, resulting in a table of best practices.<sup>51</sup> The practices included recommendations on content, dosage, delivery strategies, and training and supervision for both psychosocial stimulation and nutrition interventions.

The third paper articulates the advantages of integrated interventions, including the efficiency of delivery to the same population, shared resources, and less demand on the family. DiGirolamo, Stansbery, and Lung'aho also raise concerns about challenges of integrated interventions at the implementation level, including workload commitment, training and supervision, and communication, particularly when programs cross sectors.<sup>52</sup>

#### *Methods and topics in designing integrated interventions*

Five papers address specific methods or topics related to integrated interventions. The first paper examines how formative research is used to develop integrated interventions that address multiple topics in a coherent manner. The resulting interventions can be successfully presented by workers and understood by families. Using the domains of infant and young child feeding, responsive feeding, and child development, Bentley *et al.*<sup>53</sup> provide guidelines on conducting formative research and designing locally tailored, culturally appropriate integrated interventions.

The second paper provides guidance on the measures needed to evaluate integrated interventions, including: food and nutrition, family care, health, and child development.<sup>54</sup> Frongillo *et al.* address measures to evaluate impact, including benefits and potential harms, as well as the mechanisms that connect the intervention with the impact.

The third paper examines the timing of nutrition and child development interventions.<sup>55</sup> Wachs *et al.* describe nutrient-sensitive periods of age-linked dimensions of brain development; timing of exposures to environmental stressors for maintaining neural, neuroendocrine, and immune systems

integrity; and the sensitivity of cognitive and social-emotional development to contextual risk and protective influences. Although the early years of life are a sensitive period for biological and psychosocial interventions, environmental conditions, including interpersonal relationships, have unique and potentially long-term influences throughout life.

The fourth paper focuses on maternal psychosocial well-being, a critical consideration because most nutrition and child development interventions operate through the mother.<sup>56</sup> Zafar *et al.* propose a cognitive behavioral therapy-based intervention designed to reduce maternal mental health problems, which can be integrated into a child nutrition and development program. Community health workers (CHWs) are trained to incorporate five skills into their interactions with mothers: empathic listening, family engagement, guided discovery using pictures, behavioral activation, and problem solving.

The final paper in this section, by Ngure *et al.*, illustrates the potentially adverse effects of poor water, sanitation, and hygiene (WASH) conditions on child development.<sup>57</sup> As a nutrition-sensitive example, evidence suggests that environmental enteropathy, a subclinical condition of the gut, may mediate the relationship between poor hygiene and developmental deficits. Future interventions should consider the integration of WASH and early child-development strategies.

### *Economic considerations related to integrated interventions*

Economic impact is a critical consideration in the evaluation of integrated interventions. Alderman *et al.*<sup>58</sup> explain that benefit-cost analyses facilitate the comparison of alternative investments across different interventions, enabling policy makers to quantify economic returns related to specific policies. They provide guidelines on conducting analyses, including a focus on the timing of interventions, contemporary and dynamic complementarities, and the possibility of program-delivery synergies.

Two papers provide examples of cost-benefit and cost-effectiveness analyses of integrated nutrition and child-development interventions. One paper estimates the cost-benefit ratio for an integrated nutrition and early childhood development program in Nicaragua.<sup>59</sup> On the basis of reductions in the prevalence of anemia and improvements in cogni-

tive performance, Lopez-Boo *et al.* conclude that the discounted annual costs of the program per child are less than the discounted annual increase in beneficiary earnings.

The final paper in this section estimates the cost effectiveness of an integrated nutrition and early childhood development intervention that was integrated into the Lady Health Workers program in Pakistan.<sup>60</sup> The analysis by Gowani *et al.* suggests that the inclusion of the early child-development intervention was more cost effective than a nutrition intervention alone in promoting children's early development.

### *Capacity-building considerations*

Three papers address capacity building and program implementation. In the first paper, Tomlinson *et al.*<sup>61</sup> discuss issues related to families (structure, extended relationships, beliefs, mental health), delivery strategies (center-based care, home visiting), and the capacity of health systems and CHWs to reach the most vulnerable families to provide integrated nutrition and child-development interventions.

In the second paper, Yousafzai *et al.*<sup>62</sup> suggest a paradigm shift in providing integrated interventions. Rather than operating from a traditional model whereby educational messages are provided in a didactic manner with the objective of changing caregiver behavior, they recommend a model in which families are active partners. Health workers are trained to recognize families' strengths and to help families incorporate principles of responsive caregiving into ongoing behavioral patterns.

Finally, Phuka *et al.*<sup>63</sup> review the roles of health workers in Malawi. They illustrate that although Malawi has comprehensive policies and well-outlined coordination structures for integrated nutrition and early child-development approaches, local issues such as workload, logistics, and synchronized work schedules have to be coordinated to enable health workers to be successful.

### *Examples of integrated interventions*

Three examples of integrated interventions are provided. The first, by Hamadani *et al.*, presents evaluations of integrated programs conducted in Bangladesh, one of the poorest countries in the world.<sup>64</sup> The Bangladesh government has incorporated early child development into the national plan of action, but there are no well-evaluated

programs in which child-development activities were integrated into health and nutrition services at scale. The evaluations that have been conducted have shown that integrated interventions are feasible and effective. Recommendations for program expansion include curricula that are brief, simple, and culturally relevant; community awareness of early child-development interventions; public-private partnerships that involve community clinics; community-based interventions to enhance maternal self-esteem; and trials that compare the efficacy of home visiting versus center-based intervention.

The second paper describes the formative phase of SPRING (Sustainable Programme Incorporating Nutrition & Games), an integrated intervention to improve the survival, growth, and development of children in rural India and Pakistan.<sup>65</sup> Using three major themes from the formative research (caring for my child, feeding, and time to play), Lingam *et al.* describe how they use caregiver beliefs and practices to develop a culturally appropriate intervention to be implemented at scale through existing health systems.

The third paper describes the development and implementation of Grow Smart, an integrated micronutrient supplementation and early-learning intervention study conducted among infants and preschoolers in rural India.<sup>66</sup> The paper, by Fernandez-Rao *et al.*, includes the development of interdisciplinary collaboration, research objectives and design, management plan, formative research, selection and pilot testing of intervention and evaluation materials, and training, monitoring, and supervision of the intervention team. It highlights the collaboration with stakeholders, including village leaders and administrators of the Integrated Child Development Services, India's national program that provides early child nutrition and preschool education through village-based centers.

#### *Policy implications of integrated interventions*

Two papers address policies related to integrated interventions. Although governments and international organizations are increasingly recognizing the value of integrating nutrition and early childhood development interventions, there has been limited attention to the multisectoral aspects of integrated interventions and to the fiscal, policy, and monitoring aspects of integrated interventions. Pelletier

and Neuman describe two initiatives developed and implemented by the World Bank: SABER-ECD (Systems Approach to Better Educational Results – Early Childhood Development) and MNI (Mainstream Nutrition Initiative). SABER-ECD collects, analyzes, and disseminates data on early child development policies and programs, focusing on their integration with nutrition, health, and other areas. It is multisectoral in scope, with goals of establishing an enabling environment, broad implementation, and attention to quality. MNI is a 3-year project that plays a similar role in relation to nutrition programs and policy.<sup>67</sup> These research-based initiatives assist governments in developing, supporting, and monitoring integrated interventions.

In a final paper, Britto *et al.*<sup>68</sup> illustrate how a systems approach can be used to examine variability in program implementation. Using examples from four geographically diverse countries (Cambodia, Lao People's Democratic Republic, Kenya, and Peru), they examine early child development systems. Patterns of coordination and communication are frequently vertical, rather than horizontal or cross-sectoral. Although policies regarding early child development programs are often focused at the national level, local governance plays important roles in decision making that can affect the quality and success of integrated programs.

#### **Conclusion**

Although there is strong empirical support for early child-development programs, along with theoretical, empirical, and logistical evidence that confirms the feasibility and effectiveness of integrating child-development and nutritional interventions,<sup>9</sup> there are multiple issues to be considered during implementation. The multisectoral nature of integrated interventions requires coordination among multiple stakeholders, along with integrated organizational, monitoring, and communication systems to ensure progress and avoid gaps and duplication. A systems science framework, such as SABER-ECD, developed by the World Bank,<sup>67</sup> that incorporates the multiple interacting factors that influence early child development and nutrition may be useful in guiding intervention implementation.<sup>69</sup> Systems science emphasizes that to be effective and sustainable, interventions to promote equity need to extend beyond the child and family focus familiar to many healthcare providers to include the physical and

social environment and the connections and feedback loops within multiple sectors, along with local, national, and international policies.<sup>69</sup>

Although intervention during the first 1000 days supports children's nutritional needs and the neurodevelopmental building blocks of brain development, children require ongoing education and opportunities to develop fully.<sup>9</sup> Interventions that are focused exclusively during the first 1000 days can provide a strong beginning, but are unlikely to result in sustained promotion of equity if they do not extend into the preschool and early school-age years.<sup>9</sup> For example, in a randomized controlled trial, the Early Head Start (EHS) program had beneficial effects at ages 2 and 3 in all target areas of early child development. However, by age 5, many of the beneficial effects were not sustained.<sup>70</sup> Although the reasons underlying the lack of sustainability are unknown, one possibility is the absence of ongoing intervention. Half the children did not enroll in center-based preschool following EHS, and there is no information on the centers' ability to handle the children's advanced skills. Implementation and program scaling require a systematic approach, with careful planning and ongoing monitoring and evaluation.<sup>69</sup> We recommend that future child development/nutrition intervention and implementation research (1) employs multilevel, multidisciplinary designs that include an evaluation of the potential synergy associated with integrated interventions; (2) promotes capacity building among the sectors and workers involved; (3) examines how implementation factors, such as age at enrollment, duration, and intensity of intervention relate to impact; (4) incorporates a theory-based perspective that recognizes the interplay among environmental variables on children's development; (5) incorporates economic indicators throughout the implementation process to address benefit–cost issues; (6) involves local and national stakeholders and governance in planning and implementation; (7) focuses on the effects of early interventions (first 1000 days), but extends into the preschool years and examines the effects at least through the age of entry into primary school; and (8) employs rigorous designs that can contribute to long-term follow-up and evaluations of the effects of early intervention. Integrated child development/nutrition interventions early in life provide a promising opportunity to promote equity and to build healthy, productive citizens,

thereby extending beyond the health and well-being of individuals to sustainable development for future generations.

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## Conflicts of interest

The authors declare no conflicts of interest.

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