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# Advancing Early Childhood Development: from Science to Scale 1



## Early childhood development coming of age: science through the life course

Maureen M Black, Susan P Walker, Lia C H Fernald, Christopher T Andersen, Ann M DiGirolamo, Chunling Lu, Dana C McCoy, Günther Fink, Yusra R Shawar, Jeremy Shiffman, Amanda E Devercelli, Quentin T Wodon, Emily Vargas-Barón, Sally Grantham-McGregor\*, for the Lancet Early Childhood Development Series Steering Committee†

Early childhood development programmes vary in coordination and quality, with inadequate and inequitable access, especially for children younger than 3 years. New estimates, based on proxy measures of stunting and poverty, indicate that 250 million children (43%) younger than 5 years in low-income and middle-income countries are at risk of not reaching their developmental potential. There is therefore an urgent need to increase multisectoral coverage of quality programming that incorporates health, nutrition, security and safety, responsive caregiving, and early learning. Equitable early childhood policies and programmes are crucial for meeting Sustainable Development Goals, and for children to develop the intellectual skills, creativity, and wellbeing required to become healthy and productive adults. In this paper, the first in a three part Series on early childhood development, we examine recent scientific progress and global commitments to early childhood development. Research, programmes, and policies have advanced substantially since 2000, with new neuroscientific evidence linking early adversity and nurturing care with brain development and function throughout the life course.

### Introduction

Two *Lancet* Series on Child Development in Developing Countries (2007 and 2011) spearheaded the review of evidence linking early childhood development with adult health and wellbeing. The finding that 219 million (39%) children younger than 5 years (under-5s) in low-income and middle-income countries (LMICs) are at risk of not reaching their developmental potential, leading to an average deficit of 19·8% in adult annual income,<sup>1</sup> attracted global attention.<sup>2</sup> These two Series reviewed evidence related to key biological and psychosocial risks; summarised neuroscientific evidence on both adverse and positive experiences affecting early brain development; reviewed effectiveness of programmes and policies to improve early childhood development; provided the estimated costs of not investing in preschools; and concluded that inequities in development begin prior before conception, and that timely interventions reduce inequities and increase productivity (appendix pp 2).<sup>3-6</sup>

New evidence supports a life course perspective on childhood development and strengthens the conclusions and recommendations from the earlier *Lancet* Series, primarily through advances in neuroscience and longitudinal follow-up approaches. Poverty and adverse childhood experiences have long-term physiological and epigenetic effects on brain development and cognition.<sup>7-9</sup> Neural processes, influenced by genetic and epigenetic variation, underlie the attachment and early learning systems, influencing subsequent health and development.<sup>10</sup> Longitudinal follow-up studies among children exposed to poverty and other adverse conditions show beneficial effects of interventions on adult

wage earning,<sup>11,12</sup> competence (eg, intelligence quotient, educational attainment, and general knowledge),<sup>13,14</sup> health biomarkers,<sup>15</sup> reductions in violence, depressive symptoms and social inhibition,<sup>14</sup> and growth in the subsequent generation.<sup>16,17</sup> These findings provide strong economic justification for investment in early childhood,<sup>18</sup> especially in children younger than 3 years (under-3s).<sup>19</sup>

In response to the loss of human potential associated with early adversities, leaders from international organisations have issued urgent calls for strategies to

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This is the first in a Series of three papers about early childhood development

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### Key messages

- The proportion of children younger than 5 years in low-income and middle-income countries at risk of not attaining their developmental potential because of extreme poverty and stunting remains high (43%).
- The accumulation of adversities, beginning before conception and continuing throughout prenatal and early life, can disrupt brain development, attachment, and early learning. Developmental delays are evident in the first year, worsen during early childhood, and continue throughout life.
- Despite substantial progress in early childhood development research, programmes, and national policies since 2000, services are of varying quality with uncoordinated and inequitable access, especially for children younger than 3 years.
- Children's early development requires nurturing care—defined as health, nutrition, security and safety, responsive caregiving, and early learning—provided by parent and family interactions, and supported by an environment that enables these interactions.
- Coordination, monitoring, and evaluation are needed across sectors to ensure that high quality early childhood development services are available throughout early childhood and primary school, up to the age of 8 years.
- Action at global, national, and local levels is needed to increase political commitment to and investment in early childhood development.

	Under-5 population		Number stunted		% stunted		Number living in extreme poverty		% living in extreme poverty		Number at risk of not reaching developmental potential*		% at risk of not reaching developmental potential	
	2004	2010	2004	2010	2004	2010	2004	2010	2004	2010	2004	2010	2004	2010
East Asia and Pacific	136.2	145.7	34.1	29.6	25%	20%	30.2	18.2	22%	13%	54.7	41.7	40%	29%
Europe and central Asia	25.4	27.9	4.8	4.8	19%	17%	1.1	0.8	4%	3%	5.6	5.4	22%	19%
Latin America and Caribbean	56.8	54.1	9.1	8.0	16%	15%	4.9	3.0	9%	6%	11.6	9.7	20%	18%
Middle East and north Africa	32.3	36.5	8.0	8.6	25%	24%	1.1	1.0	3%	3%	8.7	9.1	27%	25%
South Asia	171.4	168.1	80.6	67.6	47%	40%	69.5	46.5	41%	28%	110.9	88.8	65%	53%
Sub-Saharan Africa	124.9	143.3	53.9	55.1	43%	38%	67.5	72.3	54%	50%	87.6	94.8	70%	66%
Total	547.0	575.6	190.6	173.7	35%	30%	174.3	141.8	32%	25%	279.1	249.4	51%	43%

Generated using updated data and methods. \*Calculations for the number of children at risk of not reaching their developmental potential take into account the number of children jointly exposed to stunting and poverty. Further information regarding the estimation of this joint set is provided by Lu and colleagues.<sup>22</sup>

**Table 1: Estimated number (in millions) and prevalence of under-5 children experiencing stunting or extreme poverty in 2004 and 2010**

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For the *Lancet Series* on Child Development in Developing Countries (2007) see <http://thelancet.com/series/child-development-in-developing-countries>

ensure that young children reach their developmental potential.<sup>2</sup> This Series responds to those calls. Paper 1 proposes a life course perspective and the study of global commitments to early childhood development; Paper 2 examines evidence to implement and sustain effective early childhood development programmes at scale,<sup>20</sup> and Paper 3 proposes models and strategies to promote early childhood development at scale.<sup>21</sup> This Series focuses on the period from conception up to and including under-5s. Particular attention is given to children under the age of 3, because of the importance associated with the sensitivity and vulnerability of early brain development, the relative lack of attention to early childhood development in general during this period, and the potential for service delivery through the health, nutrition, and social protection sectors.

This first paper has five objectives: (1) to update the estimates of children at risk of not attaining their developmental potential; (2) to present a life course conceptual framework of early childhood development; (3) to assess global commitments and progress in early childhood development since 2000; (4) to examine access to centre-based and home-based early childhood development programmes; and (5) to describe cross-sectoral opportunities to implement early childhood development programmes.

### Estimates of children at risk of not attaining developmental potential

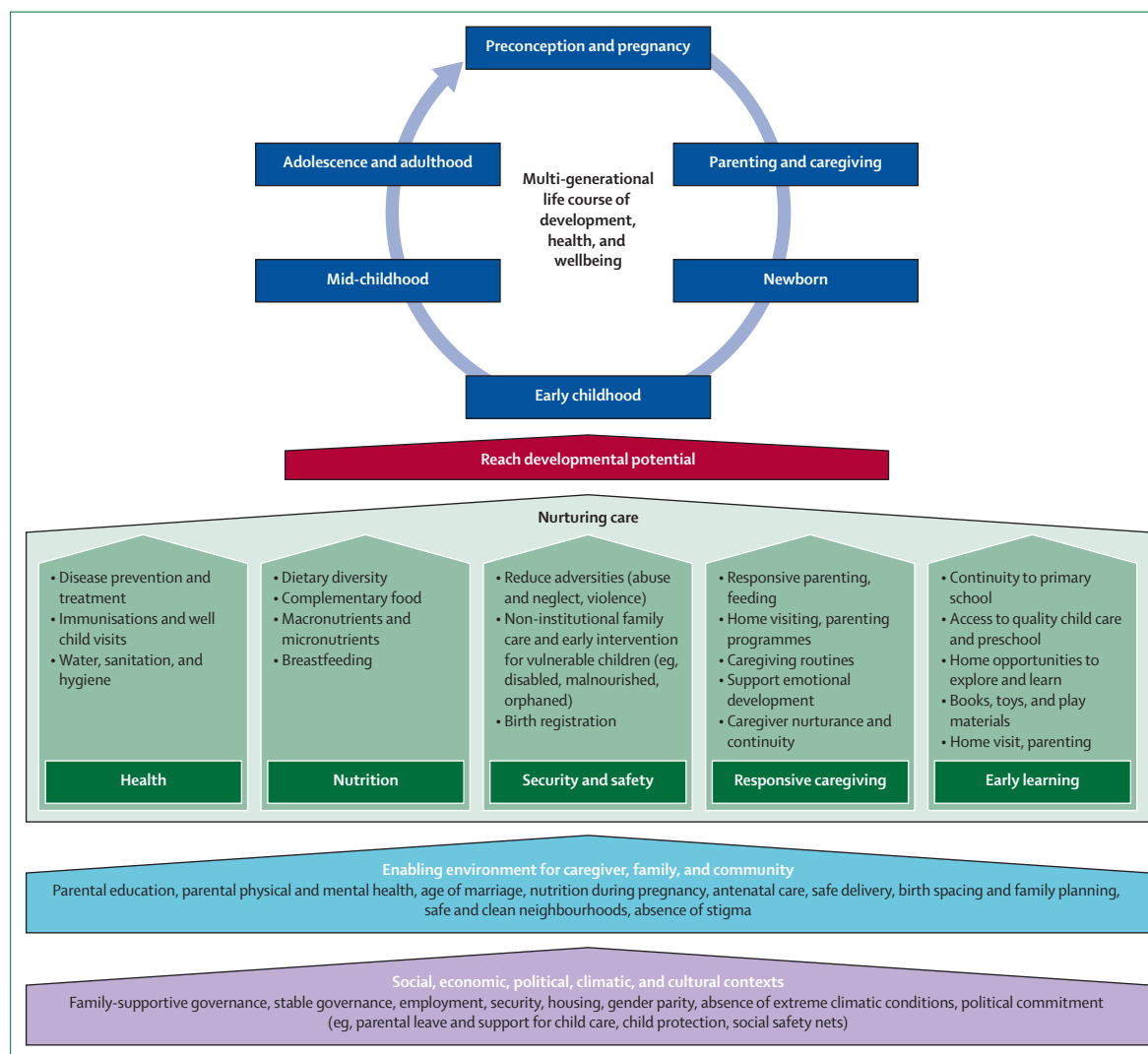
Since the 2007 *Lancet* publication of the number of under-5 children in LMICs at risk for not reaching their developmental potential due to stunting and extreme poverty; definitions of stunting and extreme poverty have been updated, with improvements to the source data and estimation methods. As a result, the estimated number of children in LMICs at risk of not reaching their developmental potential, calculated in 2004, was revised from 219 million to 279 million.<sup>22</sup> Between 2004 and 2010, the estimated number of children under 5 years in LMICs

exposed to stunting or extreme poverty, and therefore at risk of not reaching their developmental potential, declined from 279.1 million (51% of children in 2004) to 249.4 million (43% of children in 2010) (table 1).<sup>22</sup> South Asia experienced the largest decline in both the number and prevalence of children at risk (from 110.9 million to 88.8 million, and from 65% to 53%, between 2004 and 2010). Sub-Saharan Africa had the highest prevalence of children at risk of not reaching developmental potential (70% in 2004 and 66% in 2010).

Population-level assessments measure the developmental status of populations and are used for monitoring global targets, such as UN Sustainable Development Goals. Stunting and extreme poverty serve as proxy measures because they are associated with children's development, are measured globally using uniform methods, and are responsive to environmental and economic changes. Direct population-level assessments are advantageous due to their sensitivity to variations in children's development and responsiveness to programmatic interventions. However, direct assessments are often costly and time-consuming to measure, and might require developmental and cultural adaptations. Initial analyses using UNICEF's caregiver-reported Early Childhood Development Index found that 36.8% of 3-year-olds and 4-year-olds in 35 LMICs do not attain basic cognitive and socio-emotional skills, such as following directions and inhibiting aggression.<sup>23</sup> Efforts are underway to validate population-level measures that can be applied globally and used for monitoring progress in meeting targets from the Sustainable Development Goals for under-3s.<sup>24</sup>

### Life course conceptual framework of early childhood development

Childhood development is a maturational and interactive process, resulting in an ordered progression of perceptual, motor, cognitive, language, socio-emotional, and self-regulation skills.<sup>25</sup> Although the developmental process is similar across cultures, progression rates can vary as



For the *Lancet Series on Child Development in Developing Countries (2011)* see <http://thelancet.com/series/child-development-in-developing-countries-2>

See Online for appendix

**Figure 1:** The effects of contexts, environments, and nurturing care through the multigenerational life course

children acquire culture-specific skills.<sup>24</sup> The acquisition of skills and learning in middle childhood, throughout adolescence, and into adulthood builds on foundational capacities established between preconception and early childhood, with multigenerational effects (figure 1).

Children reach developmental potential when they acquire developmental competencies for academic, behavioural, socio-emotional, and economic accomplishments. Multiple factors influence the acquisition of competencies, including health, nutrition, security and safety, responsive caregiving, and early learning; these domains interact with each other and can be mutually reinforcing through the process of development. All are necessary for nurturing care and occur through bi-directional interactions, initiated by both children and caregivers, and sustained by their environments.

Nurturing care is characterised by a home environment that is sensitive to children's health and

nutritional needs, responsive, emotionally supportive, and developmentally stimulating and appropriate, with opportunities for play and exploration and protection from adversities.<sup>27</sup> Positive associations between nurturing care and children's health, growth, and development have been demonstrated worldwide,<sup>28,29</sup> supported by neuroscientific evidence that nurturing care during early childhood attenuates the detrimental effects of low socioeconomic status on brain development.<sup>9,30,31</sup>

Informed by social ecology,<sup>15,26</sup> nurturing care extends beyond families to include community caregivers and support for families.<sup>32</sup> The systems model that forms the basis for our life course conceptual framework includes both an enabling environment for caregiver, family, and community, and an enabling social, economic, political, climatic, and cultural context (figure 1). The former represents personal resources, including maternal

### Panel 1: Sensitive periods for the association of adversities with early childhood development

#### Stunting

- Evidence from low-income and middle-income countries suggests that the prenatal period<sup>39</sup> and the first 24 months after birth<sup>40–42</sup> are the most sensitive times for stunting to be associated with later cognition, executive function, and school attainment; after 24 months the association is not as strong.<sup>38,41</sup>
- Some catch up is possible in height-for-age after 24 months, with uncertain cognitive gains.<sup>43,44</sup>
- Macronutrient supplementation studies generally confirm the importance of the first 24 months for intellectual development.<sup>45</sup> Early supplementation has long-term benefits to wages, but no benefit occurred with supplementation after 36 months.<sup>12</sup>

#### Poverty

- Poverty is associated with deficits in language and cognition at 3 years that are larger at 5 years of age.<sup>46–48</sup>
- Deficits are evident from the first year of life, with deficits in executive function observed in Argentinian infants aged 6 to 14 months,<sup>49</sup> and developmental deficits observed in infants between 3 and 23 months of age in India, Indonesia, Peru, and Senegal.<sup>50</sup> Deficits in language and cognition were found at 10 to 12 months of age in Colombian children, with deficits increasing up to 42 months.<sup>47</sup>
- A longitudinal Bangladeshi study found a 0.2 SD deficit in cognition between the top and bottom wealth quintile at age 7 months that increased to 1.2 SD of intelligence quotient (IQ) by 63 months. The effect of poverty was mostly mediated (86%) by parental education, the quality of the home environment, and prenatal and postnatal linear growth up to 2 years. After 24 months, growth had only a small effect on IQ, whereas the home environment had a substantial positive effect up to 63 months.<sup>41</sup>

- Changes in poverty level after age 36 months affect cognitive development and executive function.<sup>51</sup>

#### Severe psychosocial deprivation

- Being in a residential institution is an example of profound deprivation. A randomised trial of placing Romanian children (aged 5–31 months) from institutions in quality foster care, or keeping them in the institution, presents a unique opportunity to examine sensitive periods in childhood development.
- Children in quality foster care improved in IQ (at 8 years),<sup>52</sup> attachment (at 42 months),<sup>53</sup> and electroencephalogram power and coherence (at 8 years),<sup>54</sup> compared with children remaining in institutions. Children placed before 24–26 months showed a more improved stress response (at 12 years),<sup>55</sup> language (at 42 months),<sup>56</sup> and mental health (at 54 months),<sup>57</sup> than children placed later.
- Children who remained in the institutions had a blunted stress response. Children fostered before 24 months improved in their cortisol response and children fostered before 18 months improved in their parasympathetic response.<sup>55</sup>
- Children fostered before age 15 months caught up with their environmental peers in language development; children placed after 24 months had less improvement.<sup>56</sup>
- Internalising problems improved but time of placement had no effect, and there was no improvement in externalising disorders.<sup>57</sup>
- Children in institutions had changes in brain microstructure white matter; foster care was associated with some improvement in the microstructure, regardless of placement time.<sup>58</sup>

education and maternal physical and mental health, and community resources including safety, sanitation, and absence of stigma. The latter represents structural aspects, including policies, laws, supportive organisational systems and structures, and financial wellbeing, as well as wars, conflicts, droughts, and cultural variations. These multilevel components are mediated through nurturing care to influence children's development.

#### Adversity, brain development, and protective influences

Early life adversities affect life course development, especially when multiple adversities such as poverty, nutritional deficiencies, high-crime communities, and low quality resources coincide.<sup>31</sup> Neuroscientific evidence has documented associations between low socioeconomic status in early childhood and smaller hippocampal grey matter volume,<sup>9,30</sup> which together with low frontal and temporal lobe volume, might mediate associations between poverty and low cognitive, academic, and behavioural performance.<sup>33</sup> Effects of being raised in

poverty can extend to adulthood, resulting in low task-related activation of brain regions supporting language, cognitive control, and memory skills, and high activation of regions associated with emotional reactivity.<sup>31</sup> Maternal nurturing care during early childhood can attenuate the detrimental effects of low socioeconomic status by protecting early brain development.<sup>8</sup>

#### Early brain development

Several environmental factors help explain socioeconomic status-based differences in brain development. Nutrients promote healthy brain development, with effects varying based on the timing, dose, and duration of access and deficiencies.<sup>34</sup> Nutritional deficiencies before conception and during pregnancy can result in neural tube disorders, low birthweight and low birth-length, and lifelong developmental delays or disabilities.<sup>35</sup> Although prenatal multiple micronutrient supplements benefit fetal growth, their effect on pregnancy outcomes and children's subsequent development is inconsistent.<sup>36,37</sup>

Stunting before age 2 years is related to poor child development<sup>38</sup> (panel 1). Improvements in height-for-age might occur after 2 years, but associations with cognitive gains remain uncertain.<sup>43,44,59</sup>

Nurturing care influences child development, and could attenuate the effects of adversity.<sup>51,60</sup> For instance, a randomised trial of foster care versus continued institutional placement among Romanian children in institutions found that the timing of foster placement relates to childhood stress hormone levels, a potential mediator between adversity and cognition (panel 1). The Romanian trial suggests that the negative effect of adversities can dysregulate the hypothalamic-pituitary-adrenocortical axis early in life, but might be partially ameliorated by nurturing care.<sup>55</sup>

### Timing of interventions

Children's early development is characterised by sensitive periods for skill development related to maturation and genetic–environmental interactions.<sup>61</sup> The effect of interventions varies on the basis of sensitive periods related to specific experiences or environmental conditions (panel 1).<sup>59,61</sup> For example, in Nepal, prenatal iron and folic acid supplementation was effective in producing positive downstream effects on school-age children's cognitive and executive functioning performance,<sup>63</sup> but iron and folic acid supplementation in children aged 12–35 months had no effect.<sup>64</sup> Adoption studies suggest that after age 2 years, profoundly disadvantaged children are less sensitive to contextual improvements than younger children.<sup>59</sup>

In summary, the period between conception and age 2 years (1000 days) is sensitive to nutrient effects on child growth, cognition, and subsequent school attainment.<sup>65</sup> Poverty is associated with developmental delays before 12 months, with increasing deficits to 5 years,<sup>41</sup> illustrating that sensitive periods for economic adversity extend through at least age 5 years. Additional neuroscience and child development research is needed to understand optimal intervention timing.

### Accumulation of adversities

Extreme poverty increases children's likelihood of exposure to multiple adversities, including family stress, child abuse or neglect, food insecurity, and exposure to violence, which are often compounded by living in communities with limited resources. Accumulated adversities are often more detrimental to children's development than single adversities, possibly because accumulated adversities could undermine children's physiological response systems and inhibit self-regulation and stress management.<sup>66,67</sup> Nurturing care depends on thriving families; adversities affecting families and the broader socioeconomic context could undermine the capacity of families to provide nurturing care.

Globally, large numbers of children experience multiple adversities or disabilities<sup>68</sup> and live in fragile

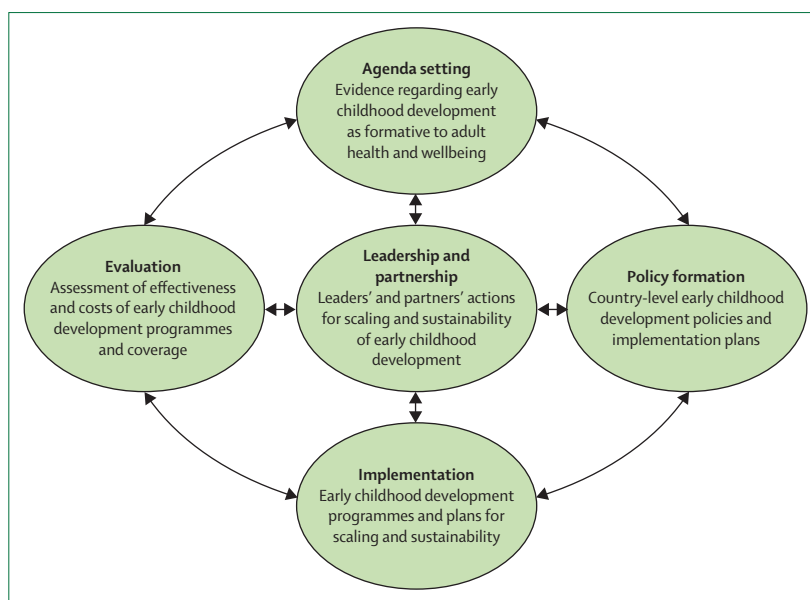


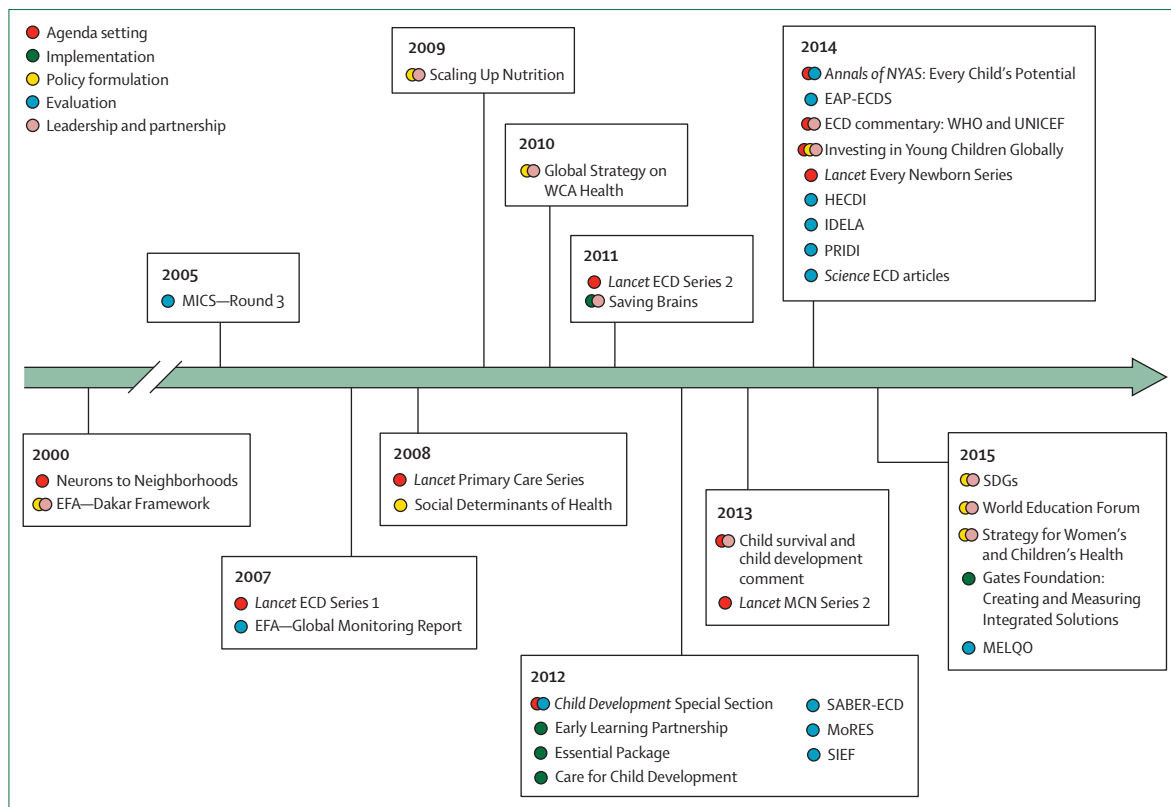
Figure 2: Policy heuristic: relations among key processes in early childhood development policies

settings, such as refugees and displaced or migrant families. Many children have poor access to health care and education,<sup>69</sup> parents living with HIV, depressed mothers and fathers,<sup>70</sup> or are in institutions.<sup>71</sup> Coordinated multisectoral, multilevel programmes might be necessary to reduce multiple adversities while enhancing protective factors and are discussed in Paper 2 of this Series.<sup>20</sup>

### Global commitments to early childhood development

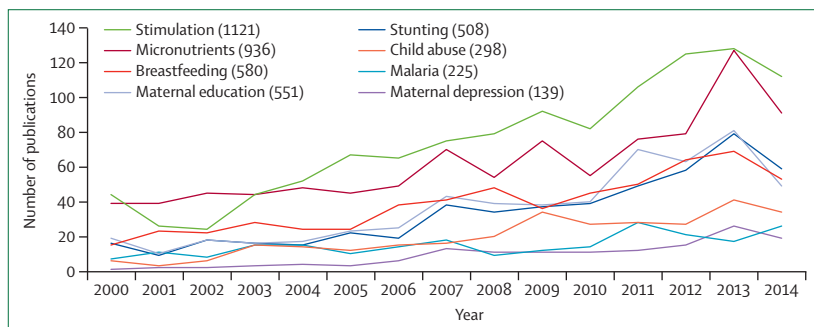
We examined changes since 2000 in global commitments to early childhood development using a policy process heuristic<sup>72</sup> (figure 2). This heuristic assesses progress in five categories: agenda setting, evaluation, implementation, policy formation, and leadership and partnership.

We used five approaches to collect data related to the heuristic. First, we conducted a 2000–14 literature review on early childhood development risk and protective factors<sup>6</sup> to examine changes in the knowledge base (appendix pp 3–11). Second, we conducted a policy analysis regarding global political commitment to early childhood development that included 19 semi-structured interviews with early childhood development leaders, and analysis of key documents. This analysis is further described in a Health Policy related to this Series.<sup>73</sup> Third, we conducted a programme analysis with leaders of governmental and non-governmental early childhood development implementation and donor agencies, including searches of their annual reports to gather information on commitment to early childhood development (appendix pp 12–13). Fourth, we reviewed policies and investments in early childhood development



**Figure 3: Timeline of events influencing early child development policy or practice, 2000–15**

EAP-ECDS=East Asia-Pacific Early Child Development Scales. ECD=Early Childhood Development. EFA=Education for All. HECDI=Holistic Early Childhood Development Index. IDELA=International Developmental Early Learning Assessment. MCN=Maternal and Child Nutrition. MELQO=Measuring Early Learning Quality and Outcomes. MICS=Multiple Indicator Cluster Surveys. MoRES=Monitoring Results for Equity System. NYAS=New York Academy of Sciences. PRIDI=Regional Project on Child Development Indicators. SABER-ECD=Systems Approach for Better Education Results—Early Childhood Development. SDGs=Sustainable Development Goals. SIEF=Strategic Impact Evaluation Fund. UNICEF=United Nations Children's Fund. WCA=Women's, Children's, and Adolescents'.



**Figure 4: Change in number of publications related to early childhood development 2000–14**

in LMICs. Finally, we summarised our findings by assembling a timeline of major 2000–15 events related to early childhood development (figure 3).

#### Research in early childhood development

Since 2000, publication numbers increased for all topics reviewed, with stimulation (n=1121) and nutrition-related topics (stunting, n=508, and micronutrients, n=936) having greater publication numbers than

malaria (n=255), maternal depression (n=139), or child abuse and neglect (n=298; figure 4). Comparing the 5 year period from 2010–14 with the 2000–04 period, publications increased by factors of 2.0 for micronutrients, 2.9 for stimulation, 3.8 for stunting, and 6.9 for maternal depression. The doubling time for general health sciences publications is estimated at 8 years (2.4 over 10 years).<sup>74</sup> The increase in publications concerning early childhood development and stimulation, stunting, or maternal depression was greater than the general trend. Despite recommendations for intervention research,<sup>3–6</sup> only a few of the publications identified in the literature review reported on interventions (n=9, 6.3% for maternal depression and n=181, 19.3% for micronutrients).

#### Policy and programme analysis

The policy analysis with early childhood development leaders (detailed in the related Health Policy<sup>73</sup>) found that framing and governance were primary challenges for advancing global priority for early childhood development. Framing refers to how early childhood development is understood and conceptualised, including the definition

	Perspective on trends	Recommendations
Agenda setting	Subtle impacts of early childhood development (ECD) interventions inhibit advocacy There is a lack of understanding about what ECD programmes entail beyond preschool Limitations include insufficient: funding, evaluation, implementation science, political commitment, and staff time and training	Improve data availability, quality, frequency, and dissemination relating to ECD, particularly for children 0–3 years Improve integration and multisectoral coordination of ECD with other sectors Receive guidelines from the ECD community on programming, coordination, and integration strategies
Implementation	ECD programmes promote equity; there has been increased emphasis on vulnerable populations, including children with disabilities, and children affected by HIV and AIDS ECD programmes target children aged 4 to 5 years and older, with a recent focus on children 0–3 years	Leverage universal population-based interventions for children younger than age 5 years (especially younger than age 3 years), in areas where prevalence of disadvantaged children is high Increase access for evidence-based programmes and policies Improve strategies to reach disadvantaged children and geographically remote or underserved areas Design programmes to be scalable and sustainable
Policy formation	ECD programmes are integrated with other programmes (eg, nutrition, maternal and child health) Coordinating among ministries and sectors requires ECD to resonate with ministry priorities	Estimate costs of ECD interventions, assess cost-effectiveness, and conduct projections to maximise investment in children and families
Evaluation	Donors are demanding rigorous and results-driven approaches Growing neuroscience knowledge, and evidence of increases in economic productivity and reductions in poverty as a result of ECD justify increased investments in ECD programmes ECD programmes have increased in scale over the past 10–15 years	Implement rigorous and systematic data collection and systems of accountability Define a core set of ECD indicators that, with adaptation, can be used globally, regionally, and nationally for monitoring, planning, and assessment Increase support for national ECD policies and implementation plans
Leadership and partnership	There is a growing cadre of stakeholders and staff who advocate for ECD programmes Partnerships among donors are important for agenda setting and increasing programme effectiveness Sustainability and cost-effectiveness promote investment	Identify sustainable funding mechanisms at multiple levels (eg, international, national, or municipal) Establish strong and effective coordinating mechanisms for sectors that contribute to ECD outcomes Promote political commitment by linking science to practice in ECD by improving understanding of the most recent evidence-based practices

Opinions of early childhood development programme implementers, funders, and policy makers on the early childhood development landscape, 2000–15.

**Table 2: Perspectives and recommendations on the early childhood development landscape**

of early childhood development, reliable and valid measures, and effective intervention strategies. The absence of clear framing impedes planning and progress as interested parties struggle to agree on basic issues. Governance refers to the actions established to implement and support early childhood development. The multisectoral nature of early childhood development is a challenge because governance is often spread across multiple sectors with limited accountability and ownership.

The programme analysis conducted with leaders of governmental and non-governmental implementation and donor agencies yielded similar findings, and were organised into a childhood development landscape representing the perspectives and recommendations of the interviewees, using the organisation of the policy heuristic (table 2). Two seemingly contradictory themes emerged under the category of agenda setting. In spite of grassroots and emerging political commitment to early childhood development programmes, interviewees expressed concern that early childhood development was neither well understood nor appreciated.<sup>75</sup> Many recommended greater advocacy and clarity from the early childhood development community. Implementation concerns included equity and reaching the most vulnerable children and families, incorporating local

contextual factors, monitoring, and attention to capacity and costing. Constraints noted among sectors that provide services to enhance children's development were related to policy formation, including the necessity and challenges of multilevel intervention and coordination across sectors. Common themes in the category of evaluation were the need for rigorous evaluations and accountability, better evaluation tools, and funding for evaluation research. For leadership and partnership, partnerships were valued because they lead to networks, knowledge sharing, and gains for driving agenda and programme effectiveness.

Recommendations for strategies to enhance early childhood development programmes focused on defining early childhood development programmes and achieving individual and population equity. Common themes were stakeholder representation and urgent needs for a systems perspective on equity and rights, along with multisectoral policy planning, implementation, regulation, quality assurance, accountability, governance, attention to scale, and advocacy (table 2).<sup>76</sup>

#### Policies and investments related to early childhood development

Globally, many stakeholders have supported growth of early childhood development policy through financial



For more on the Multiple Indicator Cluster Survey see <http://mics.unicef.org/>

and technical support for multisectoral policies, including strategic plans, guiding principles, and regulations.<sup>75</sup> However, advances in early childhood development have often been stymied by fragmentation in existing policies, laws, and programmes.<sup>75</sup>

In 2000, seven LMICs had national multisectoral early childhood development policies. By July, 2014, 68 of 215 countries worldwide (constituting 45% of LMICs) had such policies (appendix pp 14).<sup>75</sup> These statistics do not include early childhood development programmes without a unifying national policy. For example, Cuba does not have a unified national plan, but has substantial national multisectoral legislation that has achieved nearly full programme coverage for pregnant women, parents, and children (further discussed in Paper 3 of this Series).<sup>21</sup>

The World Bank initiative, Systems Approach for Better Education Results—Early Childhood Development (SABER—ECD), collects, analyses, and disseminates national and regional data on early childhood policies and programmes, serving as an important source of data on equity (appendix pp 15–16).<sup>77</sup> Despite a multisectoral early childhood development policy in 63% of participating countries (22 of 35), 31% (11 of 35) lack an institutional anchor and 59% (17 of 29) have no multisectoral operational manuals or integrated service delivery guidelines, indicating important gaps between policies and integrated implementation capacity.<sup>78</sup>

There has been substantial investment related to early childhood development since 2000. The Inter-American Development Bank has approved more than 150 projects for over US\$1.7 billion.<sup>77</sup> From 2000 to 2013, the World Bank invested \$3.3 billion in 273 projects, primarily through health, nutrition, and population programmes.<sup>80</sup> Although these investments provide support for childhood development, they do not provide the responsive caregiving and opportunities for learning that children need. Investments were relatively stable from 2000 to 2011, with large increases after 2012, attributable to increased demand from countries and shifts in World Bank policy and internal capacity.<sup>80</sup> These trends are promising, but additional investments tied to early childhood development are needed.

#### Timeline of events related to early childhood development

Our timeline includes events from 2000–15 that informed regional or global early childhood development policy or practice (figure 3; appendix pp 17–23). Advances related to agenda setting and evaluation outnumbered implementation advances, with more advances in recent years (2012–15) than in the previous decade.

Global economic growth beginning in the 1990s lifted millions of people out of extreme poverty, resulting in reductions in nutritional deficiencies (as indicated by reductions in stunting) among children younger than 5 years. Based on World Bank figures, 896 million people worldwide lived on less than \$1.90 per day in 2012, compared with 1.95 billion in 1990. Implementation of

global surveys, including the USAID Demographic and Health Surveys and the UNICEF Multiple Indicator Cluster Survey, charted trends in child health indicators, enabling international agencies and countries to set targets and evaluate progress. As valid and reliable population-based indicators of early childhood development become available and are incorporated into global surveys, countries will be able to track progress in their children's early development.

### Access to activities and programmes promoting early childhood development

#### Home activities

Low-cost activities, such as storytelling, singing, and playing with household objects, expose young children to experiences that promote early development.<sup>81</sup> According to Multiple Indicator Cluster Survey data from 2005–15, 48.4% of the nearly 230 000 3 year-olds and 4 year-olds sampled had an adult read to them, and 67.7% had an adult either name or count objects within 3 days before the survey. These figures vary by wealth quintile within countries worldwide, with reading ranging from 62.4% in the top quintile to 36.4% in the bottom quintile. Home-based activities are likely to be even lower for children under 3 years. Of 320 000 children under the age of 5 sampled, 41.8% had home access to children's books, with availability ranging from 56.6% in the top wealth quintile to 29.0% in bottom quintile families. Disparities in the number of home-based activities by country and wealth quintile (appendix pp 24) show the urgent need for global action to enhance family support for early learning. Subsequent surveys should expand information on home-based activities to children under 3 years.

Television and other media can increase home access to early childhood development programming aimed at either children or parents. Local versions of the educational television programme Sesame Street reach children in over 150 countries.<sup>82</sup> In Bangladesh, almost 50% of 3–5 year-old children watched television daily,<sup>83</sup> and among television watchers, 83% of urban and 58% of rural preschoolers watched Sesame Street. A meta-analysis representing more than 10 000 children from 15 countries found significant benefits from watching Sesame Street in literacy and numeracy, health and safety, and social reasoning and attitudes toward others.<sup>84</sup>

For children with developmental delays, disabilities, and atypical behaviours such as autism and attention deficit and hyperactivity disorders, 81 countries provide national early childhood intervention. 47 (58%) of the countries providing national interventions are LMICs.<sup>68</sup> Beneficial effects of early intervention up to and including 36 months have been shown in children in LMICs.<sup>85</sup>

#### Centre-based child care and preschool

Since 2000, child care enrolment for children under 3 years has increased substantially, especially in Latin

America, where estimates of enrolled children exceed over 3.1 million.<sup>79</sup> In Brazil, Chile, Colombia, and Ecuador, between 21% and 35% of children under 3 years are in child care.<sup>79</sup> A review of child care programmes for children under 5 years in LMICs found that overall, programmes yielded positive but modest effects on children's development, with no clear evidence for benefits to children's health and nutrition.<sup>86</sup>

The effects of child care quality on children's development vary, with stronger benefits among high quality programmes and potential for harm from poor quality programmes.<sup>87</sup> Quality is often divided into structural dimensions including infrastructure, caregiver training, and caregiver-child ratios; and process dimensions including caregiver-child interactions and opportunities for play and exploration. Process dimensions are critical for ensuring advances in child development. Through monitoring and planning, continuous quality assurance programmes are emerging.<sup>79</sup>

Access to preschool education was a central objective of Education for All.<sup>88</sup> Attending preschool benefits children's primary school performance,<sup>89</sup> especially when preschool programmes include both education and nutrition.<sup>90</sup> Preschool enrolment rates increased globally from 33% in 1999 to 54% in 2012, with particularly high rates in Latin America and the Caribbean.<sup>88</sup> Although preschools are incorporated into the educational sector in many LMICs, almost one-third of children who attend preschool are enrolled in private institutions, often operating outside the regulatory system.<sup>79</sup>

Despite an impressive increase in preschool enrolment, according to UNESCO's Global Monitoring Report, coverage ranges from 19% for low-income countries to 86% for high-income countries, with highest enrolment among children from the highest wealth quintiles.<sup>88</sup> These trends are consistent with caregiver reports from the Multiple Indicator Cluster Survey. According to data from 164 900 children across 58 LMICs, 31.4% of all 36–59-month-old children sampled had access to early education programmes, with preschool enrolment rates more than twice as high among children from the top wealth quintile (47.3%) compared with children from the lowest quintile (19.7%; figure 5).

### Opportunities to coordinate early childhood development across sectors

The implementation of early childhood development programmes is often fragmented, particularly for children under 3 years, with confusion between multisector and integrated approaches. Multisector approaches include coordinated services across sectors, ideally with unifying

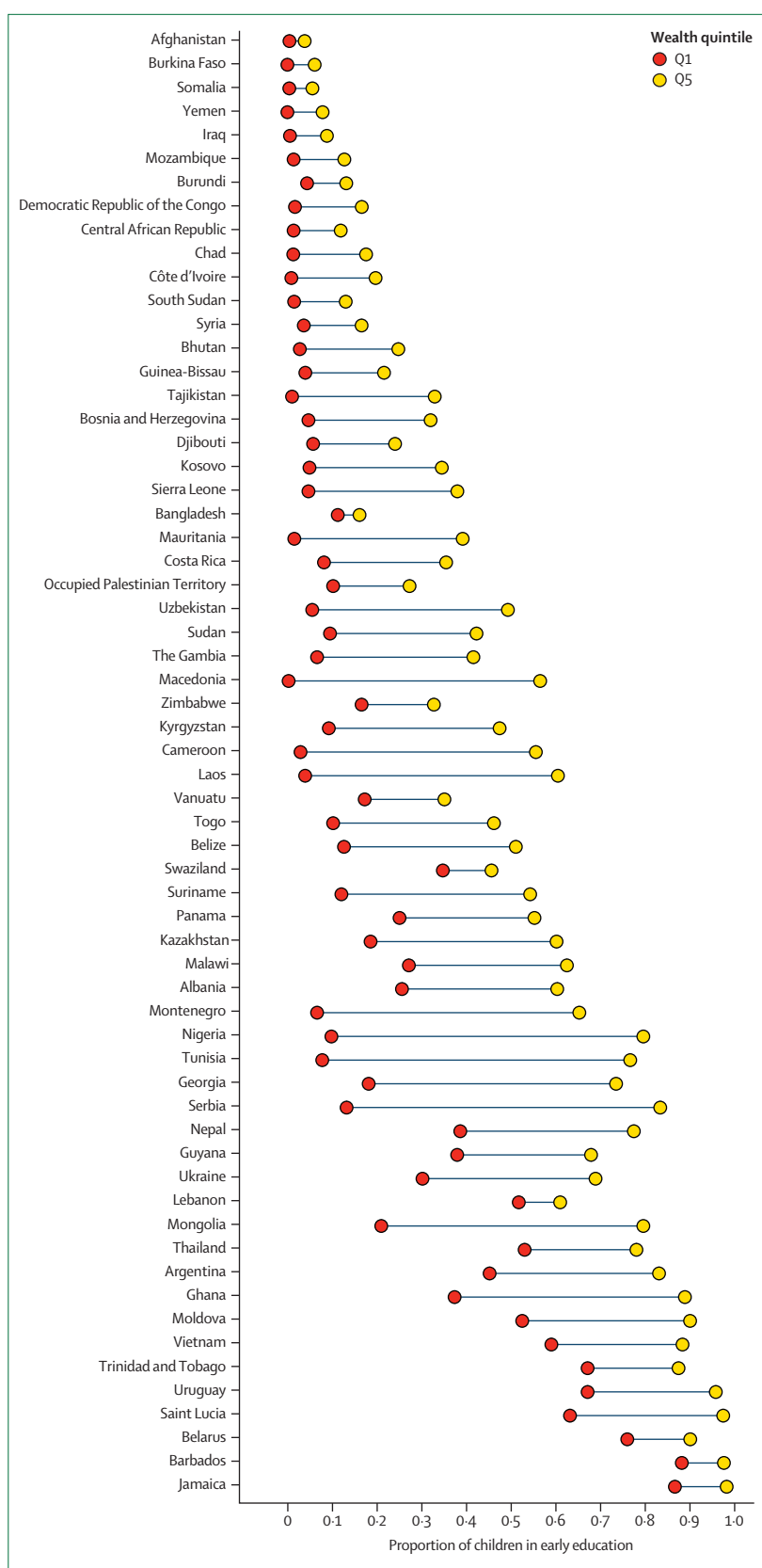


Figure 5: Proportion of children aged 3–4 years in early education, by country and wealth quintile

Data obtained from UNICEF Multiple Indicator Cluster Survey.

policies.<sup>91</sup> Integrated approaches refer to integration across services with shared messages and opportunities for synergy.<sup>92</sup> Although there have been multiple calls for integrated services,<sup>92</sup> logistical issues remain.<sup>59</sup> We outline here and in the appendix (pp 25) potential components of a multisector approach to early child development.

### Health and nutrition

The health and nutrition sectors provide opportunities for coordinated early childhood development services in early life, as the main government services in regular contact with children from birth.<sup>3,4</sup> Children who are undernourished or frequently ill are at high risk for developmental problems, emphasising the urgency of developing coordinated early childhood development programmes in collaboration with the health and nutrition sectors. Since 2000, there has been an expansion of knowledge synthesis, products, and evidence-based interventions to address maternal, newborn, and child survival.<sup>93</sup> Although health and nutrition interventions are necessary to promote child development, children need responsive caregiving and learning opportunities.<sup>59</sup> Extending the emphasis on survival to include components of nurturing care and a life course perspective would ensure that children who survive also thrive.<sup>2</sup>

Home-based early childhood development activities are often implemented by community health workers and sponsored by health, nutrition, or social protection sectors, or through non-governmental organisations. There is a broad evidence base supporting home-based interventions to build parenting capacity, which links to child cognitive and socio-emotional development,<sup>5,6</sup> with effects that extend to adulthood.<sup>14</sup> Community health workers have made major contributions to health promotion globally.<sup>94</sup> Although there are clear advantages to integrating child development with health and nutrition sectors, areas to consider include: feasible and scalable implementation strategies; personnel training and supervision on early childhood development; workload; logistics; compensation; and synchronised work schedules.<sup>95</sup> Finally, the limited routine health and nutrition contacts beyond infancy might result in a 2–3 year service gap before preschool. Although several integrated programmes have shown beneficial effects on children's development,<sup>96,97</sup> additional models are needed at scale.

### Security and safety

The WHO 2014 Global Status Report on Violence Prevention includes data from 133 countries on violence prevalence and prevention, including child abuse and neglect.<sup>98</sup> Despite global acceptance of child rights, recognition of the harmful effects of violence exposure and maltreatment on children, and endorsement of home visiting and parent education as effective in reducing risk factors for child maltreatment,<sup>99</sup> there have

been few evaluated programmes to protect children from violence and maltreatment in LMICs.<sup>98</sup>

UNICEF recommends a global prevention strategy with the following actions: (1) support caregivers; (2) help children manage risks; (3) change attitudes and norms that encourage violence; (4) provide support services for children; (5) implement child protection laws; and (6) conduct data collection and research.<sup>100</sup> These recommendations are consistent with early childhood development programming. Ensuring that teachers in preschool and early primary school have appropriate training in classroom management can reduce aggression and violence towards and among children, illustrating that preschools can provide a platform for preventive interventions.<sup>101</sup>

Increasing numbers of children are refugees from conflict, climate change, and natural disasters.<sup>102</sup> More than 50% of the 59.5 million displaced people documented in 2014 are children, many under age 5 years.<sup>102</sup> The feasibility and potential benefits of integrating early childhood development activities into services for this vulnerable group have been demonstrated,<sup>103</sup> and strategies are needed to ensure that services include such activities.

### Responsive caregiving

Effective parenting programmes have been implemented in LMICs,<sup>3,4</sup> providing evidence that methodologically rigorous parenting programmes can support the capacity of caregivers to provide the early learning environments that young children need. The evaluation of delivery models provides options for linking parenting programmes across sectors, and is discussed further in Paper 2 of this Series.<sup>20</sup> Examples include delivery of home visits by community workers linked to health or social sectors,<sup>97</sup> community-based group sessions,<sup>29</sup> and health centre-based programmes.<sup>96</sup> Parenting programmes to improve early learning might also strengthen parents' ability to manage child behaviour, support social-emotional development, and reduce child abuse and neglect.

### Early learning and education

Early childhood development programmes and opportunities for early learning improve child outcomes during subsequent schooling.<sup>89</sup> Coordination across preschools and primary schools promotes smooth transitions, enables children to build on their preschool skills, and facilitates a coordinated, sequential strategy for promoting early learning, which provides support for children across the life course.<sup>79</sup>

For the post-2015 agenda, the Sustainable Development Goals call for all children to have access to high quality pre-primary education. Achievement of this goal requires coordination of early childhood development programming within the education infrastructure,<sup>104</sup> with attention to equity in both access and quality of services.

The education sector has had limited focus on programmes for under-3s.<sup>42</sup> Greater engagement of parents and caregivers in early childhood development programmes, coordination across sectors, and inclusive policies for children with disabilities are examples of strategies to maximise returns from early learning programmes and present young children and their families with better coordinated services.

### Enabling environment for caregiver, family, and community

An enabling environment supports the family and caregivers as proximal providers of nurturing care. Support for caregivers' nutrition and mental and physical health benefits children's growth and development, and enhances caregivers' receptiveness to parenting programmes.<sup>29</sup> Attention to female education and gender equity builds capacity to promote child development and elicit necessary family support. Mothers and children benefit from shared caregiving that includes fathers and other family members.<sup>29</sup> At a community level, clean and safe neighbourhoods, access to health and education services, and interpersonal community support strengthen the ability of families to provide nurturing care.

### Social, economic, political, climatic, and cultural context

The social, economic, political, climatic, and cultural context can provide broad support and guidance for the implementation of family-friendly systems that enable nurturing care. Social protection programmes are designed to reduce poverty and provide opportunities to improve child development. Protection begins with birth registry, and continues through sustained investment in poverty alleviation, with the goal to reduce the inter-generational transmission of poverty (figure 1). A meta-analysis of the effects of multiple types of financial incentives on the coverage of child health interventions, targeting children under 5 years in LMICs, found that the most promising programmes were those that removed barriers and increased access to services.<sup>105</sup>

### Delivery strategies

Delivery strategies for early childhood development programmes are indicated (available to children identified by screening), selective (available to sub-populations at risk), or universal (available to all).<sup>106</sup> The high prevalence of young children at risk for not reaching their developmental potential in some countries and regions (>40%) supports a selective approach to early childhood development intervention that reaches vulnerable groups of children, rather than devoting limited resources to individual screening. Universal, high quality programming that reaches all children living in communities characterised by extreme poverty or malnutrition might improve equity, and is discussed in Paper 3 of this Series.<sup>21</sup>

In many countries, early childhood development services are delivered through a disjointed set of

primarily non-governmental organisations, often with few regulatory guidelines, limited attention to quality, and little coordination with other services or sectors.<sup>79</sup> As the emphasis on early childhood has increased over the past decade and governments look to increase access to early childhood development programmes, finding effective ways to leverage the non-governmental sector to increase access and ensure quality is critically important. Platforms for early childhood development services range from home visits, clinical contacts, and community-based group sessions to new approaches, such as media. These platforms are discussed in more detail in Papers 2 and 3 of this Series.<sup>20,21</sup> Implementation research can aid in the scaling of evidence-based programmes by engaging stakeholders and opinion leaders, identifying core elements of evidence-based intervention, and focusing on quality assurance and cost-effectiveness, as discussed in Paper 3.<sup>21</sup> However, caution is warranted as the transition from science to practice often involves compromises.

### Conclusions

Despite remarkable progress in early childhood development research, programmes, and policies, services for young children are inadequate and inequitably distributed. The burden of children not reaching their developmental potential remains high. The lack of attention to nurturing care as a comprehensive concept is a major concern, especially during the period of rapid brain development and learning, and the formation of caregiver-child attachments that characterises children under 3 years.

The conceptual basis of early childhood development has been well established (figure 1). The underlying science of early childhood development and the life course framework illustrate the crucial part that early childhood development plays, enabling children to become healthy and productive citizens with the intellectual skills, creativity, and wellbeing to reduce global inequities and ensure sustainable global development. However, the application of policy heuristics to existing evidence has shown that implementation of early childhood development programmes is fragmented and lacks coordination, especially for children under 3 years (panel 2).

Investment in early childhood development is increasing through advances in the health, nutrition, and social protection sectors, through programmes that promote survival, nutritional adequacy, and poverty reduction, respectively. Although these interventions provide benefits for early childhood development, they do not ensure that children reach their developmental potential. The advances in personal and societal equity that have been attributed to early childhood development require that interventions also include opportunities to promote all components of nurturing care through the family, with support from communities and social, economic, political, climatic, and cultural contexts. Nurturing care in early

childhood is the essential foundation for human capital development and should be followed by high quality schooling, support for at-risk youth, and programmes to facilitate the school-to-work transition.<sup>79</sup>

Early childhood development services are necessary to address the enormous global burden of children in LMICs who are not reaching their developmental potential and who will experience lifelong disparities in health, academic achievement, and earning potential. There is an urgent need for population-level indicators of child development, especially for the youngest children, to enable ongoing monitoring and improvement in quality.<sup>24</sup> Achieving the Sustainable Development Goals depends on ensuring adequate health, nutrition, security and safety, responsive caregiving, and early learning opportunities for the youngest children.

#### Contributors

MMB, SPW, LCHF, CTA, and SG-M (senior author) planned and wrote the paper. Co-authors contributed specific sections: AMD (programme and policy analysis); CL (recalculation of the burden based on extreme poverty and stunting); DCM and GF (analysis of data from UNICEF's Multiple Indicator Cluster Survey); YRS and JS (policy analysis); AED and QTW (economic and policy analysis); and EV-B (policy analysis). All authors reviewed the drafts, made critical comments, and approved the final submission.

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#### Declaration of interests

We declare no competing interests.

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#### References

- 1 Grantham-McGregor S, Cheung YB, Cueto S, et al. Developmental potential in the first 5 years for children in developing countries. *Lancet* 2007; **369**: 60–70.
- 2 Lake A, Chan M. Putting science into practice for early child development. *Lancet* 2015; **385**: 1816–17.
- 3 Engle PL, Black MM, Behrman JR, et al. Strategies to avoid the loss of developmental potential among over 200 million children in the developing world. *Lancet* 2007; **369**: 229–42.
- 4 Engle PL, Fernald LC, Alderman H, et al. Strategies for reducing inequalities and improving developmental outcomes for young children in low-income and middle-income countries. *Lancet* 2011; **378**: 1339–53.
- 5 Walker SP, Wachs TD, Gardner JM, et al. Child development: risk factors for adverse outcomes in developing countries. *Lancet* 2007; **369**: 145–57.
- 6 Walker SP, Wachs TD, Grantham-McGregor S, et al. Inequality in early childhood: risk and protective factors for early child development. *Lancet* 2011; **378**: 1325–38.
- 7 Shonkoff JP, Garner AS. The lifelong effects of early childhood adversity and toxic stress. *Pediatrics* 2012; **129**: e232–46.
- 8 Luby JL. Poverty's most insidious damage: the developing brain. *JAMA Pediatr* 2015; **169**: 810–11.
- 9 Noble KG, Houston SM, Brito NH, et al. Family income, parental education and brain structure in children and adolescents. *Nat Neurosci* 2015; **18**: 773–78.
- 10 Weaver IC. Integrating early life experience, gene expression, brain development, and emergent phenotypes: unraveling the thread of nature via nurture. *Adv Genet* 2014; **86**: 277–307.
- 11 Gertler P, Heckman J, Pinto R, et al. Labor market returns to an early childhood stimulation intervention in Jamaica. *Science* 2014; **344**: 998–1001.
- 12 Hoddinott J, Maluccio JA, Behrman JR, Flores R, Martorell R. Effect of a nutrition intervention during early childhood on economic productivity in Guatemalan adults. *Lancet* 2008; **371**: 411–16.
- 13 Maluccio JA, Hoddinott J, Behrman JR, Martorell R, Quisumbing AR, Stein AD. The impact of improving nutrition during early childhood on education among Guatemalan adults. *Econ J* 2009; **119**: 734–63.
- 14 Walker SP, Chang SM, Vera-Hernandez M, Grantham-McGregor S. Early childhood stimulation benefits adult competence and reduces violent behavior. *Pediatrics* 2011; **127**: 849–57.
- 15 Campbell F, Conti G, Heckman JJ, et al. Early childhood investments substantially boost adult health. *Science* 2014; **343**: 1478–85.
- 16 Behrman JR, Calderon MC, Preston SH, Hoddinott J, Martorell R, Stein AD. Nutritional supplementation in girls influences the growth of their children: prospective study in Guatemala. *Am J Clin Nutr* 2009; **90**: 1372–79.
- 17 Walker SP, Chang SM, Wright A, Osmond C, Grantham-McGregor SM. Early childhood stunting is associated with lower developmental levels in the subsequent generation of children. *J Nutr* 2015; **145**: 823–28.
- 18 Hoddinott J, Alderman H, Behrman JR, Haddad L, Horton S. The economic rationale for investing in stunting reduction. *Matern Child Nutr* 2013; **9** (suppl 2): 69–82.
- 19 Doyle O, Harmon CP, Heckman JJ, Tremblay RE. Investing in early human development: timing and economic efficiency. *Econ Hum Biol* 2009; **7**: 1–6.
- 20 Britto PR, Lyes S, Proulx K, et al, with the Early Childhood Development Interventions Review Group, for the *Lancet* Early Childhood Development Series Steering Committee. Nurturing care: promoting early childhood development. *Lancet* 2016; published online Oct 4. [http://dx.doi.org/10.1016/S0140-6736\(16\)31390-3](http://dx.doi.org/10.1016/S0140-6736(16)31390-3).
- 21 Richter LM, Daelmans B, Lombardi J, et al, with the Paper 3 Working Group, for the *Lancet* Early Childhood Development Series Steering Committee. Investing in the foundation of sustainable development: pathways to scale up for early childhood development. *Lancet* 2016; published online Oct 4. [http://dx.doi.org/10.1016/S0140-6736\(16\)31698-1](http://dx.doi.org/10.1016/S0140-6736(16)31698-1).
- 22 Lu C, Black MM, Richter LM. Risk of poor development in young children in low-income and middle-income countries: an estimation and analysis at the global, regional, and country level. *Lancet Glob Health*, 2016; published online Oct 4. [http://dx.doi.org/10.1016/S2214-109X\(16\)30266-2](http://dx.doi.org/10.1016/S2214-109X(16)30266-2).
- 23 McCoy DC, Peet ED, Ezzati M, et al. Early childhood developmental status in low-and middle-income countries: national, regional, and global prevalence estimates using predictive modeling. *PLoS Med* 2016; **13**: e1002034.
- 24 McCoy DC, Black MM, Daelmans B, Dua T. Measuring development in children from birth to age 3 at population level. Early Childhood Matters. The Hague: Bernard van Leer Foundation, 2016. <https://www.odi.org/sites/odi.org.uk/files/resource-documents/10680.pdf> (accessed Sept 21, 2016).
- 25 Sameroff A, ed. The transactional model of development: how children and contexts shape each other. New York, NY: Wiley, 2009.
- 26 Bornstein MH, Hendricks C. Basic language comprehension and production in >100 000 young children from sixteen developing nations. *J Child Lang* 2012; **39**: 899–918.
- 27 Black M, Aboud F. Theoretical basis of responsive feeding among infants and young children in high and low income countries. *J Nutr* 2011; **141**: 490–94.
- 28 Bradley RH, Putnick DL. Housing quality and access to material and learning resources within the home environment in developing countries. *Child Dev* 2012; **83**: 76–91.

- 29 Singla DR, Kumbakumba E, Aboud FE. Effects of a parenting intervention to address both maternal psychological wellbeing and child development and growth in rural Uganda: a community-based, cluster randomised trial. *Lancet Glob Health* 2015; 3: e458–69.
- 30 Hanson JL, Nacewicz BM, Sutterer MJ, et al. Behavioral problems after early life stress: contributions of the hippocampus and amygdala. *Biol Psychiatry* 2015; 77: 314–23.
- 31 Pavlakis AE, Noble K, Pavlakis SG, Ali N, Frank Y. Brain imaging and electrophysiology biomarkers: is there a role in poverty and education outcome research? *Pediatr Neurol* 2015; 52: 383–88.
- 32 Farnsworth SK, Böse K, Fajobi O, et al. Community engagement to enhance child survival and early development in low-and middle-income countries: an evidence review. *J Health Commun* 2014; 19 (suppl 1): 67–88.
- 33 Hair NL, Hanson JL, Wolfe BL, Pollak SD. Association of child poverty, brain development, and academic achievement. *JAMA Pediatr* 2015; 169: 822–29.
- 34 Georgieff MK. Nutrition and the developing brain: nutrient priorities and measurement. *Am J Clin Nutr* 2007; 85: 614S–20S.
- 35 Bhutta ZA, Das JK, Bahl R, et al. Can available interventions end preventable deaths in mothers, newborn babies, and stillbirths, and at what cost? *Lancet* 2014; 384: 347–70.
- 36 Fall CH, Fisher DJ, Osmond C, Margetts BM. Multiple micronutrient supplementation during pregnancy in low-income countries: a meta-analysis of effects on birth size and length of gestation. *Food Nutr Bull* 2009; 30 (suppl 4): S533–46.
- 37 Ramakrishnan U, Grant FK, Goldenberg T, Bui V, Imdad A, Bhutta ZA. Effect of multiple micronutrient supplementation on pregnancy and infant outcomes: a systematic review. *Paediatr Perinat Epidemiol* 2012; 26 (suppl 1): 153–67.
- 38 Sudfeld CR, Charles McCoy D, Danaei G, et al. Linear growth and child development in low- and middle-income countries: a meta-analysis. *Pediatrics* 2015; 135: e1266–75.
- 39 Christian P, Murray-Kolb LE, Tielsch JM, Katz J, LeClerq SC, Khattry SK. Associations between preterm birth, small-for-gestational age, and neonatal morbidity and cognitive function among school-age children in Nepal. *BMC Pediatr* 2014; 14: 58.
- 40 Black RE, Victora CG, Walker SP, et al. Maternal and child undernutrition and overweight in low-income and middle-income countries. *Lancet* 2013; 382: 427–51.
- 41 Hamadani JD, Tofail F, Huda SN, et al. Cognitive deficit and poverty in the first 5 years of childhood in Bangladesh. *Pediatrics* 2014; 134: e1001–08.
- 42 Manji S, Arnold C, Gowani S, et al. How are we doing and how do we get it right for children? Evolution of the roles of the public and private sector in early childhood care and education in efforts to achieve EFA goal 1. Paris: United Nations Educational, Scientific and Cultural Organization, 2015.
- 43 Casale D, Desmond C. Recovery from stunting and cognitive outcomes in young children: evidence from the South African Birth to Twenty Cohort Study. *J Dev Orig Health Dis* 2016; 7: 163–71.
- 44 Crookston BT, Schott W, Cueto S, Dearden KA, Engle P, Georgiadis A, et al. Postinfancy growth, schooling, and cognitive achievement: Young Lives. *Am J Clin Nutr* 2013; 98: 1555–63.
- 45 Stein AD, Wang M, DiGirolamo A, et al. Nutritional supplementation in early childhood, schooling, and intellectual functioning in adulthood: a prospective study in Guatemala. *Arch Pediatr Adolesc Med* 2008; 162: 612–18.
- 46 Fernald LC, Weber A, Galasso E, Ratsifandrihamanana L. Socioeconomic gradients and child development in a very low income population: evidence from Madagascar. *Dev Sci* 2011; 14: 832–47.
- 47 Rubio-Codina M, Attanasio O, Meghir C, Varela N, Grantham-McGregor S. The socioeconomic gradient of child development: cross-sectional evidence from children 6–42 panel in Bogota. *J Hum Resour* 2015; 50: 464–83.
- 48 Schady N, Behrman J, Araujo MC, et al. Wealth gradients in early childhood cognitive development in five Latin American countries. *J Hum Resour* 2015; 50: 446–63.
- 49 Lipina SJ, Martelli MI, Colombo J. Performance on the A-not-B task of Argentinean infants from unsatisfied and satisfied basic needs homes. *Interam J Psychol* 2005; 39: 49–60.
- 50 Fernald LC, Kariger P, Hidrobo M, Gertler PJ. Socioeconomic gradients in child development in very young children: evidence from India, Indonesia, Peru, and Senegal. *Proc Natl Acad Sci USA* 2012; 109 (suppl 2): 17273–80.
- 51 Hackman DA, Gallop R, Evans GW, Farah MJ. Socioeconomic status and executive function: developmental trajectories and mediation. *Dev Sci* 2015; 18: 686–702.
- 52 Fox NA, Almas AN, Degnan KA, Nelson CA, Zeanah CH. The effects of severe psychosocial deprivation and foster care intervention on cognitive development at 8 years of age: findings from the Bucharest Early Intervention Project. *J Child Psychol Psychiatry* 2011; 52: 919–28.
- 53 Smyke AT, Zeanah CH, Fox NA, Nelson CA, Guthrie D. Placement in foster care enhances quality of attachment among young institutionalized children. *Child Dev* 2010; 81: 212–23.
- 54 Vanderwert RE, Marshall PJ, Nelson CA, Zeanah CH, Fox NA. Timing of intervention affects brain electrical activity in children exposed to severe psychosocial neglect. *PLoS One* 2010; 5: e11415.
- 55 McLaughlin KA, Sheridan MA, Tibu F, Fox NA, Zeanah CH, Nelson CA. Causal effects of the early caregiving environment on development of stress response systems in children. *Proc Natl Acad Sci USA* 2015; 112: 5637–42.
- 56 Windsor J, Benigno JP, Wing CA, et al. Effect of foster care on young children's language learning. *Child Dev* 2011; 82: 1040–46.
- 57 Zeanah CH, Gunnar MR, McCall RB, Kreppler JM, Fox NA. Sensitive periods. *Monogr Soc Res Child Dev* 2011; 76: 147–62.
- 58 Bick J, Zhu T, Stamoulis C, Fox NA, Zeanah C, Nelson CA. Effect of early institutionalization and foster care on long-term white matter development: a randomized clinical trial. *JAMA Pediatr* 2015; 169: 211–19.
- 59 Black MM, Perez-Escamilla R, Fernandez Rao S. Integrating nutrition and child development interventions: Scientific Basis, evidence of impact, and implementation considerations. *Adv Nutr* 2015; 6: 852–59.
- 60 Luby J, Belden A, Botteron K, et al. The effects of poverty on childhood brain development: the mediating effect of caregiving and stressful life events. *JAMA Pediatr* 2013; 167: 1135–42.
- 61 Wachs TD, Georgieff M, Cusick S, McEwen BS. Issues in the timing of integrated early interventions: contributions from nutrition, neuroscience, and psychological research. *Ann N Y Acad Sci* 2014; 1308: 89–106.
- 62 WHO, UNICEF. Care for child development: improving the care of young children. Geneva: World Health Organization, 2012.
- 63 Christian P, Murray-Kolb LE, Khattry SK, et al. Prenatal micronutrient supplementation and intellectual and motor function in early school-aged children in Nepal. *JAMA* 2010; 304: 2716–23.
- 64 Murray-Kolb LE, Khattry SK, Katz J, et al. Preschool micronutrient supplementation effects on intellectual and motor function in school-aged Nepalese children. *Arch Pediatr Adolesc Med* 2012; 166: 404–10.
- 65 Adair LS. Long-term consequences of nutrition and growth in early childhood and possible preventive interventions. *Nestle Nutr Inst Workshop Ser* 2014; 78: 111–20.
- 66 Evans GW, Kim P. Childhood poverty, chronic stress, self-regulation, and coping. *Child Dev Perspect* 2013; 7: 43–48.
- 67 McCoy DC, Raver CC. Household instability and self-regulation among poor children. *J Child Poverty* 2014; 20: 131–52.
- 68 Mitra S, Posarac A, Vick BC. Disability and poverty in developing countries: a snapshot from the world health survey. Washington, DC: World Bank Group, 2011.
- 69 Peters DH, Garg A, Bloom G, Walker DG, Brieger WR, Hafizur Rahman M. Poverty and access to health care in developing countries. *Ann N Y Acad Sci* 2008; 1136: 161–71.
- 70 Parsons CE, Young KS, Rochat TJ, Kringelbach ML, Stein A. Postnatal depression and its effects on child development: a review of evidence from low- and middle-income countries. *Br Med Bull* 2012; 101: 57–79.
- 71 Berens AE, Nelson CA. The science of early adversity: is there a role for large institutions in the care of vulnerable children? *Lancet* 2015; 386: 388–98.
- 72 Howlett M, Ramesh M, Perl A. Studying public policy: policy cycles and policy subsystems, 3rd edn. Toronto: Oxford University Press, 2009.

- 73 Shawar YR, Shiffman J. Generation of global political priority for early childhood development: the challenges of framing and governance. *Lancet* 2016; published online Oct 4. [http://dx.doi.org/10.1016/S0140-6736\(16\)31574-4](http://dx.doi.org/10.1016/S0140-6736(16)31574-4).
- 74 Bornmann L, Mutz R. Growth rates of modern science: a bibliometric analysis based on the number of publications and cited references. *J Assoc Inf Sci Technol* 2015; **66**: 2215–22.
- 75 Vargas-Barón E. Policies on early childhood care and education: their evolution and some impacts. United Nations Educational, Scientific and Cultural Organization, 2015.
- 76 Vargas-Barón E. Building and strengthening national systems for early childhood development. In: Britto PR, Engle PL, and Super CM, eds. Handbook of early childhood development research and its impact on global policy. New York: Oxford University Press, 2013: 443–66.
- 77 Neuman MJ, Devercelli AE. What matters most for early childhood development: a framework paper. Washington, DC: World Bank Group, 2013. <http://documents.worldbank.org/curated/en/252561473963612937/What-do-we-know-about-early-childhood-development-policies-in-low-and-middle-income-countries> (accessed Sept 21, 2016).
- 78 Devercelli A, Sayre R, Denboba A. What do we know about early childhood development policies in low and middle income countries? Washington, DC: World Bank Group, 2016. <http://documents.worldbank.org/curated/en/252561473963612937/What-do-we-know-about-early-childhood-development-policies-in-low-and-middle-income-countries> (accessed Sept 27, 2016).
- 79 Berlinski S, Schady N. The early years: child well-being and the role of public policy. New York: MacMillan, 2015.
- 80 Sayre R, Devercelli AE, Neuman MJ, Wodon Q. Investing in early childhood development: review of the World Bank's recent experience. Washington, DC: World Bank Group, 2015.
- 81 Barros AJ, Matijasevich A, Santos IS, Halpern R. Child development in a birth cohort: effect of child stimulation is stronger in less educated mothers. *Int J Epidemiol* 2010; **39**: 285–94.
- 82 Cole CF, Richman BA, MCCann Brown SA. "G" is for growing: Thirty years of research on children and Sesame Street. In: Fisch SM, Truglio RT, eds. The World of Sesame Street Research. Mahwah, NJ: Lawrence Erlbaum, 2001: 147–79.
- 83 Khan M, Chakraborty N, Rahman A, Nasrin T. 2007 follow-up (wave II) evaluation of the reach and impact of Sisimpur: a technical report. Bangladesh: Associates for Community and Population Research (ACPR), 2007.
- 84 Mares M-L, Pan Z. Effects of Sesame Street: a meta-analysis of children's learning in 15 countries. *J Appl Dev Psychol* 2013; **34**: 140–51.
- 85 Rahman A, Malik A, Sikander S, Roberts C, Creed F. Cognitive behaviour therapy-based intervention by community health workers for mothers with depression and their infants in rural Pakistan: a cluster-randomised controlled trial. *Lancet* 2008; **372**: 902–09.
- 86 Leroy JL, Gadsden P, Guijarro M. The impact of daycare programmes on child health, nutrition and development in developing countries: a systematic review. *J Dev Effect* 2012; **4**: 472–96.
- 87 Grantham-McGregor SM, Fernald LC, Kagawa RM, Walker S. Effects of integrated child development and nutrition interventions on child development and nutritional status. *Ann N Y Acad Sci* 2014; **1308**: 11–32.
- 88 EFA Global Monitoring Report Team. Education for All 2000-2015: Achievements and Challenges. Paris United Nations Educational, Scientific and Cultural Organization, 2015.
- 89 Berlinski S, Galiani S, Gertler P. The effect of pre-primary education on primary school performance. *J Public Econ* 2009; **93**: 219–34.
- 90 Nores M, Barnett WS. Benefits of early childhood interventions across the world:(under) investing in the very young. *Econ Educ Rev* 2010; **29**: 271–82.
- 91 Vargas-Barón E. Planning policies for early childhood development: guidelines for action. United Nations Educational, Scientific and Cultural Organization, 2005.
- 92 Black MM, Dewey KG. Promoting equity through integrated early child development and nutrition interventions. *Ann N Y Acad Sci* 2014; **1308**: 1–10.
- 93 Bhutta ZA, Hafeez A, Rizvi A, et al. Reproductive, maternal, newborn, and child health in Pakistan: challenges and opportunities. *Lancet* 2013; **381**: 2207–18.
- 94 Perry HB, Zulliger R, Rogers MM. Community health workers in low-, middle-, and high-income countries: an overview of their history, recent evolution, and current effectiveness. *Annu Rev Public Health* 2014; **35**: 399–421.
- 95 Phuka J, Maleta K, Thomas M, Gladstone M. A job analysis of community health workers in the context of integrated nutrition and early child development. *Ann N Y Acad Sci* 2014; **1308**: 183–91.
- 96 Chang SM, Grantham-McGregor SM, Powell CA, et al. Integrating a parenting intervention with routine primary health care: a cluster randomized trial. *Pediatrics* 2015; **136**: 272–80.
- 97 Yousafzai AK, Rasheed MA, Rizvi A, Armstrong R, Bhutta ZA. Effect of integrated responsive stimulation and nutrition interventions in the Lady Health Worker programme in Pakistan on child development, growth, and health outcomes: a cluster-randomised factorial effectiveness trial. *Lancet* 2014; **384**: 1282–93.
- 98 WHO. Global status report on violence prevention. Geneva: World Health Organization, 2014.
- 99 Mikton C, Butchart A. Child maltreatment prevention: a systematic review of reviews. *Bull World Health Organ* 2009; **87**: 353–61.
- 100 UNICEF. Hidden in plain sight: a statistical analysis of violence against children. New York, NY: United Nations Children's Emergency Fund, 2014.
- 101 Baker-Henningham H, Scott S, Jones K, Walker S. Reducing child conduct problems and promoting social skills in a middle-income country: cluster randomised controlled trial. *Br J Psychiatry* 2012; **201**: 101–08.
- 102 UNHCR. Worldwide displacement hits all-time high as war and persecution increase. June 18, 2015. <http://www.unhcr.org/558193896.html> (accessed Aug 15, 2016).
- 103 Morris J, Jones L, Berrino A, Jordans MJ, Okema L, Crow C. Does combining infant stimulation with emergency feeding improve psychosocial outcomes for displaced mothers and babies? A controlled evaluation from northern Uganda. *Am J Orthopsychiatry* 2012; **82**: 349–57.
- 104 UN. Open working group proposal for sustainable development goals. 2014. <https://sustainabledevelopment.un.org/content/documents/1579SDGs%20Proposal.pdf> (accessed Sept 9, 2016).
- 105 Bassani DG, Arora P, Wazny K, Gaffey MF, Lenters L, Bhutta ZA. Financial incentives and coverage of child health interventions: a systematic review and meta-analysis. *BMC Public Health* 2013; **13** (suppl 3): S30.
- 106 Gordon RS. An operational classification of disease prevention. *Public Health Rep* 1983; **98**: 107–09.