

Strategies to avoid the loss of developmental potential in more than 200 million children in the developing world

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This paper is the third in the Child Development Series. The first paper showed that more than 200 million children under 5 years of age in developing countries do not reach their developmental potential. The second paper identified four well-documented risks: stunting, iodine deficiency, iron deficiency anaemia, and inadequate cognitive stimulation, plus four potential risks based on epidemiological evidence: maternal depression, violence exposure, environmental contamination, and malaria. This paper assesses strategies to promote child development and to prevent or ameliorate the loss of developmental potential. The most effective early child development programmes provide direct learning experiences to children and families, are targeted toward younger and disadvantaged children, are of longer duration, high quality, and high intensity, and are integrated with family support, health, nutrition, or educational systems and services. Despite convincing evidence, programme coverage is low. To achieve the Millennium Development Goals of reducing poverty and ensuring primary school completion for both girls and boys, governments and civil society should consider expanding high quality, cost-effective early child development programmes.

Introduction

This is the third paper in a series that addresses the lost developmental, educational, and economic potential of more than 200 million children under the age of 5 years in developing countries.¹ The second paper identified risks with the strongest evidence base and highest prevalence as stunting, iodine and iron deficiencies, and inadequate cognitive and social-emotional stimulation.² Less well-documented, but with consistent epidemiological evidence, are risks related to social conditions (maternal depression and violence), environmental factors (lead and arsenic), and some infectious diseases (malaria and HIV). Risk factors often co-occur and interfere with children's development, thereby contributing to a trajectory that includes poor health, lack of readiness for school, poor academic performance, inadequate preparation for economic opportunities, and perpetuation of the inter-generational cycle of poverty.

This paper examines the effectiveness of intervention programmes in developing countries. Based on the recommendations from earlier papers in this series,^{1,2} we assess programmes that promote child development through preventing or ameliorating the effects of stunting, iodine deficiency, iron deficiency anaemia, and inadequate stimulation. We also identify examples of interventions to reduce the effects of social, environmental, and infectious risks. We include only evaluations that report cognitive or social-emotional outcomes.

Child development refers to the ordered emergence of interdependent skills of sensori-motor, cognitive-language, and social-emotional functioning (figure 1). Early child development programmes³ are designed to improve the survival, growth, and development of young children, prevent the occurrence of risks, and ameliorate the negative effects of risks. Most are directed toward

disadvantaged children. Some programmes work directly with children through improved services such as growth monitoring, early child-care centres, or improved hygiene or health services; others work with parents to improve their parenting skills and resources, through home visits, group sessions, or communication for behaviour change.

Developing country interest in early child development programmes

Awareness of child development is increasing in developing countries. The health sector has advocated for early child development programmes for children with low birth-weight,⁴ developmental delays,⁵ and from low-income disadvantaged environments.⁶⁻⁸ Child development information is often incorporated into growth monitoring charts. Government-supported preschool programmes for children are increasing; in the past 15 years, at least 13 developing countries have instituted compulsory preschool or pre-primary programmes.⁹ By 2005, the World Bank had financed loans to 52 developing countries for child development programmes, for a total of US\$1680 million, at least

Search strategy

Databases searched were MEDLINE (PubMed), Embase, Psych Info, the Cochrane Review, the Educational Resources Information Center (ERIC), the World Health Organization, the World Bank and the International Bureau of Education for UNESCO (United Nations Educational, Scientific and Cultural Organization), SIGLE (grey literature from Europe), LILACS (Latin American and Caribbean Health Services), and UNICEF. The UNICEF and World Bank databases were searched and queries were sent to international organisations that may have had access to unpublished evaluations, including Plan International, Save the Children, Christian Children's Fund, Aga Khan Foundation, Bernard Van Leer Foundation, Consultative Group for Early Child Care and Development, and regional early child development networks.

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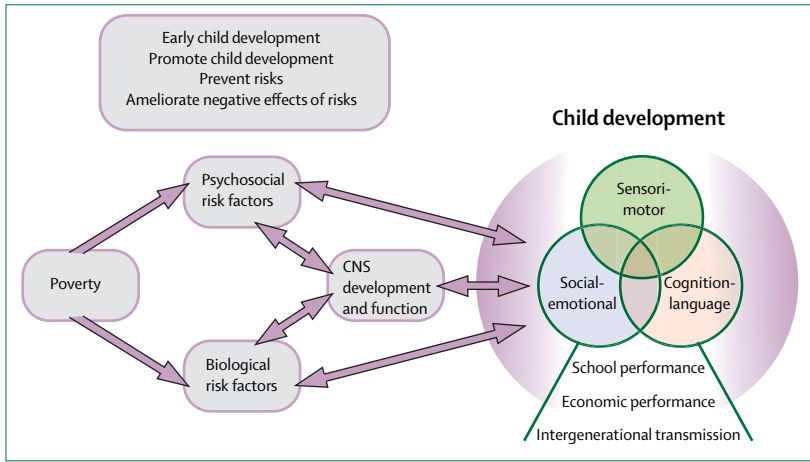


Figure 1: Conceptual model of how interventions can affect early child development

30 developing countries had policies on early child development,¹⁰ and UNICEF was assisting governments in supporting parenting programmes in 60 countries.¹⁰ Despite this interest, there have been few systematic evaluations of early child development programmes in developing countries.

Early child development programmes Improving food intake and reducing stunting

Both efficacy trials and programme evaluations have shown that improving the diets of pregnant women, infants, and toddlers can prevent stunting^{11,12} and result in better motor and mental development.^{2,13,14} Food supplementation during the first 2–3 years of life improves cognition at 3 years of age and beyond.^{13,15} One trial showed an improvement in motor development with exclusive breastfeeding.¹⁶ The longest follow-up duration is from Guatemala, where supplementation before age 3 years showed beneficial effects on schooling, reading, and intelligence tests during adulthood (25–42 years).¹⁷

Conditional cash transfers provide funds dependant on behaviour, such as participation in nutrition monitoring and supplementation programmes.¹⁸ Evidence from a conditional cash transfer programme in Mexico for more than 20 million people showed that transfers to women plus direct nutritional supplements for young children and nutrition education¹⁹ were associated with children's improved growth and motor development.^{18,20} Conversely, analysis of such a transfer programme in Brazil noted that recipient children grew slower than non-recipients, perhaps because families feared that benefits would be discontinued if their child grew well.²¹

Reducing iodine and iron deficiencies

Assessments of efficacy trials and programmes of iodine interventions provide conclusive evidence of a significant effect on cognition and behaviour.² Salt iodisation remains the most cost-effective way of delivering iodine and of substantially improving cognition. At least 30

developing countries have reached the 2005 goal of sustainable elimination of iodine deficiency through universal salt iodisation:¹⁰ 69% of households consume iodised salt, with rates of 86% in Latin America, 85% in east Asia, but only 47% in central Europe and central Asia.¹⁰

Iron deficiency anaemia impedes child development.² Detrimental effects in infants and toddlers might not be readily reversed by iron therapy, suggesting the need for a preventive approach.²² Iron supplementation to prevent anaemia in young children has positive effects on motor, social-emotional, and language development.² Innovations for iron supplementation include: microencapsulated ferrous fumarate plus ascorbic acid supplied as sprinkles added to complementary foods;²³ growing plant varieties with higher iron content;²⁴ removing phytates from plants that inhibit iron absorption; soaking maize flour in excess water with phytase and decanting the water before cooking the flour;²⁵ and new iron fortification methods that eliminate aftertaste, reduce risk of excess intake, and maintain bioavailability.^{26,27} These approaches are promising for the reduction of iron deficiency and anaemia in young children.^{26,27} A 6-month trial in South Africa assessed the effect of iron and other micronutrient-fortified maize porridge on infant development and reported better motor development in the fortified porridge group than the non-fortified group.²⁸

Concerns have been raised about giving iron supplements to iron replete infants, eg, decreased linear growth^{29,30} or increased hospitalisations and death in a malarial region.³¹ These issues should be studied further and need to be considered in public health programming.

Stimulation combined with nutrition and health programmes

Stimulation occurs through responsive and increasingly complex developmentally appropriate interactions (matched to the child's emerging abilities) between caregivers and children that enhance child development.^{32,33} Both cognitive and social-emotional skills provide the basis for later academic and employment success.^{1,34,35}

Inadequate stimulation and interactions can affect child development through disrupting basic neural circuitry. Neural disruptions are measured through stress hormones,³⁶ brain images,³⁷ and event-related potentials.³⁸ Early stimulation may enhance neurocognitive processing and brain functioning, particularly for premature infants.³⁹ The effects of early stimulation are also evident in the dramatic improvements in child development in undernourished, institution-raised children adopted into middle-class homes. A study of Korean girls adopted into middle-class families illustrates the synergistic effects of malnutrition and environmental deprivation on children's intelligence.^{40,41} IQ scores of children adopted after 2 years of age and with a history of malnutrition scored worse than equally malnourished children adopted at less than age 2 years (figure 2), but both were close to average.

Similar age-related findings have been reported in institutionalised Romanian children adopted into middle-class homes.⁴²

In developed countries, long-term benefits from high-quality early intervention programmes for disadvantaged children include higher verbal and mathematics achievement, greater success at school (ie, less grade repetition, higher graduation rates), higher employment and earnings, better health outcomes, less welfare dependency, and lower crime rates than similar non-participants.⁴³⁻⁴⁸ For children younger than 3 years, combining family and centre-based components is more effective than either alone.^{49,50} Cost-benefit ratios for seven programmes in developed countries ranged from 1.8 to 17.0.⁴⁵ Programmes for disadvantaged children during early childhood have a better rate of return than programmes introduced later in life.³⁴

Myers⁵¹ reviewed the effects of nutrition and child development programmes on school progress (repetition, promotion, and dropout) in developing countries before

1990. Three of the four nutrition programmes, and six of the nine programmes with schooling data, showed significant effects of early intervention, particularly for the most disadvantaged. The absence of effect in four studies was attributed to automatic promotion, poor quality of the schools, and methodologically weak evaluation.

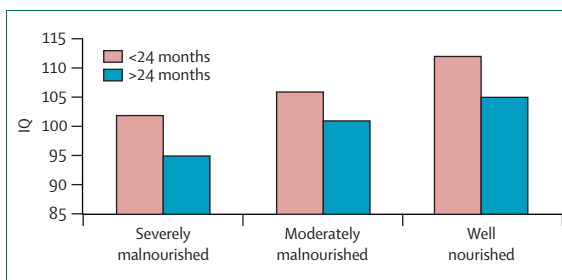


Figure 2: IQ scores among female Korean orphans varying by history of malnutrition and age of adoption

Data taken from references 40 and 41.

Sample size*	Intervention	Age	Outcome measure	Significant effects	Effect size of cognitive measure	Scale†	
Centre-based							
Guinea ⁵²	877	Informal community-based early learning centres	2-6 years	Cognitive development (Simplified Boehm Basic Concept Test) at 5 years	Cognitive development controlling for socioeconomic status p<0.05	0.33 0.66 socioeconomic status controlled	2
Cape Verde ⁵²	803	Formal preschool	3-6 years	Cognitive development (Simplified Boehm Basic Concept Test) at 5 years	Cognitive development with socioeconomic status controlled p<0.05	0.29 0.48 socioeconomic status controlled	3
Bangladesh ⁵³	208	Preschool run by NGO, feeding	4.5-6.5 years	(1) Cognitive development from WPPSI-III (2) Local school readiness assessment test (3) Play observation scale	(1) Treatment>control p<0.05 (2) Treatment>control p<0.05 (3) Treatment>control p<0.05	(1) 0.20-0.23 (2) 1.40 (3) 0.19-0.72	1
Burma ⁵⁴	(1) 1880 (2) 268	Community-based early child development centre and community support	3-5 years	(1) Primary school pass rate (2) Academic achievement tests (language, mathematics, thinking skills)	(1) Treatment=85%, control=72% (2) Treatment=86%, control=69% in language and mathematics; treatment=82%, control=73% in thinking skills	Not available	2
Nepal ⁵⁵	935	Community-based early child development centre (education and health)	3-6 years	(1) Primary school pass rate (2) Repetition rate for grade 1 (3) Yearly dropout rate after 4 years	(1) Grade 1: treatment>control by 32% Grade 2: treatment>control by 38% (2) 5.5% (1/15 of national norm) (3) 1.2% (1/10 of national norm)	Not available	2
Vietnam ⁵⁶	313	Centre and home (education, parenting, nutrition)	0-3 years for nutrition; 4-5 years for education	Raven's Colored Progressive Matrices at 6.5-8.5-year-old	Early child development+nutrition > than nutrition only on Raven's Colored Progressive Matrices. Greatest effect in malnourished children	Roughly 0.25 based on estimated SD	1
Colombia ^{57,58}	333 children all underweight 170 at follow up (all but higher socio-economic status group underweight initially)	Day care centre-based feeding and stimulation; 5 groups: food alone, and food+different periods of stimulation, and high socioeconomic status group	42 months up to 75 months (varying amounts)	Stanford-Binet IQ test	Greatest effect for children enrolled for the maximum time (4 years) and beginning earliest (age 4 years). Supplementation without stimulation had no effect on psychological development. Duration benefited performance.	Not available	1
Argentina ⁵⁵	More than 125 000 children	Increase in preschool places	3-5 years	Third grade mathematics and Spanish achievements	1 year of pre-primary increased mean third grade test score by 8% of mean or by 23% of SD. Child attention, effort, class participation, and discipline were also significantly higher in experimental group	0.23	3

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Parenting and parent-child interaction

Jamaica ⁶⁰	163	Home-visits by roving caregivers (health, nutrition, parenting, income-generating)	3–36 months	Griffiths Mental Developmental Scales Parent knowledge and practice	Treatment>control in Griffiths Score. Knowledge greater, practice was not	0.5 socioeconomic status controlled	1
Jamaica ⁵⁹	130	Home-visits by health aides (parenting)	9–30 months	(1) Griffiths Mental Developmental Scales, (2) Mothers' knowledge and practices of childrearing	Mothers showed improved knowledge and practices of childrearing. Children scored higher in the treatment group	(1) 0.8 socioeconomic status controlled	1
Colombia ^{61,62}	433 families	Nutritional supplement programme, a stimulation programme (home visit), or both A=Control A1=Stimulation B=Food 6 months to 3 years C=Food third trimester to 6 months D=Food third trimester to 3 years D1=Food+stimulation (Food: 623 cal+20g protein per child, 856 cal+38.4g protein per woman)	Prenatal to 3 years, follow up at 6 years	Griffiths Mental Developmental Scales at 4, 6, 12, 18, 24, 36 months Locomotor, personal-social, speech and language, eye-hand coordination, Einstein scale applied through 18 months	Food greater than control on all subscales and total; D (food prenatal to 3 years) greater than control (food third trimester to 6 months); treatment effects generally greater for girls Food and stimulation each affected different aspects of performance. Food affected motor development. Stimulation affected language, but no additive effects of food and stimulation on development. Stimulation plus supplementation had larger effect on growth than supplementation alone at 3 and 6 years.	Not available	1
Bolivia ⁶³	454	Adult literacy programmes and home visits (parenting, health, nutrition) in matched groups with and without intervention	24 months; some older	Psychosocial development (summary score of fine motor, gross motor, hearing, and language, personal and social assessment)	Preschool scored significantly better than parenting programme and control group; Children in parenting group scored higher than controls, controlling for age (p<0.07) on cognitive test	Not available	2
Turkey ⁶⁴	217	3 (centre) x 2 (mother training) design; Centre=educational, custodial, or none. Mother training=received or not received	3–5 years	10 year follow-up: (1) School attainment (percentage of children still in school) (2) Turkish school achievement test (3) WISC-R vocabulary test	(1) Mother training=86% of children still in school; non-mother training=67% still in school; no significant effect of centre attendance on percentage still in school. (2) Mother training =8.56; non-mother training=7.89; no significant effect of centre; but there was an interaction of parent training and child preschool attendance on test score. (3) Significant effect for both mother training and centre on tests.	(2) 0.45	1
Bangladesh ⁶⁵	170 Treatment 159 Control	Parent groups that meet weekly for 1 year; mean attendance was 16 sessions (range 0–42; assessment 2 months after end of programme)	2 years or 3 years	(1) Maternal knowledge (2) Home Scale and subscales (3) Receptive vocabulary (4) Weight/height (5) Five preventative health behaviours (6) Mother-child picture talk	(1) Treatment>control (2) Treatment>control, also for stimulation scale (3) Not significant (4) Control >treatment (5) Treatment>control (6) Not significant for stimulating talk	(1) 0.31 mother knowledge (2) 0.034 on HOME scale	2

*Sample size for the evaluation, not for the whole programme. †Scale: 1=coverage fewer than ten villages, 2=coverage of ten or more villages, or a district but not national programme; 3=national-level government programmes. WPPSI=Wechsler Preschool and Primary Scale of Intelligence. HOME=Home Observation for the Measurement of the Environment (Scale).

Table 1: Child-care centre programmes and parent-child interventions for child development in developing countries

We reviewed programmes implemented in developing countries since 1990 using six criteria: (a) randomised controlled trial or matched comparison group; (b) intervention before age 6 years; (c) effectiveness or programme evaluations (not efficacy trials); (d) child development assessed; (e) targeted disadvantaged children; and (f) developing country. 35 studies from developing countries were identified, of which 20 met the criteria (tables 1 and 2 and search strategy).¹ The programmes fell into three groups: centre-based early learning (N=8); parenting or parent-child (N=6); and

comprehensive (N=6), including health and nutrition interventions.

Centre-based programmes

All eight evaluations recorded a substantial effect on children's cognitive development. Preschools were provided in Guinea and Cape Verde,⁵² Bangladesh,⁵³ Burma,⁵⁴ Nepal,⁵⁵ Vietnam,⁵⁶ and Colombia,⁵⁷ and pre-primary schools were expanded in Argentina.³⁵ Most reported gains in non-cognitive skills such as sociability, self-confidence, willingness to talk to adults, and motivation. Longitudinal studies

Country	Sample size*	Intervention	Age	Outcome measure	Significant effects	Effect size of cognitive measure	Scale†
India ⁶⁹	3724	Integrated childcare centre; preschool education, support for pregnant and lactating mothers, growth monitoring, feeding, assistance for child immunisation and some emergency health	3–6 years	Motor and mental development using WHO Milestones assessment	Integrated Child Development Services significantly better than controls; stronger effect for younger; both nourished and undernourished performed better than matched controls	Not available	3
Peru ⁷²	304	Preschool and non-formal preschool, community nutrition programmes	3–5 years	Grades (A–C) in mathematics and language (Spanish) as assessed by the first grade teacher.	Both students in formal and non-formal preschool performed better than no pre-school	Not available	3
Bolivia ¹³	1198	Child care centres in home for stimulation; feeding health and nutrition monitoring, education of mother	6–72 months	Gross and fine motor skills, language and auditory skills, and psychosocial skills	Effects stronger at younger age (2–3 years) with longer duration (>17 months)	0.4–1.5 depending on test	2
Uganda ⁷³	2010	Communication on early child development, health and nutrition, child health days, village grants on nutrition or early child development centres	0–6 years	(1) Ugandan version of the British Abilities Scale (2) Parenting practices (3) Nutritional status	(1) No significant difference (2) Significant difference in parent attitudes and behaviour towards early child development (3) Significant difference for younger than 1 year		2
Philippines ^{74,75}	6693	Family day-care programmes, home visits on parenting and nutrition, improved health and nutrition services, feeding	0–4 years	Early child development checklist of gross and fine motor skills, receptive and expressive language, social-emotional skills, cognitive skills, and self-help skills and development index	For Developmental Index, all differences significant (p<0.05) for children with duration of exposure >17 months, and for all children aged 2–3 years at enrolment for all durations. Strongest effect for language	Ranged from 0.5–1.8 for specific scales, ages, and durations	2
Bangladesh ⁷⁶	300 children with growth faltering	Stimulation in therapeutic feeding centre, home visits, and group meetings (treatment=centres with child development interventions, control 1=nutrition centres without child development programmes, control 2=well-nourished)	6–24 months	Bayley Scales of Infant Development	Treatment>control 1 for mental development, not motor; control 2>control 1 in mental and motor development. No effect of stimulation intervention on nutritional status	0.37	1

*Sample size for the assessment, not for the whole programme. †Scale: 1=coverage fewer than ten villages; 2=coverage of ten or more villages, or a district but not national programme; 3=national-level government programmes.

Table 2: Comprehensive programmes for child development in developing countries

(Nepal,⁵⁵ Argentina,³⁵ Burma,⁵⁴ and Colombia⁵⁸) recorded improvements in the number of children entering school, age of entry, retention, and performance.

Parenting and parent-child programmes

Four parenting programmes used home visiting, and all reported positive effects on child development.^{59–65} In Jamaica, parenting practices improved when children and parents were actively involved in a home-visiting programme, but not when the parent component was limited to information sharing.⁶⁰ In Bolivia, information and skill building about health, hygiene, nutrition, and development, linked with a literacy programme for indigenous women and home visits, resulted in higher test scores for participants' children than those of matched non-participants.⁶³

Two programmes used group sessions with mothers. In Turkey, where mothers practised skills to play with their children, there were short-term and long-term

effects on child development.⁶⁴ In Bangladesh, mothers' knowledge of child development and child rearing increased after information-based sessions, but there was no effect on child development,⁶⁵ perhaps because there were no practise or skill-based activities with families.

Comprehensive programmes

Six programme evaluations met the criteria for this group (table 2) and show the changes in programme models from 1975 to the late 1990s. The Integrated Child Development Services (ICDS) in India began in 1975, and provided counselling to pregnant and lactating women about nutrition, growth monitoring for children 0–5 years, and feeding and preschool centres for children 3–6 years old. The programme has been implemented at low cost, and currently serves more than 30 million children.⁶⁶

In 1992, the National Institute of Public Cooperation and Child Development in India compared around

14000 ICDS children with 2000 control children from non-participating communities that had similar services, and reported less likelihood of ICDS children being severely malnourished and greater likelihood of attending school.^{67,68} In three of the wealthier states, participating 3–5-year-old children scored higher on measures of child development than matched non-participants from neighbouring towns, with greater effects for younger and for malnourished children in two of the three states.⁶⁹ These assessments indicate that the ICDS can be effective, but a World Bank evaluation in 2002 indicated that the ICDS had “only modest positive effects”,⁷⁰ probably because of low funding, work overload of community workers, and insufficient training.⁷¹

In the early 1980s, Peru developed a community preschool and feeding programme for disadvantaged children. An evaluation in 1999 showed that first graders who had attended the programme did not differ on indices of school performance from those in formal preschools, but both groups had higher scores than children who did not attend the programme, controlling for socioeconomic variables.⁷²

Three projects, supported by the World Bank, in Bolivia, Uganda, and the Philippines illustrate various models for early child development. In the early 1990s, the PIDI (Proyecto Integral de Desarrollo Infantil) programme in Bolivia trained low-income urban women to run child-care centres in their homes for malnourished children 6–72 months, and funded them to upgrade their homes, provide food for the centres, and run health and nutrition monitoring and educational activities.¹⁴ Non-participants were compared with children who had at least 6 months of exposure. There were benefits in growth in children younger than 36 months and benefits in cognitive and psychosocial development, irrespective of age. The estimated cost was US\$43 per month per child, 40% of which was for food.

The Uganda Nutrition and Early Child Development Project began in the late 1990s.⁷³ Communities within

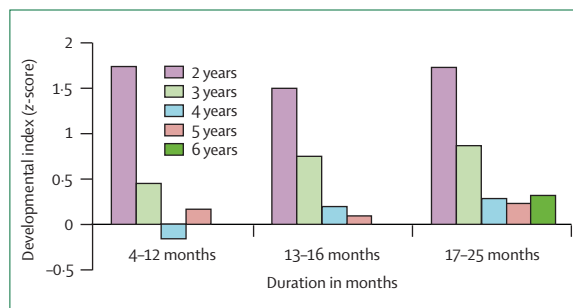


Figure 3: Effects of the Philippine Early Child Development Programme on standardised Developmental Index score as a function of child's age at enrolment and duration

Developmental index varies by child's age at programme enrolment and duration of time in programme, favouring younger children with longer duration. All differences are significant ($p < 0.05$) for 17–25 months duration and for 2-year-olds and 3-year-olds for all durations compared with non-programme children. Adapted from data available in Armejin.⁷⁴

25 districts were divided into intervention and control. Intervention communities received radio and newspaper messages on child stimulation, positive parenting, health, hygiene, and nutrition. Child health days every 6 months for the whole community provided growth monitoring and promotion, immunisation, deworming, and health care. Each intervention community could receive community grants for nutrition or early child development, and most chose nutrition. After 2 years, there were substantial improvements in breastfeeding practices, growth rates in the youngest children, and parental attitudes and behaviour supporting early child development, but there were few effects on cognitive development of children aged 3·5–6 years, possibly because of the low intensity of the intervention.

In the late 1990s, the Philippines increased training and supplies to existing services for children aged 0–5 years using an integrated, multi-sectoral approach for delivering a combination of services,^{74,75} and added community child development workers responsible for parenting education on health, nutrition, and child development. The evaluation showed that programme communities had more feeding programmes, parent education, and home-based child care programmes than control communities, adjusting for child age and programme duration.^{74,75} Children who had been exposed for more than 18 months showed a benefit in cognitive development, with effect sizes up to 1·8 SD in language development for 2–3 year-old children (figure 3). There was no effect on haemoglobin, despite an iron supplementation programme, nor on stunting, but participating children older than 4 years were heavier than non-participants.

Panel 1: Characteristics of successful early child development interventions

- Integration of health, nutrition, education, social, and economic development, and collaboration between governmental agencies and civil society.
- A focus on disadvantaged children.
- Sufficient intensity and duration and include direct contact with children beginning early in life.
- Parents and families as partners with teachers or caregivers in supporting children's development.*
- Provide opportunities for children to initiate and instigate their own learning and exploration of their surroundings with age-appropriate activities.
- Blend traditional child-rearing practices and cultural beliefs with evidence-based approaches.*
- Provide early child development staff with systematic in-service training, supportive and continuous supervision, observational methods to monitor children's development, practice, and good theoretical and learning-material support.*

*Adapted from Jaramillo and Mingat.¹¹¹

A component of psychosocial stimulation was added to the Bangladesh Integrated Nutrition Project, a national nutrition programme for malnourished children. A 12-month randomised controlled trial of home-visiting and mothers' group sessions in community centres reported substantial benefits to the children's cognitive development and behaviour (fear, timidity), but no effect on growth.⁷⁶

In summary, five of six early child development programmes showed beneficial effects. The recent programme models have been integrated into existing community-based systems and include families more effectively than earlier models. However, as the Uganda results indicate, low-intensity programmes that do not direct services toward children might have limited effect on child development outcomes.

Factors consistently associated with programme effectiveness

Numerous factors are associated with success of interventional programmes (panel 1). Providing services directly to children is more effective than only providing information to parents; demonstrations and opportunities for skill building and practice with parents increased effectiveness.^{60,64,65} Disadvantaged children, including children who are stunted, benefit more than advantaged children.^{13,44-48,54,55,56,77} Younger children (2–3 years) benefit more than older children (5–6 years), even after adjusting for duration.^{14,57,74} Longer exposure results in more consistent and larger effect on child development.^{3,75} For example, disadvantaged preschoolers in Cali, Colombia, with 4 years of intervention achieved test scores that were similar to a middle-class sample, whereas children with less intervention lagged behind (figure 4).^{57,58}

Evaluations from Guinea, Cape Verde, and Bangladesh recorded associations between multiple measures of preschool quality and children's cognitive performance.^{52,53} The International Association for the Evaluation of Educational Achievement (IEA)'s assessment of pre-primary programmes involving 1500 children from ten countries (three developing countries) identified programme quality (eg, more child-initiated activities and small-group rather than large-group activities) as a critical contributor to cognitive development.⁷⁸ Dimensions of quality that are important for child development are programme structure (children to staff ratio, group size, staff training, and physical environment), and processes (warmth and responsiveness of the caregiver, emotional tone of the setting, and variety of activities).^{79,80}

Programmes that have assessed intensity report a linear relation between frequency of home visits and improvements in child development.⁸¹ Beneficial effects of combined programmes have been found on efficiency of delivery, cost savings, and effect.^{61,62,82,83} Most evaluations did not have the design or sample size to isolate the effects of individual components or to test for synergistic effects.⁸⁴

Monitoring child development

Currently, there are no globally accepted indicators for child development. Indicators would improve countries' abilities to set targets, allocate resources, monitor progress, and ensure accountability, but a simple measure is hard to construct. Child development is often measured through individual assessments of developmental changes in multiple domains (eg, cognitive, language,

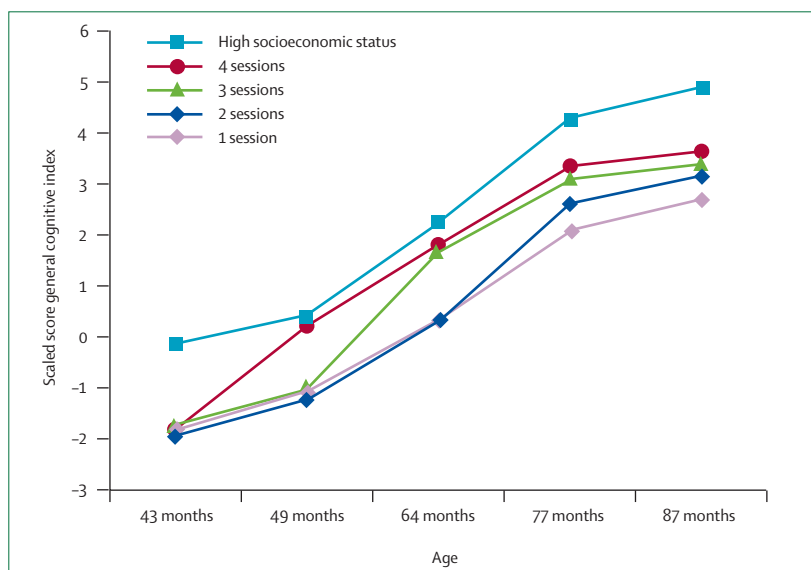


Figure 4: Change in general cognitive index of disadvantaged children in Cali, Colombia, by age of child and number of preschool 9-month sessions, compared with children of high socioeconomic status who received no interventions

Adapted with permission from: McKay H, Sinisterra L, McKay A, Gomez H, Lloreda P. Improving cognitive ability in chronically deprived children. *Science* 1978; 200: 270–78.

	Total gross enrolment ratio				Repetition rate, grade 1	Dropout rate, all grades
	1990	1998	2001	2002/3	2001/2	2001/2
Arab States	10.8	13.5	19.6	17.7	3.7%	7.2%
Central and eastern Europe	74.0	50.6	60.2	74.3	1.1%	2.3%
Central Asia	37.9	15.2	22.3	28.8	0.1%	3.5%
East Asia and the Pacific	32.1	50.6	54.5	56.2	0.6%	n/a
Latin America and the Caribbean	43.6	57.0	67.3	60.9	8.1%	20.5%
North America and western Europe	68.9	86.3	87.0	86.8	0.8%	n/a
South and west Asia	n/a	19.5	26.4	32.2	5.9%	35.1%
Sub-Saharan Africa	n/a	5.0	5.8	5.6	16.8%	40.5%
Countries in transition	72.4	23.3	30.5	34.6	0.2%	1.8%
Developed countries	72.5	76.1	81.9	81.1	1.0%	2.3%
Developing countries	n/a	31.9	35.0	34.3	7.8%	25.5%
World	n/a	43.7	48.6	48.6	4.0%	15.1%

UNESCO, EFA Global Monitoring Report 2005⁹ and EFA Global Monitoring Report 2006.¹³¹ Attendance in preschool and pre-primary education has generally increased since 1990, apart from the former Soviet Republics, where preschool education was widely available in 1990. With the collapse of the USSR, many countries dropped their state-supported early child development programmes. However, in the past few years, there has been a resurgence of early child development programmes, almost to their former level. Although preschool enrolment is low overall in sub-Saharan Africa, the rate is over 25% in 14 of the 33 countries with data, such as Kenya (48%), Ghana (47%), and Namibia (28%).

Table 3: Gross enrolment ratios for preschool and pre-primary education and repetition and dropout

social-emotional). Concerns of culture specificity in content and administration have also slowed the development of global indicators.⁸⁵

Social, environmental, and infectious risks

Social risks

There have been few evaluations of social protection interventions designed to mitigate the effects of social risks (eg. maternal depression, exposure to domestic and community violence, and stigma and loss due to HIV/AIDS) on children from developing countries. Women in developing countries have high rates of stress and depressive symptoms,^{86,87} often associated with poverty, lack of support, and negative life events. Children of depressed mothers are at risk for poor development, in part mediated through inconsistent and unresponsive parenting.^{88,89} Reductions in maternal depressive symptoms with moderate to large effect sizes were shown in four psychosocial interventions,⁹⁰⁻⁹³ but no substantial effect was seen on child competence in the one study that looked at these effects.⁹¹ In Jamaica, mothers' depression scores declined after participating in a parenting intervention, similar to evidence from developed countries showing that teaching mothers practical caregiving skills has beneficial effects for both mothers and children.⁹⁴⁻⁹⁶

Violence toward young children often occurs through excessive corporal punishment, child abuse and neglect, and exposure to violence.⁹⁷ Responses include law reform on standards of care and mechanisms for surveillance and improving parenting practices. In some countries, supportive and therapeutic services (including therapeutic day-care) for young children who have witnessed or experienced violence have been established.⁹⁸ Although there is evidence that home

visiting can be an effective strategy for preventing child abuse,⁹⁹ results are not consistent.¹⁰⁰ There are few programmes directed toward young children in developing countries, and no evaluations were located.

Parental loss is often associated with violence or disease-related mortality, including the HIV/AIDS pandemic. In 2004, there were 43.4 million orphans (age 0-17 years) in sub-Saharan Africa, of which 28% were due to HIV/AIDS.¹⁰¹ A breakdown of these data by age showed that 7 million orphans (16%) were younger than 6 years and 23 million (52%) were younger than 12 years.¹⁰² Interventions for younger children affected by AIDS, such as home visiting, support for families, ensuring access to care, and community-based child care are limited in scale and have not been rigorously assessed.¹⁰²

Environmental risks

The evidence that environmental toxins such as lead and arsenic can compromise child development^{103,104} is a major reason for reducing exposure. Chelation, even oral chelation¹⁰⁵ or the removal of lead from children's blood and bone stores, although successfully reducing body burden, has not resulted in improvements in children's developmental functioning. Mitigation programmes (including provisions of deep water-wells and education) successfully reduce arsenic concentrations in exposed individuals, but there are no findings on whether they result in improvements in child development. Systematically preventing exposure is probably a more effective and efficient strategy than treatment, but the challenge is the extensiveness of environmental toxin exposure.

Infectious risks

Severe malaria and HIV/AIDS have been associated with poor child development.² Effective malaria prevention and control include insecticide treated bednets and artemisinin-based combination therapies.¹⁰ Until recently, coverage of treated bednets for children under 5 years of age was estimated at less than 5%,¹⁰⁶ but countries are now rapidly scaling up coverage, with around 50 million nets expected to be delivered in 2006 and some countries expected to exceed the Abuja targets in 2006. Although the effect on children's development has not been sufficiently studied,¹⁰⁷ benefits to later cognitive abilities following chemoprophylaxis before the age of 6 years have been reported.¹⁰⁸

Mother-to-child transmission of HIV can be prevented, but in 2005, only 9% of pregnant women in low-income and middle-income countries received services to prevent transmission to their newborn babies, and only 9.2% of HIV-positive pregnant women received prophylactic antiretrovirals.¹⁰⁹

Future directions and crucial issues

In the final section we discuss priorities for improving the development of the 200 million children younger than 5 years at risk for cognitive and social-emotional deficits.

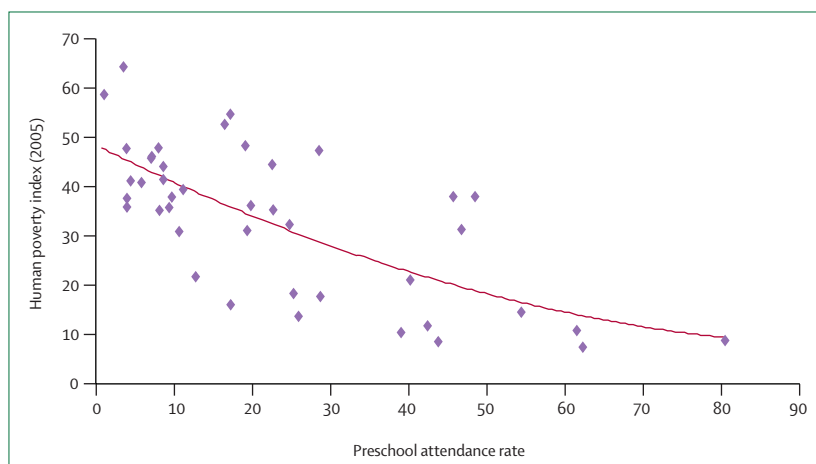


Figure 5: Preschool attendance by human poverty index for 40 developing countries

Data for preschool attendance from the Global Monitoring Report.⁹ Poverty levels (human poverty index) are from UNDP's Human Development Report. Human poverty index is a composite index measuring deprivations in the three basic dimensions captured in the human development index: a long and healthy life, knowledge, and a decent standard of living. UNDP, Human Development Report 2005, New York 2005. <http://hdr.undp.org/reports/global/2005/>.

Investing in early child development programmes

Despite the substantial evidence that comprehensive early development programmes are effective in increasing children's chances of success, government investment is low. Preschool or kindergarten enrolment, the only early development programme that is monitored worldwide, was 35% in developing countries in 2001.⁹ The rate has increased during the past 15 years in east and west Asia and the Pacific,⁹ although the regions with the highest need (assessed by grade 1 repetition and dropout) have shown slower progress (table 3). Programme coverage is negatively associated with countries' general poverty index (figure 5), leaving the poorest countries with almost no investment in early child development. However, some countries, such as India, have invested in programmes, despite poverty. If the current rate of progress continues, the disparity between rich and poor countries in preschool attendance (figure 6) will increase.¹⁰⁰ Jaramillo and Mingat¹¹¹ estimate that in Africa, an increase in the preschool gross enrolment rate to 40% during the next decade could reduce repetition rates and increase the proportion of grade 1 students who reach grade 5 from 65% to 78%.

Investments are low for multiple reasons. For example, governments are organised sectorally and no one sector is responsible for early child development. The problem is not visible, and governments might be unaware of the cost to individual and society of not investing in early child development programmes (panel 2).^{112,113}

There are human rights and economic reasons to invest in child development programmes (panel 3). The Convention for the Rights of the Child established the principle that children have the right to survive and to develop, and governments are responsible for supporting families in their childrearing.

Evidence indicates that early development programmes are beneficial for their costs. There are many considerations when estimating reliable benefit-to-cost ratios, including: measuring all benefits and costs in monetary terms, such as the value of increased academic performance; assessing diverse resource costs; and balancing between immediate gains versus long-term benefits.¹¹⁴ Recent estimates of benefit-to-cost ratios for interventions for early child development yield ratios substantially above 1 in developing countries,¹¹⁵ and in developed countries.³⁴ In PIDI (Bolivia), the benefit of a 5% increase in cognitive scores and a 2% increase in height translated into a benefit of between \$1.8 and \$3.66 per dollar of project cost.¹⁴

Reducing disparities

Achievement differences in children from different socio-economic groups widen over time.³⁴ Early interventions can reduce disparities. If enrolment in high-quality programmes were increased to 100% for low-income children in the USA, disparities in readiness for school would be reduced up to 24% between black and white children and up to 36% between Hispanic and white children.¹¹⁶ In Cali, Colombia³⁷ there was a difference of

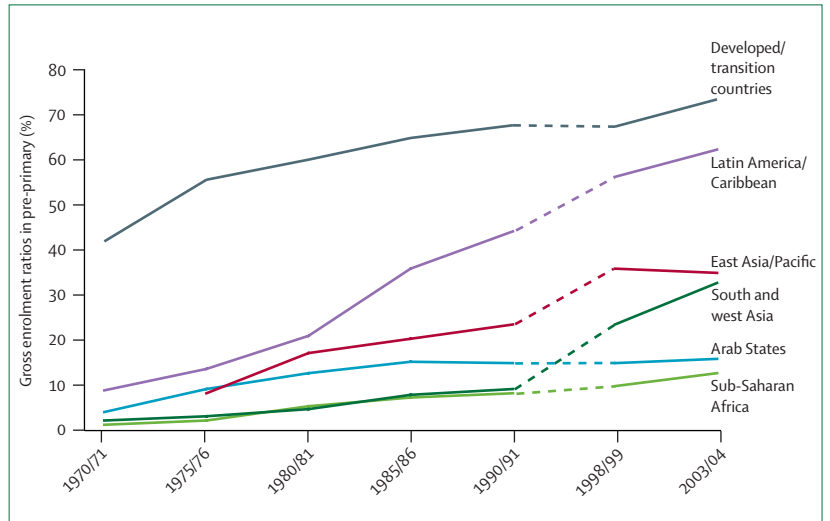


Figure 6: Change in preschool gross enrolment ratios from 1970 to 2003-04 by region
Data for east Asia and the Pacific are for developing countries only; Australia, Japan, and New Zealand are included under developed countries. The broken line signifies a break in the data series due to a new classification. Reproduced with permission from EFA Global Monitoring Report Team. EFA Global Monitoring Report 2007. Strong foundations: early childhood care and education. Paris: UNESCO, 2006.¹¹⁰

Panel 2: Reasons that governments do not invest in early child development interventions

- Children's loss of developmental potential, and the cost of loss of developmental potential, both for individual children and poverty alleviation, are not recognised.
- There are no globally accepted indicators for child development to monitor progress or ensure accountability.
- Governments respond to short-term effects and find difficulty in justifying the long-term investment in human development.
- There are multiple organisational stakeholders for young children, so the responsibility for early child development is not assumed by any entity.
- There is not a single strategy for promoting early child development.

Some items were modified from Heaver¹¹² and the World Bank.¹³⁰

Panel 3: Why governments should invest in interventions for early child development

- It is the most cost-effective period in the child's life to invest.
- Events in the early years of a child's life influence the child's productivity and learning ability throughout the life course, and are effective strategies for reducing poverty among disadvantaged populations.
- Programmes increase the efficiency and effectiveness of school expenditures by reducing drop-out and repetition.
- Increased schooling for girls has a long-term effect on their children's survival, growth and development.
- Interventions are more sustainable because parents and families carry these changes over to subsequent children.
- There is a strong evidence base on effective interventions for early child development.
- The Convention on the Rights of the Child ensures every child the right to development as well as survival, and requires governments to support families in childrearing.

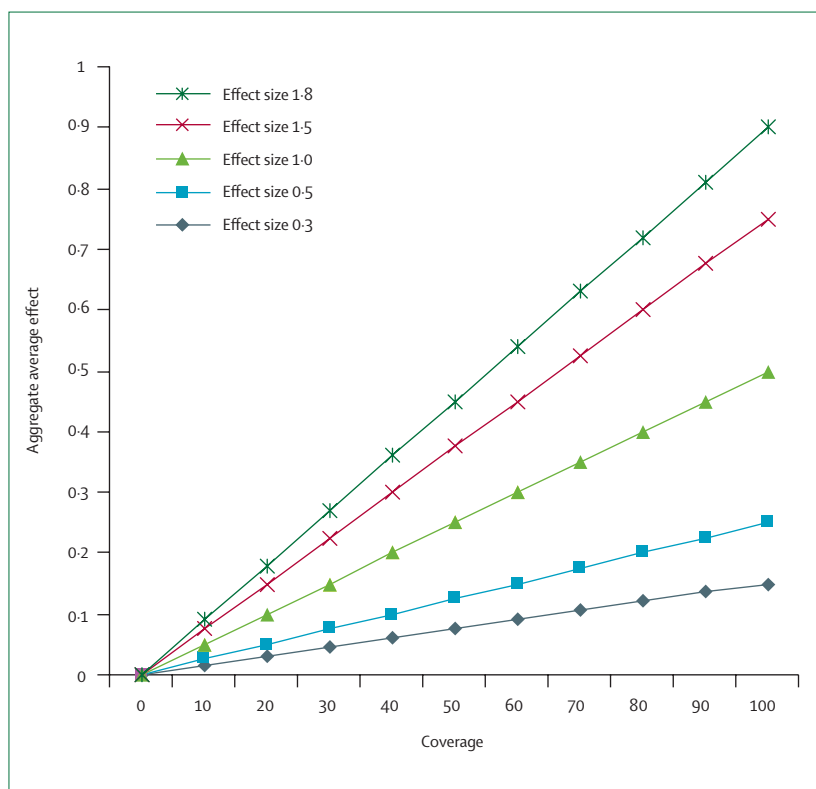


Figure 7: Estimated changes in number of years of school passed as a function of aggregate effect size and coverage of early child development programmes
 Effect sizes are based on the range of estimates in tables 1 and 2. Benefits are the increases in schooling attainment for individuals based on estimates of the relation between preschool cognitive tests and completed schooling attainment using longitudinal data that started in pre-school ages and continued through young adulthood in Brazil¹¹⁷ (age 18 years for 152 males) and Guatemala^{13,118} (ages 25–42 years for 1471 females and males), controlling for maternal schooling, parental family income (Brazil), or socioeconomic status (Guatemala), and birth year and sex for Guatemala. Aggregate average benefit is the product of the range of individual benefits times the programme coverage. If coverage was not expanded randomly and the hardest cases were left for last, the lines probably would be less steep as coverage became very high.

Panel 4: Policy and programme recommendations

- Implement early child development interventions in infancy through families and caregivers, and add group learning experiences from 3 to 6 years, particularly for disadvantaged children as a poverty reduction strategy.
- Ensure that development programmes combine health and nutrition services with early learning, rely on families as partners, and have adequate quality, intensity, and duration to affect children's development cost effectively.
- Incorporate early child development into existing services and systems to increase programme coverage.
- Monitor the effectiveness of programmes with outcome measures of child development.
- Increase advocacy on the importance of early child development and the consequences of the loss of developmental potential to individuals and to society.
- Include programmes in policies and financial allocations at national, local, or international levels.
- Create coordinating mechanisms for ministries that share the responsibility for early childhood development.
- Ensure that all children are adequately nourished, including micronutrients, such as iodine and iron.

1.5 SD between middle-income and low-income 4-year-olds before intervention. The gap was reduced by 60% with 4 years of preschool (figure 4).

To estimate the effects of early child development on schooling and adult earnings among disadvantaged groups in developing countries, we used longitudinal data beginning before age 5 from 152 Brazilian males, 18 years of age,¹¹⁷ and 1471 Guatemalan adults, age 25–42 years.^{13,118} Both data sets included standardised assessments of preschool development and schooling attainment, as well as controls for maternal schooling and parental income or socioeconomic status, and birth year and sex for Guatemala. We used effect sizes from the review of programmes (tables 1 and 2), ranging from 0.3 to 1.8, to obtain the individual benefits on increased schooling attainment, and we varied the assumed programme coverage rates from 0% to 100% to obtain aggregate average benefits. Analyses across the two data sets found that with 90% coverage, an increase of 1 SD in pre-school cognitive skills is associated with an aggregate benefit of around two-thirds to more than one grade of additional schooling (figure 7 has the derivation of estimated benefits). Estimates for Guatemala that control for random measurement error find effects over five times as large. The estimates from Brazil and Guatemala (not controlling for measurement error) and estimates from developing countries of the economic returns of schooling suggest that preschool participation contributes to increases of around 5–10% in lifetime labour income.¹¹⁹

Integration of early child development programmes into other systems

Policy decisions on programmes often span multiple ministries (eg, health, education, welfare) and need coordination across sectors.¹²⁰ The health system is often the only infrastructure that reaches children younger than 3 years and therefore can initiate programmes to promote early development and prevent risks. Health visits or growth monitoring sessions¹²⁰ have added recommendations for child development.¹²¹ The Care for Development Intervention, a module of WHO's Integrated Management of Childhood Illness, is based on interactive learning and includes strategies for improving psychosocial care and responsive feeding. Two pilot studies showed the feasibility of delivering the intervention in resource-poor settings,^{122,123} and a controlled evaluation trial in Turkey showed that the Care for Development Intervention had a positive effect on parenting behaviours.¹²⁴ In the Congo, surveyed parents reported that they would like more information about their children's development in their health visits,¹²⁵ and in the USA, incorporating developmental counselling into primary care has improved quality of care and parenting practices.¹²⁶ These innovations are promising but their effect on child development has not yet been assessed.

Panel 5: Research recommendations

- Identify the characteristics of child development programmes that are effective and can be expanded and implemented through existing health, nutrition, education, and social protection services.
- Examine the role of early child development programmes in mitigating the effects of multiple disadvantages, including poverty.
- Research parenting interventions to identify the most effective and scaleable strategies.
- Assess possible synergies among programme components to guide implementation recommendations.
- Define a core set of globally accepted measurements and indicators for child development that can be adapted across countries for monitoring, planning, and assessment.
- Improve and assess strategies to increase effectiveness of outreach to disadvantaged children, including orphans.
- Strengthen the evidence base for the effects of maternal depression, exposure to violence, parental loss, toxins, malaria and other infectious diseases on child development and identify effective interventions to reduce their risks and adverse consequences.
- Create and test a method for estimating the costs of different models of early child development programmes.

The educational system can promote child development by supporting comprehensive programmes for early child development. If the programmes are of high quality, have family involvement, and when needed, provide health care and food supplementation or micronutrients, evidence suggests that disparities among the most disadvantaged children can be reduced before school entry. Linking early development programmes administered through the health system with programmes in the educational system increases the likelihood of building intervention follow-up for children at risk.

Early child development programmes can be coordinated across ministries, non-governmental organisations (NGOs), and civil society. In Turkey, parenting messages are provided by the health care system, the Ministry of Agriculture, the Ministry of Labor, and even the Military.¹²⁷ In Cuba, the Educate your Child programme covers 98% of young children. National, district, and local committees support community volunteers' (primarily health workers) work with families through home visiting and informal early learning centres to improve survival, growth and development.¹²⁸

To increase coverage of early child development programmes and improve their quality and effectiveness

we need better advocacy strategies, coordination mechanisms, and improved policy (panel 4). Research is needed on approaches to delivering feasible effective child development programmes at scale and on the effects of synergies on child outcomes (panel 5). Effect and cost-effectiveness evaluations of these efforts are a priority for guiding future policies and programmes.

Conclusion

Effective interventions are available to reduce the developmental loss currently estimated to affect more than 200 million children under 5 years of age in developing countries, by promoting child development and preventing or ameliorating developmental loss. The most effective interventions are comprehensive programmes for younger and disadvantaged children and families that are of adequate duration, intensity, quality, and are integrated with health and nutrition services. Providing services directly to children and including an active parenting and skill-building component is a more effective strategy than providing information alone.

The papers in this series show that early interventions promote child development and prevent or ameliorate developmental loss. Despite the strength of the findings and the evidence for the effectiveness of investing in child development early in life, the response, particularly in the poorest countries, has been slow. Children's rights are threatened by the failure of countries to develop their human capital, resulting from the lack of attention to early development. Interventions to promote early child development are cost-effective investments to ensure that children are prepared for educational and economic opportunities, thereby reducing disparities and achieving the Millennium Development Goals of reducing poverty and hunger and ensuring primary school completion for girls and boys. Countries can make a commitment to the future by investing in early child development programmes that reach all young, disadvantaged children through comprehensive child development programmes of quality and by developing the financing and policy mechanisms for sustainability.

Contributors

P L Engle and M M Black are the lead authors and are responsible for the overall manuscript. The other authors (J R Behrman, M Cabral de Mello, P J Gertler, L Kapiriri, R Martorell, and M E Young) contributed to various sections of the manuscript. All authors, including the members of the International Child Development Steering Group, revised and edited the entire manuscript.

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Conflict of interest statement

We declare that we have no conflict of interest.

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