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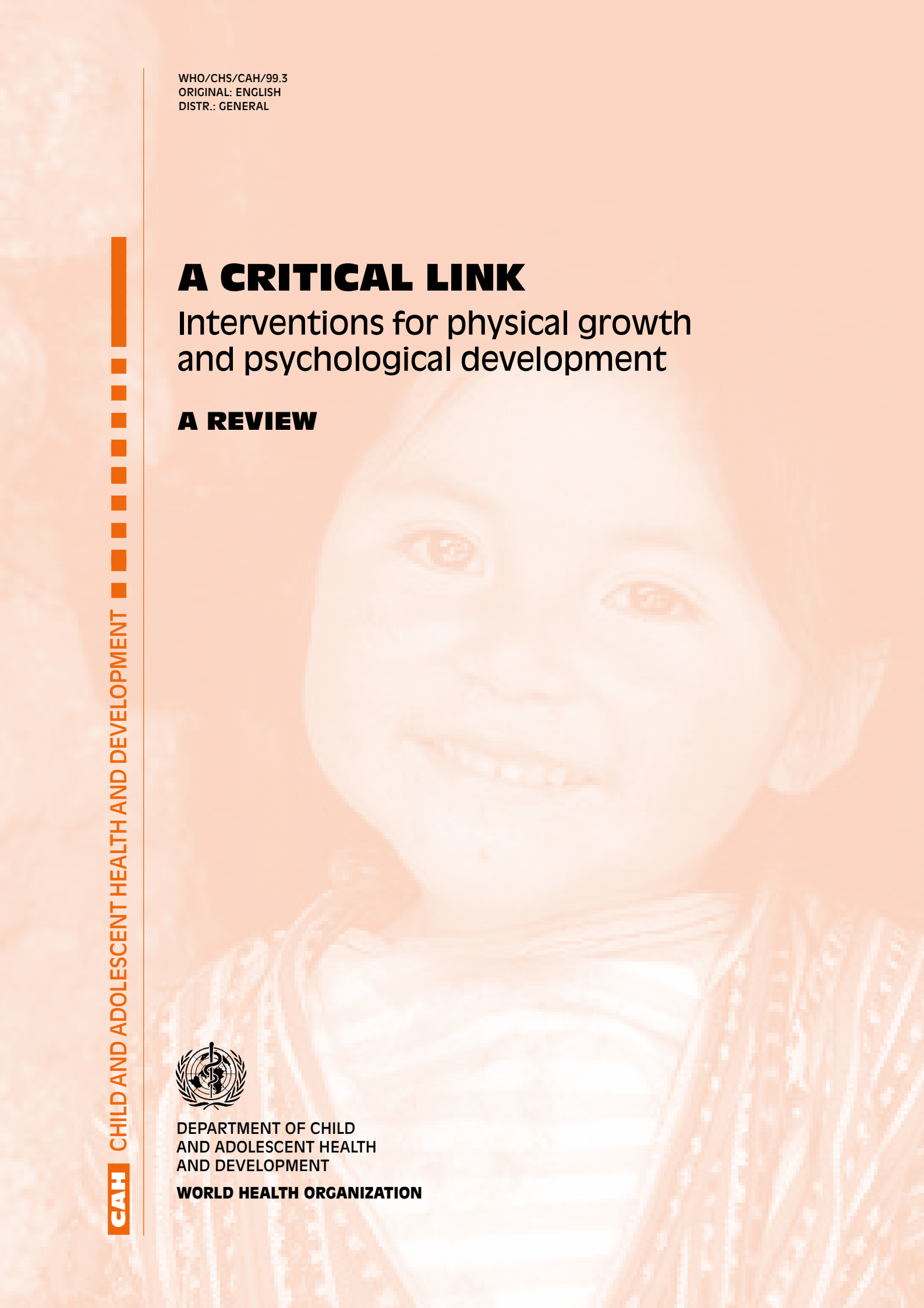
Interventions for physical growth and psychological development

A REVIEW



CAH CHILD AND ADOLESCENT HEALTH AND DEVELOPMENT

DEPARTMENT OF CHILD
AND ADOLESCENT HEALTH
AND DEVELOPMENT

WORLD HEALTH ORGANIZATION

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Executive Summary

Introduction

The future of human societies depends on children being able to achieve their optimal physical growth and psychological development. Never before has there been so much knowledge to assist families and societies in their desire to raise children to reach their potential.

This review documents the critical relationship between nutritional status and psychological development, and demonstrates the potential of combining interventions that enhance early childhood development and those that improve child health and nutrition into an integrated model of care.

In the past several decades, the relationships among health, physical growth, psychological development and parental caregiving have become clearer. There is an extensive scientific basis for the effectiveness of interventions to promote growth and to promote psychological development, even under poor socio-economic and environmental conditions. Moreover, when these interventions are implemented simultaneously, there is even greater impact. For example, children who are better nourished and less lethargic are more curious and exploratory, and therefore make better use of opportunities to learn how to problem solve and manipulate objects. Children are also more able to explore and learn when parents provide a stimulating environment and are responsive to their children's verbal and non-verbal cues.

The premise behind interventions to promote growth and development *simultaneously* is that feeding behaviours that increase nutrient intake and psychosocial support for children's development require similar skills and resources from caregivers.

The premise behind interventions to promote growth and development *simultaneously* is that feeding behaviours that increase nutrient intake and psychosocial support for children's development require similar skills and resources from caregivers. Research shows that parental feeding behaviours can influence the quality and quantity of children's dietary intake. Parental psychosocial support, such as providing learning materials or conversing with young children, also significantly affect development. These two kinds of behaviours are closely related. For example, a parenting *skill* that could influence both feeding and psychosocial support is noticing attempts of children to communicate, and responding in a way that is appropriate to their needs and developmental level. A parental *resource* that affects both feeding and psychosocial support is sufficient time and flexibility for the caregiver to provide the support when it is needed.

In principle, combined growth and development interventions that help families practise "responsive parenting" have the potential to promote better psychological development, as well as physical growth. Combined growth and development interventions may also permit greater efficiency in the delivery of services to aid children and their families, such as through existing child health programmes.

Review findings

This review summarizes three types of interventions:

- Interventions (psychosocial or nutrition) to support psychological development.
- Nutrition interventions to support physical growth.
- Combined interventions to improve both growth and psychological development.

The following critical findings arose from the review, and provide the basis for advocating more widescale implementation and testing of combined programmes.

Psychosocial interventions significantly improve psychological development. For

example, children attending pre-school centre-based programmes gain an average of about eight IQ points by the time they are ready to start school. They are also less likely to repeat primary school grades or be placed in special education classes. Interventions that provide both direct services to children and support to parents, through parenting education and life skills development, have been shown to be the most effective. These effects are also seen in large-scale programmes such as the Integrated Child Development Services (ICDS) in India.

■ **Nutrition interventions significantly improve psychological development in disadvantaged populations**. The review demonstrates that increased intake of nutrients and energy during the first two years of life, and prenatally through supplements to mothers, have significant positive impacts on cognitive and motor development. For example, interventions to prevent iodine deficiency have dramatic effects on cognitive development, as well as on the prevention of the physical stunting that accompanies iodine deficiency. Similarly, breastfeeding is associated with improved cognitive development, and the relationship may be causal.

■ **Nutrition interventions significantly improve physical growth in poor and malnourished populations**. Balanced protein and energy supplements during pregnancy improve birthweight and reduce the incidence of intrauterine growth retardation. Food supplementation for infants and young children has documented impacts on physical growth. Other types of effective nutrition interventions include caregiver education about diets and feeding practices for young children, breastfeeding promotion, and zinc supplementation in zinc deficient areas. Programmes that include education, food supplementation and/or micronutrient supplementation can result in reductions in the prevalence of moderate and severe undernutrition.

■ **Combined interventions to improve both physical growth and psychological development have even greater impact in disadvantaged populations at risk of malnutrition**. Research shows us that caregivers from poor families in developed and developing countries can acquire new nutrition knowledge, feeding skills, and responsive parenting techniques that can improve their children's nutritional status and cognitive development simultaneously. In combined interventions, the psychosocial support provided by increased stimulation appears to have greater effects on psychological functioning than on physical growth, whereas nutritional supplementation improves both growth and development. The combination of stimulation and supplementation interventions appears to have a greater effect on cognitive development than either one alone. These combined nutrition and psychosocial interventions had significant impacts on both growth and development in every study that tested this relationship. Even large-scale programmes, such as the ICDS Project in India or Head Start in the United States, have shown improvements in nutritional status or cognitive development, and some have improved both growth and development.

Having the greatest impact

The review also identified a number of conditions, such as children's ages and programme characteristics, under which the impact on growth and development is most likely to be seen.

- Interventions during the earliest periods of life—prenatally, during infancy and early childhood—are likely to have the greatest impact. Interventions to support psychological development after this particularly vulnerable early period, however, are also effective.
- The children in greatest need due to poverty or parents' lack of knowledge are generally the ones who show the greatest response to growth and development interventions. At the same time, families need a minimum level of resources. Identifying the families and children who are mostly likely to benefit from such interventions should improve outcomes.
- Growth and development programmes that utilize several types of interventions and more than one delivery channel are more efficacious than those that are more restricted in scope. Types of interventions include nutrition education on diet and feeding practices, providing supplementary foods or micronutrient supplements, teaching parents about child development milestones, demonstrating cognitive stimulation activities or other activities to improve parenting skills. Types of delivery channels are individual home visits, group counselling, childcare centres and mass media.
- Combined programmes could be more efficient at delivering services through reductions in

delivery costs, less duplication of services, and appropriate identification of those who are most likely to benefit. There are also likely to be savings for families as a result of easier access when services are combined and families are more likely to be motivated to seek those services.

- Programme efficacy and effectiveness appear to be greater when parents are more involved.

Next steps

When discussing the future of combined interventions, a number of challenges arise. Many potential models for combined interventions to promote physical growth and the psychological development of infants and young children have not yet been implemented. Others have been implemented but not systematically evaluated, which is essential for the expansion of programmes. However, this review serves as a critical starting point in discussing recommendations for immediate action.

- We need to develop and test a model of combined interventions that could reach a large proportion of children who are at risk of growth and development faltering. An example is a culturally-adaptable counselling package that combines nutrition counselling on complementary feeding (with food supplementation, as necessary) with counselling on psychosocial care (e.g. warmth, attentive listening, proactive stimulation, and support for exploration and autonomy). The counselling should involve the child's primary caregiving system (e.g. the family) and build on its existing strengths.
- We should develop and implement new activities to promote appropriate feeding and responsive parenting in existing child health programmes. Activities could be incorporated into well-child clinics, primary health care consultations for childhood diseases, prenatal care, and nutrition programmes, such as growth monitoring, nutrition education, breastfeeding promotion, and nutrition rehabilitation centres.
- We should expand and strengthen the health, nutrition, and breastfeeding components of existing early childhood care and development (ECCD) programmes. This can be done both in childcare centres and with parents and caregivers by providing counselling and training on responsive parenting and appropriate feeding.
- We need to design an expanded research agenda to compare and evaluate the effectiveness of different content, programme venues, and delivery channels—for example, breastfeeding promotion through community-based primary health care, and delivery by community health workers, women's groups, and school teachers. Training materials for community workers, monitoring and evaluation tools, and other tools for cultural adaptation, planning, and community participation should be developed together with the counselling strategies.

Chapter 1

Introduction

Survival, growth and development in the earliest years of life are fundamental for the future of every individual and for the future of the societies into which those individuals are born. Never before in human history have societies had so much knowledge to assist families in raising healthy children.

However, these crucial formative years remain a time of peril and loss—disease and malnutrition not only claim the lives of millions of children throughout the world, but they also damage their growth and development, diminish their quality of life in the present and compromise their future.

A remarkable degree of consensus is emerging on the essential requirements that positively influence a child's early growth and development as well as on the ways that parents and others can provide our youngest children with a healthy start.

Carnegie Task Force (1994)

This review brings together evidence showing that nutrition interventions and early childhood care and development (ECCD) programmes have positive impacts on the physical growth and cognitive, motor, and behavioural development of young children. It provides guidance for designing interventions that stimulate psychological development and those that improve nutrition and child growth, and considers various programme models for doing so.

Thus, the emphasis in the review process was to identify and compare efficacy trials and programme evaluations of growth and development interventions, and to interpret the evidence on the factors contributing to their effectiveness. The review builds on the seminal work by Myers (1992) who described combined programme models almost 10 years ago.

The review was also undertaken with the view that it is important for society to provide children with the best services to ensure their rights to health. These rights are outlined in the United Nations Convention on the Rights of the Child, now ratified by almost all member states of the United Nations, which states that children have the right to "the enjoyment of the highest attainable standard of health". The Convention also supports States' identifying the best interventions for child health, nutrition, and development.

Strengthening and expanding existing strategies, and identifying and testing creative new approaches can help ensure that all children have access to the essential requirements for healthy growth and development.

Benefits of investing in early childhood care and development programmes

Psychological development (mental, motor, social and behavioural) occurs through maturation and daily interaction with the environment. When this environment is inadequate, children often do not achieve their full potential for cognitive, social, and behavioural development. Given the rapid rate of mental and motor development in infants and young children (Condry, 1983), there has been great interest in instituting early interventions to provide stimulating, responsive environments that nurture psychological development, and prevent the cumulative deficits often seen among disadvantaged children. Recent research suggests that ECCD programmes for children during their first two or three years of life are more likely to forestall deficits in learning and psychological development than initiation of interventions in the pre-school or school-aged period (Ramey and Ramey, 1998).

ECCD programmes comprise a variety of interventions, including early education and socialisation activities for children, education for parents, and social support for families. These programmes enhance cognitive development, motivation for learning, and readiness for school (Myers, 1992; Young, 1995), and improve

parent-child interaction and family functioning (Olds and Kitzman, 1993; Benasich et al., 1992).

How society benefits from early childhood care and development programmes is difficult to quantify, as such calculations are by nature imprecise and subject to a number of assumptions. However, these calculations provide a good indication of the value of investing in early childhood, such as:

- Increased human resource development (via better school achievement).
- Cost-savings and increased efficiency of primary schooling (lower rates of grade repetition and remedial education).
- Higher educational attainment.
- Increased earning potential.
- Reductions in juvenile delinquency and its associated costs.
- Increased commitment to marriage.
- Increased social mobilisation and community involvement, and reduced social and economic inequalities in developing countries (Zigler et al., 1992; Barnett, 1996; Schweinhart, Barnes and Weikert, 1993; Myers, 1992).

One early childhood care and development programme in the United States is a concrete example of the economic value of such projects. A cost-benefit assessment conducted when the project participants reached young adulthood concluded that the benefits to society outweighed the project costs more than five fold (Barnett, 1985; Barnett, 1995). When participants turned 27 years of age, an even greater benefit was found—an estimated $7 for each dollar invested (using constant dollars).

Benefits of investing in programmes to improve child physical growth

Physical growth is a very sensitive indicator of nutritional and health status in infants and young children. Undernutrition is associated with greater risks of death (Pelletier et al., 1994), severe infection (Black et al., 1984), and delayed cognitive and psychomotor development (Lasky et al., 1981; Pollitt et al., 1993). Most growth retardation occurs very early in life. The two periods of highest vulnerability are during intrauterine development and between 6 and 24 months of age when the child is making the transition from exclusive reliance on breastmilk to consumption of the family diet (Brown and Begin, 1993). An infant born at low birthweight is at higher risk of mortality and morbidity (McCormick, 1985) and a variety of developmental problems (Aylward et al., 1989). Prevention of undernutrition in infants and young children is critical because growth deficits are generally not recouped, even with adequate feeding in later years (Martorell et al., 1992; Martorell, 1995).

Growth retardation in early childhood also has important implications for human resource development through its effects on morbidity, school achievement, and work capacity in adulthood. From the perspective of public policy and expenditures for social services, the costs of many types of nutrition interventions are low relative to the potential benefits and relative to other health interventions (McGuire, 1996).

Benefits of investing in programmes that combine ECCD and nutrition interventions

Two basic principles outlined in the World Health Organization (WHO) Constitution provide a strong argument for designing programmes that combine ECCD and nutrition interventions:

- "The healthy development of the child is of basic importance."
- "Health is a state of complete physical, mental and social well being and not merely the absence of disease or infirmity."

A recent World Bank conference reiterated this perspective: "… health and cognitive interventions need to be interactive and designed as integrated programmes of nutrition, health, and psychosocial stimulation" (Young, 1997).

Although there is still much to be learned about the interactions of physical growth, illness and psychological development, and how they are related to family and social conditions, the intimate relationship of physical and psychological growth has been well established. Only recently has the scientific evidence for these powerful relationships become available (see recent reviews, such as Engle, Menon and Haddad, 1997; Gorman, 1995; Martorell, 1997; Wachs and McCabe, 1998; Walker et al., 1998).

Interaction at three critical points

Nutrition and psychological development interact at three different critical points: (1) at the level of the child; (2) between the child and his or her family or caregivers; and (3) in the design and delivery of programmes.

The child

The intimate relationship between physical growth and psychological development is particularly evident in the first years of life. This helps explain why prenatal and early childhood nutrition interventions—without a psychosocial component—can also have an impact on psychological development (Martorell, 1997). Likewise, early psychosocial stimulation programmes to improve cognition (one aspect of psychological development) may also have effects on physical growth (Super et al., 1990; Martorell, 1997). The most significant fact, though, is that children who receive *combined* nutrition and stimulation programmes perform better than those who receive either type of intervention alone. For both nutrition and psychosocial interventions, earlier appropriate interventions appear to have greater impacts than later interventions (Pollitt et al., 1993; Husaini et al., 1991; Waber et al., 1981; Grantham-McGregor et al., 1991).

The child and the family

The growth and development of a child depends not only on the care, food and resources provided by a caregiver, but also on the characteristics and behaviours of *both* the child and his or her caregivers. For example, better-nourished children tend to be more active and exploratory and more able to elicit interaction from parents (Chavez et al., 1975), all of which contribute to learning. Similarly, a child with well-developed psychosocial skills, who is able to engage the caregiver, may then be more effective in demanding and obtaining food. Thus, early interaction between children and caregivers affects subsequent interactions (Engle and Ricuitti, 1995).

Increasing caregivers' skills and resources may enable them to provide not only improved nutritional care, but also improved psychosocial care. Caregivers who are responsive in a feeding situation also tend to be more responsive and stimulating in play situations, and those who show dysfunctional behaviour while feeding their children are also dysfunctional in other interactions. As a result, implementing feeding and other care practices in a responsive, stimulating way is likely to result in social and cognitive, as well as nutritional, improvements (Black et al., 1994; Puckering et al., 1995; Polan et al., 1991).

Design and delivery of programmes

The third level of interaction takes place at the programme planning and implementation stage. A programme that incorporates nutrition, health, and psychosocial stimulation may be able to provide all three kinds of inputs more efficiently by combining delivery mechanisms. There is a growing emphasis on the integration of nutrition, health, and ECCD intervention strategies among agencies that fund and implement international development programmes. For example, UNICEF has developed a conceptual model for child survival, growth, and development that places care at the centre (Jonsson, 1995; Engle, 1997; Engle et al., 1997; Zeitlin, 1996). *Care* is defined as "the provision in the household and the community of time, attention and support to meet the physical, mental and social needs of the growing child and other household members" (Engle, 1992). The provision of care is a critical link between food and health resources, and the child's physical growth and psychological development. The World Bank also recommends the integration of health, nutrition, and psychosocial stimulation in programmes for early childhood (Young, 1997).

The three levels of interaction—the child, the child and the family, and programmes—will be discussed throughout the paper.

Questions to be addressed by the review

A number of recent reviews have clarified what we know about the linkages of malnutrition and lack of stimulation with later growth and development (e.g. Martorell, 1997; Gorman, 1995; Young, 1997; Walker et al., 1998; Levitsky and Strupp, 1995; Strupp and Levitsky, 1995; Pollitt et al., 1996). The potential benefits of investing in programmes to improve both physical growth and psychological development are substantial in light of the role of undernutrition and disadvantaged environments in perpetuating deficits in growth, cognitive function and other aspects of psychological development.

The issue is how best to promote healthy growth and development. The review addresses four key questions:

- To what extent and through what means can psychological functioning be improved for children living in disadvantaged environments?
- To what extent and through what means can child physical growth be improved in settings where chronic undernutrition is prevalent?

- To what extent and through what means can nutrition and psychological development be improved simultaneously through combined health, nutrition, and psychosocial interventions?
- Are there effective models for combined interventions, and are these models feasible for implementation on a public health scale?

The chapters that follow address these questions based on data from many different sources, including experimental studies, community-based efficacy studies, and evaluations of large-scale programmes.

Chapter 2 discusses methodological issues raised in the review. It addresses the outcome measures by which answers to the key questions, stated above, can be examined. It also orients the reader to basic issues that affect the interpretation of studies.

Chapter 3 concerns interventions that are aimed at supporting and improving child psychological development, including cognitive, motor, and social development.

Chapter 4 examines interventions aimed at supporting physical growth.

Chapter 5 presents combined growth and development interventions, both experimental studies that were designed to test the impact of combined growth and development interventions, and effectiveness trials of full-scale programmes that have included both interventions. This section also examines the combined approach from a programmatic perspective, discussing the possible advantages and disadvantages of various models of combined approaches.

Chapter 6 summarizes the results of the review and discusses the findings in relation to the questions raised above.

Chapter 2

Background and methodology for the review

This review draws on several decades of research in nutrition, epidemiology, psychology, anthropology, and other biological, medical and social science fields. We utilized a number of excellent analytical reviews and meta-analyses of specific topics within the larger framework covered by this review. We analysed primary sources only for key studies for which greater detail was needed. For each topic, a computer-assisted search identified new work published after the date of previous reviews.

Measuring impact: the selection of outcome measures

Outcome measurement—of child growth and/or cognitive, motor, and psychosocial development—was a primary criterion when selecting studies and programmes. The definition of an *outcome* is discussed in general terms below. The results of intermediate outcomes related to child growth and development, when measured, were also reviewed. *Intermediate outcomes*, such as changes in parent knowledge, are important because they help establish plausibility and identify the pathways by which interventions have impact. Sequelae or *long-term outcomes* help estimate the benefits to society of investing in growth and development interventions.

Development is usually categorized as:

- ***Cognitive (or mental) development*, including memory, problem-solving, and numerical understanding (and, for some authors, language development).**
- ***Language development*, the ability to communicate with others, to comprehend speech and express thoughts (receptive and expressive language).**
- ***Social-emotional development*, including an understanding of the relationship of self to other, ability to regulate oneself and one's emotions, development of social skills.**
- ***Temperament*, a biologically-based tendency such as the ease or difficulty with which a child approaches routine and novel situations.**
- ***Fine and gross motor development*, including child's ability to sit, walk, run, and handle small objects.**

Outcomes related to child development

Psychological development refers to the emergence of skills and competencies that help a child adapt and function in his or her environment. These skills and competencies become more complex as the child ages and matures.

Assessing children's developmental status poses several problems because the process is complex and always affected by the cultural context. The impact of child development interventions is typically assessed by standardized tests of cognitive and motor development in infants and young children. Also used are observational assessments of behaviours related to development, learning, social interaction, or subsequent performance in school, and prevalence of mental deficiency. The tests used to assess pre-school ability have mainly been designed in industrialized, Western countries. Unless they are adapted for content and format, and standardized locally, they are subject to inaccurate interpretation. However, as noted by Pollitt (1998), the problems with externally designed tests may be less serious if testing evaluates programme progress (rather than children) or compares groups within a similar cultural context.

Unique difficulties arise in assessing cognitive abilities of infants. The most popular global assessments prior to 18 months of age, such as the Bayley Scales of Infant Development, are not particularly predictive of later functioning, whereas tests from 3 years onward are quite predictive (Pollitt, 1998). Available assessment tools for infants that are predictive of later performance tend to be time intensive and difficult to administer, particularly under field conditions. The term

psycho-motor development is used more often than cognitive development for infants because it is difficult to distinguish cognitive from motor development in children younger than 12 months.

Other dimensions of psychological development, such as social-emotional development, receive less attention, particularly outside the industrialized world. Yet, emotional adjustment is important for the child's capacity to learn and develop, as well as for cognitive, motor, and language development. Emotions are linked to physical conditions, including malnutrition (e.g. Lozoff, 1998).

A few aspects of social-emotional functioning have been evaluated outside of industrialized countries. Several studies have examined predictors of aggressiveness such as exposure to violence in the community (Liddell et al., 1994; Chikane, 1986). Quality of attachment—the unique and powerful affective relationship that develops between child and caregiver—is a significant predictor of many aspects of later functioning (e.g. Valenzuela, 1997). Attachment has been assessed in many different cultures, but some investigators have questioned whether the construct has cross-cultural validity. Relatively few other measures of social-emotional development have been examined in different cultural contexts.

Emotional adjustment is important for a child's capacity to learn and develop, as well as for cognitive, motor and language development.

Tools for evaluating the immediate environment of the child have been designed for use in research and programme evaluation (e.g. Bradley and Caldwell, 1984). These instruments include measures of family interaction, including social-emotional characteristics, parents' knowledge and practices related to childcare and feeding, and the quality of the home environment.

Caregivers have many types of interactions with children, such as washing, feeding, and carrying. All these care behaviours have both an instrumental (or task-related) and an affective (emotional) component. In addition to recording the instrumental activities, these tools also measure affective aspects, such as parental responsiveness, warmth, and encouragement of cognitive, language and motor development (Engle, Menon and Haddad, 1997; Engle and Riccuiti, 1995). Other aspects that are typically measured with instruments such as the HOME Inventory (Bradley and Caldwell, 1984) include avoidance of restriction and punishment, organization of the environment, provision of a safe play environment for the child, and opportunities for variety in daily stimulation. An adapted HOME Inventory has been used in a number of different cultural contexts (Bradley et al., 1989).

Long-term measures of individual outcomes

The long-term effectiveness of early child development programmes has been assessed by measures of functioning during later childhood, adolescence, and adulthood (Gomby et al., 1995). Variables measured include placement in special needs classes, school progress and achievement (grade levels passed and failed), functional or useful knowledge, earning potential, criminal record, and even marital status. Many researchers feel that these measures are more appropriate than IQ test scores, since they reflect important functional consequences of early experiences (Gomby et al., 1995). Although some of these measures will not be appropriate in all settings, a similar approach to assessing functional competence can be utilized in any environment (Pollitt et al., 1993).

Outcomes related to child growth

Child growth is an indicator of past and present conditions including food intake, health status, and activity levels, and a predictor of future impairments in health and performance that may result from poor nutrition in childhood. Growth is an important indicator of the impact of nutrition interventions because it is a relatively short-term outcome that can be measured in a standardized way and predicts a range of other functional out-comes. Weight is likely to show changes more rapidly than height.

Child growth is an indicator of past and present conditions including food intake, health status, and activity levels, and a predictor of future impairments in health and performance that may result from poor nutrition in childhood.

Child growth has been measured two ways: (1) rates of increase and increments over specified periods of time, and (2) attained size at a given point in time (e.g. weight-for-age, weight-for-height, and height-for-age, based on standardized indices).

Attained size measures of height-for-age and weight-for-height reflect different nutritional conditions. Weight-for-height usually reflects short-term variations in nutritional input, whereas height-for-age reflects longer-term or chronic conditions (WHO, 1995). In many studies, height-for-age is associated with cognitive growth, whereas weight-for-height is rarely associated with cognition (UNICEF, 1998). Weight-for-age is also associated with cognitive development, but less closely.

The effectiveness of interventions for pregnant women, designed to improve foetal growth, is measured by birthweight, differentiated into children born prematurely or at term. Children born below 2500 grams at term (40 weeks) are called *small for gestational age*, or SGA, and are likely to have suffered inter-uterine growth retardation (IURG). Children born prematurely are also likely to have low birthweight. The distinction between low birthweight and small for gestational age may be hard to ascertain if data on gestational age are not available. In situations in which low birthweight is caused by nutritional deficiencies in the mother, birthweight and cognitive performance have been linked, particularly among older children, but the data are not entirely consistent (Pollitt et al., 1996).

Assessing intermediate outcomes, such as diet or feeding practices, is also important when they contribute to understanding how the intervention had impact. A number of strategies for measuring feeding behaviour have been developed (e.g. Bentley et al., 1991; Engle et al., 1996). Selected biochemical indicators of nutritional status are relevant for this review when nutrition interventions were designed to improve micronutrient status.

Theoretical background for the review

The four key questions addressed by this review stem from extensive basic research on physical growth and psychological development. This basic work provides the rationale for interventions to improve growth and development. Although this review was not intended to revisit that evidence, the intervention studies included often refer to these theoretical underpinnings:

- Malnutrition causes both poor physical growth and developmental delays.
- Malnutrition—measured by growth faltering—is causally related to mortality in infancy and early childhood, and interventions that reduce the incidence of malnutrition can be expected to reduce mortality dramatically.
- There is evidence that in many communities with endemic malnutrition, both feeding practices and the selection of foods for infants and young children from the food sources that are available within the community are not optimal.
- In infancy and early childhood, when children are fully dependent on others for their nutrient intake, the *proximate* causes of malnutrition are: (1) receiving diets of poor quality and inadequate quantity, and (2) inappropriate feeding practices and behaviours related to food preparation, frequency, and interactions. There are, in turn, multiple socio-economic, cultural, and psychological determinants of these causes.
- Many households in conditions of poverty potentially have the resources to provide adequate diets and use good feeding practices that support normal growth. Lacking are the knowledge and skills about how to do this within their local environmental and cultural context.
- Many other households in conditions of poverty are more severely constrained economically and require assistance in the form of supplementary, nutritious foods and/or nutrient supplements for their infants and small children, and for consumption by mothers during pregnancy and lactation.
- Many children in developing countries and disadvantaged populations in industrialized countries experience delays in motor and cognitive development that negatively affect their school performance, their ability to maximise their educational opportunities, and their social functioning later in life.
- An important factor in developmental delays associated with malnutrition is the evolution of the interaction between the malnourished child and his or her caregivers, in which the child becomes progressively more apathetic and less demanding, and caregivers provide less stimulation and responsive interactions.
- Feeding is a central aspect of caregiving in infancy and early childhood, and the teaching of feeding skills provides an opportunity to teach other caregiving skills, such as responsive parenting to stimulate motor and cognitive development.

In summary, interventions to address malnutrition (improving food and feeding practices) and to promote child development (responsive parenting) are both important. There may be additional benefits of combining activities and integrating these interventions.

Steps or process by which interventions are developed

The development of an effective public health intervention, such as oral rehydration therapy (ORT) for diarrhoea, involves a sequence of research steps, each of which makes a different contribution to the formulation of the final intervention (Figure 1 from de Zoysa et al., 1998). The steps are dynamic and iterative. Not all steps are required for every intervention. However, an awareness of these steps helps to identify where the greatest research investments have been placed and which aspects have not received adequate attention.

The five steps most commonly found in the development of an intervention are:

1. Describe the problem.
2. Identify risk factors (such as biological and behavioural risk factors).
3. Explore the context and identify the determinants of the risk factors.
4. Select or formulate possible interventions.
5. Test the interventions in carefully controlled, double-blind efficacy trials (de Zoysa et al., 1998).

Successful clinical efficacy trials of an intervention do not mean it will also succeed as a public health intervention. Four additional steps are essential to determine the utility or effectiveness of the intervention under real-world conditions. Step 6 is to formulate the intervention for implementation in usual public health conditions, and Step 7 involves testing it under controlled conditions, but in a public health context. These steps can be labelled efficacy trials of public health interventions (de Zoysa et al., 1998).

The last two steps assess the effectiveness of the public health intervention. Step 8 is the evaluation of how well the intervention functioned as a large-scale public health programme, rather than a small-scale experiment. Finally, Step 9 is the continual monitoring and evaluation of the indicators for programme improvement.

Unfortunately, many public health interventions do not go through Steps 6 through 9. Often, interventions are scaled up without appropriate concern for effectiveness and are later found to be ineffective. In general, this review emphasizes community-based interventions. Thus, the studies analysed are primarily community-based efficacy trials (Step 7) and effectiveness trials (Step 8). However, some of the studies reported can be classified as clinical trials to test an intervention (Step 5).

Dimensions of research rigor to consider in evaluating interventions

There are three main dimensions in public health interventions that affect the rigor of the research, and therefore the analysis and interpretation of data. These dimensions also vary in relation to the steps in the research process described above:

Figure 1. Steps in the research process

Adapted from de Zoysa et al., 1998.

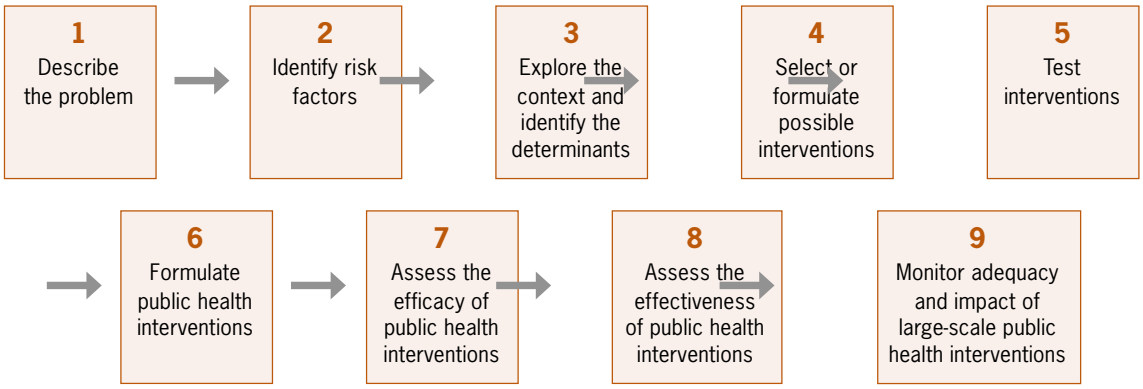


Table 1. Cross-cutting dimensions to consider in the interpretation of impact evaluations

Dimension	Issues that affect interpretation
Degree of control	■ Adequacy or fidelity of implementation: the degree to which the intervention is delivered as planned (e.g. verification that the supplement was actually consumed, home-visits conducted, etc.)
	■ Evaluation design: the degree to which the design controls for bias and confounding, allowing causal inferences (e.g. probability, plausibility, or adequacy designs)
Context and conditions	■ Appropriateness of intervention to the culture and the community
	■ Degree of risk if nothing is done and chance of benefit from intervention (affected by targeting, rates of participation, availability of resources)
	■ Appropriateness of the mode of delivery
	■ Specification of other conditions under which an intervention is effective or efficacious (i.e. effect modifiers)
Level of intervention	■ Interventions at the level of the individual, family, community, or society are affected by different numbers and types of intervening and contextual factors that influence impact

1. The degree of control in the delivery of the intervention.
2. The context and conditions in which the intervention is implemented, and the degree to which the intervention is appropriate to that context.
3. The level of the intervention in terms of how directly the input is related to the biological outcome. (For example, in vitamin A interventions, the most direct locus is represented by giving capsules directly to children; an intermediate locus is represented by an intervention to change the availability of vitamin A in the household such as home gardening; and a more distant locus is a food policy intervention that is intended to increase vitamin A in the food supply.)

We refer to these three as dimensions to emphasize the point that they are continua. Also, it should be noted that the dimensions are cross-cutting, and each dimension influences the others and has implications for the interpretation of results. Table 1 summarizes the main points to consider for each dimension.

Degree of control: adequacy of delivery and evaluation design

In identifying the degree of control in an evaluation, it is important to distinguish between efficacy and effectiveness. *Efficacy* refers to the impact of an intervention under ideal, controlled conditions. This is usually possible only within a research study, and has been referred to here as Step 7 in the research and development process. *Effectiveness* describes the impact under usual conditions, such as during implementation of a programme (Step 8). Even under field research conditions, the degree of control is not absolute and results must be interpreted in light of the context and conditions under which the intervention was implemented. It is important also to have an assessment of whether or not the intervention actually took place, an *adequacy* assessment.

It is logical to first review the evidence of efficacy when assessing potential impact of any type of intervention. If efficacy is established, then one should next consider evaluation studies of the effectiveness of full-scale programmes that include one or more of these proven approaches. We begin each of the intervention review sections with an examination of efficacy studies and then examine the results of effectiveness evaluations, recognizing that the dividing line between *model* and *full-scale* programmes, and between *efficacy* and *effectiveness* studies, is not always clear-cut.

In general, the degree of control over delivery is highest in model interventions that are developed to test efficacy. *Probability designs*, which are characterized by random assignment to treatment and control groups, allow for statistical determination of whether or not the intervention had an effect. Such randomized trials are the preferred design for demonstrating efficacy. *Plausibility designs* do not involve random assignment but achieve some degree of control by considering the relative impact either before and after or in groups

with and without the intervention. Such designs are used to establish whether or not the intervention had an effect above and beyond that caused by other external influences. In reviewing evidence for efficacy, we looked for studies with information indicating a high degree of control over implementation and that used probability or plausibility designs.

How well an intervention was actually delivered is an important consideration in the interpretation of results from efficacy studies and effectiveness evaluations. A lack of impact cannot be interpreted to indicate that the underlying assumptions or intervention design were incorrect without verifying that the implementation occurred as planned. Information on the fidelity or adequacy of implementation is considered in the interpretation of impacts reported in studies reviewed here.

How well an intervention is actually delivered is an important consideration in the interpretation of results from efficacy studies and effectiveness evaluations of nutrition and psychosocial interventions.

The degree of experimental control is much lower in full-scale programmes than in efficacy trials. Thus, the effectiveness evaluations identified by this review represent a lower degree of control over implementation, and evaluations assess programme effectiveness in a real-world context, with all the factors that limit or enhance implementation. The fidelity or adequacy of implementation must be considered to understand the factors contributing to the programme's success or lack of impact.

Context and conditions of the intervention

Closely related to the issue of degree of control is the appropriateness of the intervention for the context. Impact is influenced not only by the characteristics of the intervention, but also by the characteristics of the context where it is implemented, and how well they match. Thus, when reviewing efficacy trials one should discuss *contingent* efficacy because the impact seen is contingent on contextual issues, such as whether the intervention being tested is appropriate for that population.

An intervention proven to be efficacious may be ineffective if implemented in a programme that is unable to achieve adequate coverage, utilization, or sustainability. In other words, it is not only *what* type of intervention is applied that determines effectiveness, but also *how* and *where* the intervention is implemented, and to *whom*. An intervention that is effective in one setting cannot necessarily be transplanted successfully to another context without adaptation. Factors external to the specific intervention, such as existing infrastructure, policy, political and cultural context, may also influence effectiveness.

In summary, degree of control and the context, in combination, affect the degree to which impact can be attributed to a type of intervention. The strongest causal inference on impact comes from designs that deliver probability or high plausibility results and interventions that are appropriate to the context where they are implemented. If either of these conditions is not met in an efficacy trial, it complicates the interpretation. For example, a supplementation trial of women in New York City (Rush et al., 1980) was very well-designed and implemented to investigate causal relationships between dietary intake during pregnancy and birth outcome, but it was conducted in a population that was not actually deficient in the nutrients supplied. Thus, the results did not replicate findings in malnourished populations and contributed little to understanding of the role of supplementation during pregnancy in malnourished women.

Level of intervention: where in the causal pathway does the intervention occur?

The third main dimension that affects the interpretation of impact is the level at which the intervention occurs in the causal pathway leading to the expected outcomes. An intervention aimed at a cellular or a behavioural process may be implemented at the level of the individual, family, community, or society. The more distal the intervention is from the biological process or behaviour it is intended to affect, the greater the opportunity for intervening and contextual factors to affect its impact. As in the example above, if supplemental vitamin A capsules are given directly to children and no impact is seen, this could mean that the supplement was inactive, that the supplemented children did not have a deficiency of vitamin A, that the children lacked adequate retinol binding protein (due to protein energy malnutrition) or that vitamin A is not efficacious in improving the outcome of interest. If testing has eliminated the first three possibilities, stronger conclusions about the efficacy of vitamin A supplementation per se could be made.

On the other hand, if the intervention was a home gardening project, narrowing the field of possible explanations would be quite different. Intervening factors could have occurred, for example, at the level of family or community participation, access to land or inputs, success of the food production, consumption by the family, or consumption by the child.

Interventions on several levels will often be required to address population needs in order to support the improvement of child growth and development. In general, this review concentrates on interventions at the individual and family level because most of the model programmes designed to evaluate efficacy are implemented at this level.

Chapter 3

Interventions to support psychological development

This chapter reviews interventions aimed at improving the psychological development of disadvantaged or at-risk children and families, either through child centre-based education, or via home visits or other activities to improve parenting skills and stimulation within the home. We included programmes for low birthweight (LBW) and non-organic failure-to-thrive (NOFTT) infants, but excluded interventions targeted specifically to children with physical disabilities or organically-based mental disabilities. However, many of these programmes are designed to reduce developmental delays caused by inadequate nutrition, health, and socio-economic conditions.

All outcomes were related to psychological development. Psychosocial interventions, including stimulation, are described first, followed by nutritional interventions. Next, the chapter discusses efficacy trials of nutrition interventions that did not include any stimulation or psychosocial intervention, but that evaluated psychological outcomes.

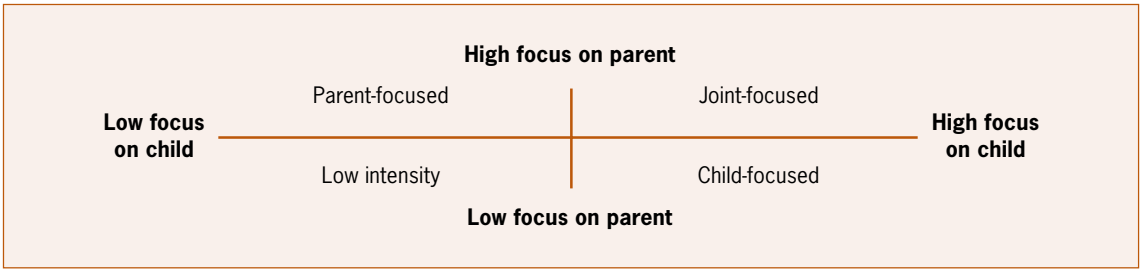
Impact of ECCD interventions on psychological development

Model programmes in the United States provide much of the evidence for the efficacy of early childhood care and development (ECCD) interventions. Although ECCD programmes abound in other parts of the world, there have been few efficacy trials outside the U.S. Examples of full-scale early education programmes that include a nutrition component (which is common for ECCD programmes, especially in developing countries) are described in Chapter 5.

The review examines whether and under what circumstances single-focused interventions are effective, but does not cover the extensive body of literature that compares different theoretical approaches, such as specific teaching methods. Although this information is essential for intervention development, it is outside the scope of this review. This literature is reviewed elsewhere (Ottenbacher et al., 1987).

The most common model for early childhood care and development programmes is *centre-based* pre-school education in which children are brought from their homes to a central location, such as a school, a community building or other public site, or in some cases, a private home. Other forms of psychosocial intervention improve the child's psychological development *within the context of the family and the home*. Meisels (1992) suggests that *centre-based* and *family-based* interventions can also be characterized as *child-focused*, *parent-focused*, or *joint-focused* as shown in Figure 2. Child-focused approaches involve high intensity (frequent, or many hours or weeks), direct interventions with children, whereas parent-

Figure 2. Dimensions of focus in early childhood care and development programmes
(from Meisels, 1992)



focused interventions involve direct contact with parents. Joint-focused programmes include high intensity components for both children and parents.

Behavioural changes for children and parents are expected impacts of these programmes. Although this review is limited to psychological development outcomes, such as performance on cognitive and motor tests, parenting behaviour and parents' life skills (e.g. education level) may be equally significant and mediate or provide the means by which interventions are effective, particularly those with a focus on parents. Evidence of the maternal benefits from early interventions has been reviewed by Benasich et al. (1992).

Child-focused interventions that provide psychosocial stimulation directly to the child

When psychological development activities in childcare centres are implemented with high quality, they consistently show a positive impact on cognitive function and IQ scores (Consortium for Longitudinal Studies, 1983; Haskins, 1989; Gomby et al., 1995; Hertzman and Wiens, 1996). Barnett (1995) cites reviews of programmes for disadvantaged children, including those implemented on a large scale, that can result in an average increase of about eight IQ points at programme completion. In addition, four recent re-search projects in the United States have found similar effects, especially the centre-based programmes (Barnett, 1995). Positive outcomes have been reported for programmes in other developed countries, including Ireland and Australia (Boocock, 1995).

Children who participate in early childhood care and development (ECCD) programmes show stronger performance on IQ tests. They are also less likely to repeat grades or be placed in remedial or special education classes.

To address the question of longer-term effects, Barnett (1995) reviewed 36 early childhood programmes in the U.S. that followed children to at least age 8. Children who participate in early child education programmes show stronger performance on IQ tests until they enter school, after which there is often a decline. However, other types of important long-term impacts have been documented, such as lower rates of grade repetition or placement of children in remedial or special education classes (Barnett, 1995; Hertzman and Wiens, 1996; Consortium for Longitudinal Studies, 1983).

One of the most carefully evaluated U.S. projects is the Perry Pre-school Program in Ypsilanti, Michigan, instituted in the early 1960s. As is characteristic of many children from impoverished backgrounds, the young children in the project initially appeared to have low cognitive ability, as judged by pre-school IQ tests. The intervention provided psychosocial stimulation and increased children's cognitive performance by the time they entered school. From this head start, they experienced greater success and commitment in school, which was reinforced by the perceptions of parents and teachers. The intervention eventually led to less deviant behaviour, higher educational attainment and other indicators of social development, even through 27 years of age (Schweinhart and Weikart, 1980; Schweinhart, Barnes and Weikart, 1993; Barnett, 1996).

A number of studies provide insight into programme and participant characteristics that increase impact, such as intensity and duration of programmes (Gomby et al., 1995; Hertzman and Wiens, 1996), and gender (Barnett, 1995). Although most pre-school programmes serve 3- to 5-year-olds, research on programme effectiveness and "neurological evidence that the environment influences infant brain development" (p. 15, Gomby et al., 1995), show that services begun during infancy have greater impact (Ramey and Ramey, 1998). Early Head Start, a new initiative of the Head Start Bureau in the U.S., reflects this perspective by serving children from 0–3 years of age (U.S. Department of Health and Human Services, 1993).

Opinions vary concerning the extent to which pre-school programmes have demonstrated long-term benefits (Gomby et al., 1995; Haskins, 1989) but there is enough evidence to suggest that such effects *can* be achieved with high-quality, intensive programming. The long-term results of pre-school, centre-based interventions must be interpreted in light of the poor home and school environments that disadvantaged children continue to experience after pre-school. Even participants in the most successful programmes are still at a considerable disadvantage compared to middle-class children. Results from programmes around the world provide evidence that "pre-school experience helps low-income children narrow, but not close, the achievement gap separating them from more advantaged children" (p. 94, Boocock, 1995).

Parent-focused interventions to improve parenting skills and psychosocial stimulation in the home environment

Many of the model interventions that are designed to improve parenting skills and aspects of the home environment are implemented through home visits. Programmes using home visits vary in goals, level of intensity, type of families served, and type of staff.

In the U.S., programmes to improve parenting skills have shown inconsistent and more modest effects on psychological outcomes than have child-focused programmes (Gomby et al., 1995). Programmes that provide weekly or less frequent home-visits are much less intensive than the child-focused programmes described above, so lower impact on the type of performance measured by IQ tests might be expected. However, home-visiting has been found to be an effective component of programmes targeting low birthweight and premature infants (Olds and Kitzman, 1993; Hertzman and Wiens, 1996), non-organic failure to thrive children (Black et al., 1995), and undernourished children in developing countries (Grantham-McGregor et al., 1991; Waber et al., 1981). Olds and Kitzman (1993) reviewed four randomized trials of home visiting interventions that were designed to work with parents to improve the psychological development of pre-term and low birthweight newborns. All of the trials found consistent evidence of increased psychological test performance.

In programmes directed to parents and children who are at social and economic risk, the results are more mixed. A review of 15 randomized trials with disadvantaged families found six with significant effects on psychological development of children. The programmes that had an impact on psychological development also demonstrated positive effects on parental caregiving, such availability of toys and books, mother-child interaction and verbalization, parental attitudes toward children, and behaviour management. In addition, two trials that did not find significant cognitive effects did, however, improve aspects of caregiving, such as responsiveness, teaching behaviour, and encouragement (Olds and Kitzman, 1993). There is also some evidence that benefits may extend to siblings of the target child (Olds and Kitzman, 1993; Seitz and Apfel, 1994), probably as a result of improved parenting skills and parent-child interaction.

Parent-focused interventions to improve child psychological development also demonstrate positive effects on parental caregiving, such as improved mother-child interaction and verbalization, parental attitudes toward children, and behaviour management.

The results of the review of these randomized trials show that programmatic aspects of delivery, as well as participant characteristics, are extremely important. Many of these programmes began the intervention with pregnant women or picked up children immediately after birth. The duration of the intervention was usually about two years. The frequency of home-visits ranged from weekly to monthly, with variation across programmes, and also within programmes depending on the age of child and the degree of need (St. Pierre et al., 1995).

The strongest impact was obtained in broad-based, comprehensive programmes that employed professionals as home visitors, rather than in narrowly-focused programmes that were implemented by para-professionals (Olds and Kitzman, 1993). Intensity (or frequency) is also important. A carefully designed trial on effectiveness related to frequency of home visits in Jamaica showed significant improvements with weekly visits, marginal effects with bi-weekly visits, and no effects for monthly visits. Frequency was more important than professional versus para-professional status of the home visitor (Powell and Grantham-McGregor, 1989).

Interventions that augment home visits with services such as centre-based early childhood care programmes show the greatest impact to psychological development.

In sum, parent-focused interventions show more impact on parenting behaviours, and child-focused interventions have stronger effects on children. Home visits are a promising strategy for addressing the constellation of social problems that contribute to unfavourable home environments. They have been most successful when directed to those with greatest needs, such as young mothers and families of low birthweight babies. Parent-focused interventions also have potential benefits for siblings and other family members. The greatest impacts were seen in programmes that augmented home visits with services such as centre-based early childhood care programmes (Gomby et al., 1993). This finding

led Weiss (1993) to conclude that home visiting is a necessary, but not sufficient, component of programmes to improve child well-being.

Social and cultural contexts are significant. As previously noted, most of the programmes with impact evaluations were U.S.-based. Poverty in the U.S. has changed over the past 30 years and is now more likely to be linked with lack of time for children due to single-parenting and employment of all parents, and social dysfunction such as alcohol and drug use, domestic conflict, and street violence (Hernandez, 1995). Families in developing countries have a lack of knowledge or skills, rather than social dysfunction. Because the proposed intervention provided knowledge and skills rather than attention to other existing social problems such as drug abuse, activities were more effective for families in developing countries than for high-risk families in the U.S.

Joint-focused interventions to improve parenting skills, and to provide psychosocial stimulation to children and supportive services to parents

Joint-focused programmes vary in the amount of direct attention given to parents and children. Some are fundamentally child-focused, in that they provide intensive centre-based services to children, but also provide supportive services to parents, possibly through parent meetings.

Some joint-focused programmes begin with home visits and then add centre-based care as the children get older. The Infant Health and Development Programme (IHDP) is a multi-site, randomized trial in the United States that was designed to test the efficacy of a comprehensive early intervention to reduce the developmental and health problems of premature, low birthweight infants. Activities were home-based in the first year of life. From 12 to 36 months the children attended an intensive centre-based programme five days a week, and regular group meetings were held for parents. At programme completion, the children in the intervention group scored significantly higher on IQ tests, and the odds of scoring in the range of significant developmental delay (below an IQ of 70) were 2.7 times higher for control children (IHDP, 1990).

Although it would be valuable to determine the relative benefit of the parent and child components of joint interventions, it is difficult to separate the effects of the different components, or to determine the advantage of intervening with both children and parents. In studies in which this has been possible, combined parent and child interventions have been found to be more effective than either one alone for children's psychological development. Project CARE in the U.S. found stronger effects on psychological development when the intervention combined intensive educational programmes for children with family support as compared with family support only (Miller and Bizzell, 1983, cited in Hertzman and Wiens, 1996).

Interventions that are both child- and parent-focused are more effective than either one alone for children's psychological development.

A study in Turkey examined the effects of pre-school programmes with educational components versus custodial daycare programmes versus staying at home. A training programme for mothers designed to help them foster cognitive development (using the Home Intervention Programme for Preschool Youngsters or HIPPY curriculum) and to become sensitized to the child's needs was assessed using each of these care arrangements. Attendance at an educationally-oriented pre-school programme and, to a lesser extent, mothers' participation in the home training programme, were associated with better scores on cognitive tests and school performance. The effects of the two combined interventions (parent training and educationally-based centre care) were the greatest (Kagitcibasi et al., 1988).

Greater degree of involvement with a programme has generally been associated with increased impact, but it is likely that more motivated parents are both more likely to be involved, and more likely to have better parenting skills anyway, thus requiring caution in the interpretation of findings. An evaluation of the impact of IHDP found that high child involvement resulted in the greatest impact on psychological development, regardless of the level of parental involvement. High parental involvement plus high child involvement resulted in the largest improvement in scores on a home environment evaluation protocol (Liaw et al., 1995).

Other approaches to serving both children and parents are *two generation programmes*, such as Even Start and the Comprehensive Child Development Program. Two-generation programmes are based on a relatively new approach in the U.S. that provides early childhood education to children and provides training on parenting skills, as

well as services such as education, literacy, or job training to help parents improve their economic situation (St. Pierre et al., 1995). These programmes integrate services to parents and children with the aim of having a longer-term impact on both. However, since the programmes are recent, no longer-term evaluations are available.

Programmes that combine early education and family support have been reported to reduce the risk of antisocial behaviour and chronic delinquency by improving parenting behaviours, enhancing mothers' life and job opportunities, and improving verbal abilities of children (Yoshikawa, 1995). However, a review of six *two generation* programmes found more limited effects (St. Pierre et al., 1995). Of the four programmes that evaluated psychological development, only one showed significant effects. The lack of effect on psychological development may reflect the fact that the education component for children was limited to home visits prior to age 4, and then Head Start for most of the programmes. Some programmes simply referred clients to services provided by other organizations, resulting in little consistency in the quality and frequency of child education activities provided (Gomby et al., 1995; St. Pierre et al., 1995).

Five of the programmes documented positive effects on parenting behaviours, and three were able to produce significant differences in the percent of mothers who obtained a high school diploma. However, these increases in educational attainment were not reflected in income, and only one showed an impact on employment (St. Pierre et al., 1995). Two-generation programmes were successful in increasing the participation of children and their parents in relevant social and educational services. As with other programmes, the greater the child or parental participation, the greater the impact (St. Pierre et al., 1995).

St. Pierre et al., (1995) conclude that (1) effects on children can only be maximized through high-intensity interventions with children; (2) effects on parents require quality services directed to parents, and (3) evidence is lacking on the efficacy of achieving effects on children solely through interventions with parents. They caution that high-quality, intensive services targeted to both children and parents will be expensive, but balance this against costs of remedial programmes, which are also expensive. Finally, they suggest that while there has been considerable research on the characteristics of high-quality early childhood care and development programmes, further research is needed to discover more innovative approaches to interventions for parents. It should be noted that the interventions reviewed by St. Pierre and colleagues are almost exclusively in developed countries, and their applicability in developing countries remains to be determined.

Effectiveness of ECCD programmes

There are many effectiveness studies of ECCD programmes that examine quality and impact when these programmes are taken to full-scale implementation. In this review, we provide a few examples of programme effectiveness in different contexts.

As is true of efficacy trials, U.S. pre-school programmes provide much of the current knowledge on the effectiveness of full-scale early childhood interventions. Of these, Head Start has been the most broadly implemented and evaluated. Recent studies compared the performance and progress of Head Start participants to non-participants with similar backgrounds. These studies have demonstrated important impacts of the Head Start programme on children (Lee et al., 1988; Currie and Thomas, 1995). A review of various full-scale child development programmes in the U.S. found positive effects on *pre-school psychological test scores*, although they were smaller and less consistent than those found for model programmes (Barnett, 1995). The *long-term effects* of these full-scale programmes on school progress were more favourable, however, with eight of 10 studies finding statistically significant reductions in grade retention or special education placement (Barnett, 1995).

In a review of research on cost-effectiveness, Barnett and Escobar (1989) concluded that a variety of early childhood education interventions are effective, and these interventions for disadvantaged children are sound public investments. They note a lack of research on the links between programme characteristics, the context of children's lives, costs and outcomes. One example of the importance of the context of children's lives comes from Brooks-Gunn et al. (1993). They found that characteristics of the neighbourhood, especially presence or lack of affluent neighbours, were associated with childhood IQ, teenage births and likelihood of leaving school early, even after

Early childhood education interventions for disadvantaged children are effective and a sound public investment.

adjustment for family socio-economic status (SES).

Although significant efforts have been made to review the information on programmes outside the U.S., these reviews have been hampered by the lack of well-designed evaluations (Young, 1996; Myers, 1992). Noting the difficulty in making definitive statements, Young (1996) concludes that early childhood interventions are linked to such benefits as higher scores on tests of cognitive function, higher school enrollment and lower rates of grade repetition and drop-outs.

Impact of nutrition interventions on psychological development

This section examines the effects of nutrition interventions on psychological development. These interventions were exclusively nutritional and did not involve ECCD. (Combined ECCD and nutrition interventions are described in Chapter 5.) Unlike the previous section, much of the research reported here was conducted in developing countries.

Improving nutrition through supplementary feeding

The lack of knowledge about the importance of dietary quality lead early investigators to focus primarily on the effects of increased macronutrients (energy and protein) on children's psychological development. In these supplementary feeding interventions, the subjects (or in some studies, their families) were provided with extra food, with the intention of examining the effects of greater dietary intake on physical growth and psychological development. The results of these interventions suggest unequivocally that "there is evidence to support nutritional effects on behaviour independent of social and environmental factors" (p. 2243S, Gorman, 1995; also Martorell, 1997; Walker et al., 1998). Specifically:

- Supplementary feeding of women when they were pregnant (Joos et al., 1983) and/or lactating has shown strong and consistent positive effects on motor development of infants. Effects on children's psychological development are more evident from 18 months onward than prior to 18 months (Gorman, 1995; Pollitt and Oh, 1994; Grantham-McGregor et al., 1991; Husaini et al., 1991; Pollitt et al., 1993; Waber et al., 1981).
- Supplementary feeding of infants and young children has resulted in significant increases in "broad measures of cognitive development" (p. 2241S, Gorman, 1995). This has been consistently demonstrated in spite of variations in measurement instruments and in intervention models (Pollitt and Oh, 1994; Grantham-McGregor et al., 1991; Husaini et al., 1991; Pollitt et al., 1993; Waber et al., 1981; Engle et al., 1992).
- Longer-term impacts of early supplementation have been reported in several studies. Pollitt et al. (1993) found that participants who received a high-energy protein supplement (prenatally and in early childhood) performed better on numerical knowledge, functional knowledge, vocabulary and reading achievement in adolescence than those who received a low-energy, no protein supplement. Impacts were greatest among participants from the most needy families and among those given more schooling opportunities. Chavez, Martinez, and Soberanes (1995), in a follow-up of a small sample from Mexico, also reported long-term significant effects of early food supplementation.

Mechanisms for effects of malnutrition on development

How improvements in nutrition operate to affect psychological development is not well understood (Gorman, 1995; Meeks-Gardner et al., 1995). The information provided by supplementation trials does not provide definitive answers to questions of possible mechanisms (Gorman, 1995). However, three decades of research on linkages between malnutrition and behaviour has led to significant changes in the theoretical models of how nutrition could affect brain function. In the 1960s, "it was feared that malnutrition endured during certain sensitive periods in early development and would produce irreversible brain damage, possibly resulting in mental retardation and an impairment in brain function" (Levitsky and Strupp, 1995). In their recent review of non-human animal studies, Levitsky and Strupp conclude:

> We now know that most of the alternations in the growth of various brain structures eventually recover (to some extent)…. However, recent neuro-pharmacological research has revealed long lasting, if not permanent, changes in brain neural receptor function resulting from

> an early episode of malnutrition. …The kinds of behaviours and cognitive functions impaired by malnutrition may be more related to emotional responses to stressful events than to cognitive deficits per se, the age range of vulnerability to these long-term effects of malnutrition may be much greater than we had suspected, and the minimal amount of malnutrition (hunger) necessary to produce these long-term alternations is unknown." (p. 2212S)

The most consistently observed effects of gestational or lactational malnutrition in animals are changes in motivation, increased emotional reactivity and less ability to learn new things from the environment (Strupp and Levitsky, 1995). These emotional and motivational effects have been reported in many animal studies. Animals, like humans, tend to be stressed by novel situations, aversive reinforcement such as electric shock, or loss of a reward (Smart, 1998). Malnutrition seems to lower the animal's threshold of arousal, resulting in more intense reactions to unpleasant stimulation or a more frequent expression of emotionality or anxiety in situations that evoke stress. Strupp and Levitsky (1995) suggest that in addition to direct effects of malnutrition, deficits in cognitive function may occur because an animal that experiences a protracted period of malnutrition learns to interact less fully with the environment, or experiences the poorer caring environment provided by a depressed and malnourished mother.

Timing and duration of supplementation

In her review of the effects of nutrition supplementation on psychological development, Gorman (1995) concluded that gestation and the first two years of life are the most important periods for supplementation, and that longer duration of supplementation is also associated with better outcomes. Similarly, Pollitt (1996) concluded that greater impacts on cognitive outcomes were seen with earlier and longer supplementation. His generalizations are based on comparative analyses of supplementation trials in Guatemala and Colombia that initiated supplementation at different times (ranging from prenatal to 72 months) and for different durations. However, very early supplementation has been shown to have negative results, possibly because it interferes with breastfeeding. In the Guatemalan study, supplementation was very limited until children were in their second year, due to a cultural pattern of extended exclusive breastfeeding. Therefore, it probably did not replace breastfeeding (Pollitt et al., 1993). In a longitudinal study in Bogota, Colombia, supplementation during the first six months was not associated with cognitive outcomes, and subjects who began supplementation after 6 months of age actually performed better than those who began earlier (Waber et al., 1981).

Gorman (1995) and Pollitt (1996) draw attention to the positive effects of nutrition interventions after early childhood. The interpretation of results must take into account the chronological pattern of malnutrition in different populations. In some parts of the world, children are at risk of malnutrition mainly in infancy and early childhood, whereas in other places a combination of dietary characteristics and practices, and disease patterns result in a much longer period of vulnerability.

There is some flexibility in the capacity of children to respond to the timing of nutrition supplementation; there is not a single point beyond which improved nutrient intake will have no effect. However, this generalisation does not necessarily hold for micronutrients, for which critical periods are more clearly defined. These issues are discussed later in the chapter.

Activity levels and behavioural responsiveness

Pollitt et al. (1993) have proposed that the association between nutritional status and psychological development may be mediated by motor maturation, activity level, and exploratory behaviour. This is consistent with the data showing significant effects of supplementation on motor development in infants.

In a longitudinal intervention study in Mexico, supplemented infants were shown to be more active and to spend much more time playing and less time being carried or restricted in a crib (Chavez et al., 1975). As they grew older, they spent more time talking and less time crying than un-supplemented children did. These behaviour patterns, in turn, led to changes in parental behaviour such that supplemented children received more care and attention from both parents, were spoken to and listened to more, and received more instructions, praise and rewards. Supplemented children also scored higher on tests of psychological development (Chwang et al., 1995).

In Indonesia, a short-term (14 weeks) trial of supplementary feeding of infants found signifi-

cant impacts on motor (but not mental) development scores (Husaini et al., 1991).

Analysis showed that effects of supplementation on motor development were independent of, rather than mediated by, effects on weight. The authors hypothesise that the additional energy independently resulted in both the "accretion of adipose tissues and neural activation that broadened children's behavioural repertoire" (Husaini et al., 1991).

In the Jamaican supplementation trial with children aged 9-24 months (described in Chapter 5), the stunted children were less active than non-stunted children at the time of enrollment, and activity levels were correlated with locomotor development. The difference in activity level disappeared by the 6-month follow-up, regardless of whether or not the children were supplemented. Nutritional supplementation had a positive effect on psychological development, but there was no evidence that this effect was mediated through increased levels of gross motor activity (Meeks-Gardner et al., 1995). Grantham-McGregor (1995) has suggested that activity level *per se* is not the critical factor, but rather the *quality* of the child's exploration, which relates to the environment in which the activity takes place.

Issues in defining mechanisms

A number of methodological and theoretical issues must be considered when interpreting the effects of improved macronutrient nutrition on psychological development. The validity and relevance of the measures of psychological development must be considered. Several authors have suggested that the developmental scales used, particularly those related to psychological development in infancy, may not measure the indicators that are most sensitive to nutritional insult or most predictive of later achievement (Gorman, 1995; Husaini et al., 1991).

Most of the studies were not able to randomize controlled trials. The studies cited here can be characterized as *high plausibility* designs (de Zoysa et al., 1998). Treatments were assigned randomly, but often by community rather than by individual. With this design, it may not be possible to control for all potential differences among communities even with statistical controls. Re-analyses of data from the trials in Guatemala, for example, indicated that despite similarity of the villages regarding children's growth and dietary patterns, there were some differences in social and economic characteristics (Engle et al., 1992; Pollitt et al., 1993).

In many of these studies, researchers had difficulty determining that there was actually a net increase in nutrient intake, even when the intervention was implemented under relatively controlled field conditions. Therefore, it is difficult to determine whether there is a dose-response relationship between nutrient intake and psychological test scores (Gorman, 1995). Finally, in order to isolate the effects of energy and protein supplementation, many of these studies provided micronutrient supplementation to both treatment and control groups. It is not known how micronutrients may have complemented the effects of the food supplements on children's development.

An important theoretical issue is the degree of undernutrition and deprivation in the population. Most of these studies were implemented in populations with chronic undernutrition and a high prevalence of stunting among children. The greater the malnutrition, the greater the potential for response (Pollitt et al., 1993).

Another important issue concerns the availability of resources to complement the provision of food from an external source. For example, in Bogota, the strongest effects of the intervention were seen in children from homes with greater resources, such as higher levels of maternal education (Waber et al., 1981). Gorman (1995) suggests that both need (e.g. poor socio-economic status) and resources (e.g. maternal education) interact to improve the outcome of nutrition interventions.

Supplementary feeding interventions can significantly improve psychological development in young children, and these effects can persist over time.

Despite the methodological and theoretical problems that affect interpretation, these studies provide consistent evidence that supplementary feeding interventions are efficacious in significantly improving psychological development in young children, and that that these effects can persist over time.

Rehabilitation of severely undernourished children

Severely malnourished children score poorly on tests of psychological development and exhibit

behavioural abnormalities that could affect learning (e.g. apathy and reduced exploration of the environment) (Grantham-McGregor, 1995). However, few studies have assessed the effects of nutrition rehabilitation following an episode of severe malnutrition on psychological development. It is very difficult to establish a causal relationship because the effects of the acute episode of undernutrition cannot be separated from the children's poor home environments, which often provide inadequate stimulation and care, as well as inadequate diets. In theory, this question would be addressed by randomized assignment to dietary or stimulation interventions. However, such studies obviously cannot be conducted on ethical grounds.

Grantham-McGregor (1995) reviewed the available evidence and reported that developmental test scores of severely malnourished children are usually extremely low, but scores tend to improve shortly after these children recover from the acute malnutrition. Thereafter, however, performance remains low compared to that of matched controls or siblings. No specific type of deficits have been demonstrated to be associated with acute malnutrition, and she postulated that the acute episode probably adds little to the effects of the underlying chronic undernutrition and deprived environment.

Correction of micronutrient deficiencies

Diets that are low in energy and protein are nearly always deficient in at least some micronutrients, and poor dietary quality is also a significant contributor to malnutrition of children in the developing world. This section reviews studies that have examined how correcting micronutrient deficiencies affects psychological development.

Iodine

Iodine deficiency during pregnancy results in the birth of babies with severe retardation of physical growth and psychological development (cretinism). These severe effects of intrauterine iodine deficiency (IDD) are irreversible (Levin et al., 1993). There is also considerable evidence that even milder forms of the deficiency, in utero, are associated with lower scores on psychological tests. Children and adults who are iodine deficient tend to be cognitively limited compared to those who are iodine replete. Based on a meta-analysis of 18 studies, Bleichrodt and colleagues found that the mean cognitive scores for iodine-deficient groups of children and/or adults was about 13 IQ points lower than those of non-deficient groups (Bleichrodt and Born, 1994; Bleichrodt et al., 1996).

The efficacy of prenatal iodine supplementation in correcting and preventing IDD is well accepted and internationally recognized (ICN, 1992*[1]). In Ecuador (Fierro-Benitez et al., 1989*), children whose mothers had received iodized oil prior to the second trimester of pregnancy demonstrated better school performance than controls, although both groups had impaired performance. Controlled randomized trials in Papua New Guinea demonstrated that injecting pregnant women with iodized oil can prevent cretinism in their children (if women receive injections prior to pregnancy), and reduce stillbirth, infant mortality and defects in motor performance of apparently normal children (Conolly et al., 1979*). Whereas the effects of iodized oil injections were shown to persist for three to four years or longer, oral doses of 1ml are considered to provide protection against IDD for one year, and doses of 2 ml provide coverage for three years.

Iodine supplementation during pregnancy is critical, particularly in iodine-deficient areas.

Iodine deficiency during childhood also seems to affect cognitive function, although to a lesser degree than in utero. In Bolivia, school children were randomly assigned to receive oral iodized oil or a mineral oil placebo (Bautista et al., 1982*). Improved iodine nutrition and psychological performance were seen in both groups, but there were no differences between groups. This finding was interpreted to reflect the contamination of the village environment with iodine, probably due to urinary excretion by treated children. Shrestha (1994) conducted an iodine supplementation trial among schoolchildren in Malawi and found that supplementation resulted in significant improvements in psychological development.

These results suggest that in iodine deficient areas, supplementation during pregnancy is critically important. Evidence for the effectiveness of iodine supplementation during childhood on psychological development is mixed, but supplementation of school children, particularly girls who will be mothers, is recommended.

[1] All references marked with an asterisk are included as cited in Hetzel, 1989.

Iron

Iron deficiency anaemia (IDA) in infants and young children is associated with significantly lower scores on psychological tests (Pollitt, 1993a; Lozoff et al., 1991; Lozoff, 1998). Pollitt noted that deficits of 0.5 to 1.5 standard deviation units in scores on infant development scales or IQ tests of children have been found quite consistently across studies and age groups. Moreover, these effects of iron deficiency anaemia during infancy are associated with lower developmental test scores at 5 years of age (Lozoff et al., 1991) and have been shown to have effects during school age in studies in France, Israel, and the U.S. (summarized in Lozoff, 1998), even controlling for other differences between children and families. Studies of less severe iron depletion have found psychological impairment less consistently (Idjradinata and Pollitt, 1993; Soewondo et al., 1989).

Iron deficiency anaemia in infants and young children is associated with significantly lower scores on psychological tests.

The question of whether the consequences of iron deficiency anaemia can be reversed or prevented is critical given the consistent findings of long-term effects of IDA. The data regarding the reversibility of psychological deficits among young children with IDA does not provide a clear answer (Lozoff, 1998). Some studies have found significant improvements on some developmental test scores after supplementation (Oski and Honig, 1978; Idjradinata and Pollitt, 1993; Soewondo et al., 1989; Aukett et al., 1986). Other studies have not (Lozoff et al., 1991; Lozoff et al., 1982; Walter et al., 1989). In five more carefully designed studies, one has shown a strong positive effect (Idjradinata and Pollitt, 1993), two studies have shown effects only among children who have clearly improved in iron status after treatment, and two showed no effect after treatment regardless of hematological status (summarized in Lozoff, 1998). On the other hand, most studies have suggested that iron supplementation among school-aged children leads to improved school performance (Watkins and Pollitt, 1998).

The second key question is whether prevention through iron supplementation can be effective in eliminating cognitive delays by limiting iron deficiency anaemia. Moffatt et al. (1994) randomly assigned iron-fortified or non-fortified formula to a group of low-income infants in Canada and found that the fortified formula prevented the decline in psychological development scores seen among control children. The scores of the children in the control group improved at 15 months such that differences between the groups disappeared. No effects on mental scales were seen. Results of an investigation in Chile should provide additional answers to this question (Lozoff, 1998).

In iron intervention studies, it is important to control for compliance because the recipients of supplementation suffer more side effects and are therefore less compliant than the control group. For example, Aukett et al. (1986) found a much higher impact of supplementation when compliance was statistically controlled.

How iron deficiency affects psychological development is under debate. There may be direct effects on brain development. Lozoff (1998) and Roncagliolo et al. (1996) have proposed that iron deficiency during the first year of life, when the brain grows most rapidly, may result in permanent harm to psychological functioning. They suggest that iron deficiency may result in inadequate myelination of the central nervous system. Children with IDA have also been found to be fearful, wary, hesitant, restless, and less happy in several studies, which may also affect test performance and learning (Lozoff, 1998). It is still not clear whether IDA affects specific cognitive processes (related to different types of learning, problem complexity, information load, etc.), generalized intelligence, or attention and motivational factors that affect test performance (Lozoff, 1989; Soewondo et al., 1989; Pollitt, 1993).

Iron supplementation interventions that successfully improve the iron status of infants and young children with iron-deficiency anaemia can improve performance on tests of psychological development, although not always to the level of children who have not suffered anaemia. From a public health perspective, this is important because a substantial proportion of children in developing countries experience iron deficiency to some extent. Lozoff (1998) concludes, "even though questions about causality and reversibility with treatment remain, it appears that iron-deficiency anaemia identifies children at risk for long-lasting developmental disadvantage relative to peers." (p. 179)

Zinc

A review of the few studies available on the impact of zinc supplementation (Golub et al., 1995) found little evidence of an effect on psychological development. However, Friel et al. (1993) reported an impact on motor development scores of very low birthweight (<1500 g) babies supplemented with zinc. Zinc supplementation for periods of one to seven months has resulted in increased activity levels among children aged 12–13 months in India (Sazawal et al., 1996) and infants aged 6-9 through 11–14 months in Guatemala (Bentley et al., 1997). The relationships among zinc status, activity patterns and psychological development merit further investigation.

Other micronutrients

Evaluations of direct effects of other micronutrient interventions on psychological development have not been reported. It is reasonable to assume that the well described disability and morbidity that results from some micronutrient deficiencies would have effects on learning ability and access to education (Levin et al., 1993).

Effects of breastfeeding on psychological development

A number of recent studies have found significant associations between breastfeeding and psychological development of children (de Andraca et al., 1998). However, identifying the mechanisms for these associations is difficult. First, breastfed and non-breastfed infants differ on many characteristics that may be associated with the choice of whether to breastfeed, such as degree of prematurity or perceived weight (Doan and Popkin, 1996). Second, the formula given to non-breastfed infants varies considerably by study, depending on the kind of formula available when the study was performed. Third, mothers who choose to breastfeed differ on educational as well as personality dimensions from those who choose not to breastfeed, and these subtle differences are probably associated with parenting styles that affect psychological development of children. Finally, the act of breastfeeding itself may have significant impacts on children's development. Because breastfeeding mothers tend to differ from non-breastfeeding mothers on hard-to-measure variables, and because breastfeeding cannot be randomly assigned, it is doubtful that a conclusive test can be designed to show breastfeeding improves psychological development (de Andraca et al., 1998).

Data from seven studies of the effects of breastfeeding on psychological development during infancy and at later ages were summarized by de Andraca et al. (1998). These studies indicate significant differences in the test scores of the children ranging from 4 to 10 IQ points, but these differences diminish, and in some cases disappear, when differences in families' education and economic level are statistically controlled (e.g. Rogan and Gladen, 1993, Morrow-Tlucak et al., 1988; Bauer et al., 1991). Given the limitations of research designs to test the hypothesis conclusively, the results are open to alternative interpretations (Uauy and de Andraca, 1995).

Some mechanisms proposed to explain psycho-neurological differences between breastfed and artificially-fed children relate to the presence of components in breastmilk such as long-chain lipids that are important for structural development of the nervous system (Lanting et al., 1994). Another proposed mechanism is improved mother-child communication and interaction, which lead to enhanced psychological development (de Andraca et al., 1998).

The act of breastfeeding itself increases the quality of the mother-child interaction, and impacts positively on the child's development.

In general, beneficial effects of feeding human milk to children appear to be more evident for low birthweight pre-term infants than term infants. Lucas et al. (1992) examined the effects of breastmilk on pre-term infants, independent of breastfeeding. Infants (< 1,850 g) fed breast milk by tube in early life had higher cognitive scores at 18 months and at 7–8 years of age than those who did not receive breast milk. Three groups were defined: infants whose mothers chose to express breastmilk for feeding, infants whose mothers chose not to give breastmilk, and a third small group of infants whose mothers wanted to provide breastmilk but were unable to do so. It should be noted that the formula was not fortified to the level that is currently recommended. This study can be characterized as a *plausibility study* that attempted to control for other possible explanations statistically when random assignment was not possible. Despite efforts to control for socioeconomic status and mother's education, the authors admit that their procedures might not

fully control for differences in parenting and genetic endowment. However, they argue that the evidence for a role of breastmilk in psychological development is strengthened by the demonstration of a dose-response relationship between the proportion of diet supplied by breastmilk and the outcomes. Further, children whose mothers wanted to express breastmilk but were not successful did not differ on test scores from children whose mothers chose not to provide breastmilk. Therefore, the authors suggest that breastmilk, rather than individual differences between mothers based on breastfeeding choice, should explain these results.

A definitive test of the psychological effects of breastfeeding has not been possible given the difficulties in constructing a *probability design* noted above. However, studies have shown that infants are highly sensitive even in the first week of life to stimuli related to breastfeeding. For example, they can differentiate the smell of their own mothers from other women, particularly the smell of breastmilk (Porter, 1989; Varendi, Porter and Winberg, 1994). They respond to visual contact with the mother, which is more frequent during breastfeeding than bottle feeding (de Andraca et al., 1998). The hormonal system of the mother also responds to the stimulus of sucking and child presence (Jellife and Jellife, 1978). Thus, it is likely that the act of breastfeeding itself increases the quality of the mother-child interaction.

Nutrition education and growth promotion

To the best of our knowledge, there have not been any efficacy trials of nutrition education or growth promotion programmes in which psychological development was examined as an outcome. To the extent that such interventions are successful in improving diets of undernourished children, one might expect an effect on psychological development.

Interventions that provide information and motivation to improve child feeding practices could have an effect on child development through increasing responsive, positive interactions between the caregiver and the child (Engle and Ricciuti, 1995). A few programmes have begun to integrate parenting education or activities to improve caring behaviour into nutrition education, and an example is discussed in Chapter 4. Research trials of the impact of nutrition supplementation implemented in combination with early childhood development activities are reviewed in Chapter 5.

Chapter 4

Interventions to support physical growth

Impact of nutrition interventions on physical growth

This chapter examines the positive impacts that nutrition interventions have on measures of physical growth, such as birthweight, weight-for-age, weight-for-height, height-for-age, or increments in weight or height. Physical growth as an outcome is important because of the evidence linking poor growth to subsequent morbidity, mortality, and lower performance in work capacity and school achievement (Martorell, 1995). Our emphasis here on physical growth does not imply that growth per se is an essential goal of interventions to improve child well-being, but that the various measures of physical growth are valid indicators of past and present nutritional deprivation, and of future outcomes of functional significance, such as school achievement or employment.

Various measures of physical growth are valid indicators of past and present nutritional deprivation, and of future outcomes of functional significance, such as school achievement or employment.

Supplementary feeding of pregnant and lactating women

Energy intake has a well-established direct causal impact on intrauterine growth (Kramer, 1987) and maternal undernutrition is one cause of low birthweight (LBW). A clear example of this comes from a study of the Dutch famine during which sharp drops in energy intake resulted in decreases in maternal weight and subsequent reductions in birthweight (Stein and Susser, 1975; Susser, 1991).

As noted in Chapter 3, food supplementation has been the main method used to demonstrate the effects of improved energy and protein intake on physical growth. Several studies have been conducted to show the effect of supplementary feeding of pregnant women on intrauterine growth. A recent review of seven trials shows that supplementation was associated with increases in maternal weight gain and mean birthweight, and a decrease in the number of small-for-gestational age (SGA) babies. A recent community-based trial found that supplements delivered to pregnant women in Gambia through a primary health care system resulted in a significant increase in mean birthweight. This effect was particularly marked in *hungry season*, when the rate of LBW was reduced by 33 percent (Ceesay et al., 1997).

Susser (1991) concluded that the expected mean change in birthweight associated with food supplementation is 300–400 grams in a famine situation, 50–90 grams in undernourished populations in developing countries, and about 40 grams in socially-deprived populations in developed countries. Pinstrup-Anderson et al. (1993) estimated that increased energy intake can impact birthweight by 8–34 grams per 100 000 kcal ingested. The latest review of the evidence from randomized, controlled trials concludes that the mean change in birthweight from supplementation is about 100 grams (de Onis et al., 1998).

How supplementary feeding affects birth outcome is unclear. Susser (1991) found that maternal diet had a stronger effect on birthweight than maternal weight gain had. While some reviewers (Kramer, 1993; Gülmezoglu et al., 1997) cite the lack of a consistent relationship between the impact of supplementary feeding and the *degree* of pre-pregnancy undernutrition, others (Pinstrup-Anderson et al., 1993) note that a greater benefit is seen among women who are more malnourished.

One explanation for the lack of consistent conclusions is that, even among undernourished women, the extra intake from the supplements affects the mother and foetus differently. Supplementation of *moderately* malnourished women tends to increase birthweight without much impact on maternal weight, apparently because

energy is channelled to the foetus. Severely malnourished women, on the other hand, may not be able to *afford* channelling the nutrition to the foetus. As a result, supplementation has a greater impact on maternal weight gain and less on birthweight (Olson, 1994; Winkvist et al., 1994; Winkvist et al., 1998). Because previous studies have not examined this maternal versus infant impact, the effects of supplementation are not yet well described.

Most of the available studies used probability or high plausibility designs and were able to achieve a high degree of control over implementation. Usually there are other factors that cannot be fully controlled in field situations. The results of maternal supplementation studies are contingent on maternal nutritional status prior to supplementation. Take-home supplements are often shared with other family members, and on-site feeding may result in a reduced home intake. Thus, the net increase in intake is likely to be considerably less than the amount of supplement that was provided.

The effects on child growth of maternal supplementation during lactation have not been studied as extensively as has supplementation during pregnancy. There is evidence that supplementation of malnourished mothers can result in increased breastmilk production, as measured by infants' intake (Gonzales-Cossio et al., 1991), and such effects are presumed to bode well for infant growth. However, an impact of supplementation of lactating women on infant growth has not yet been clearly demonstrated.

Supplementary feeding programmes for children less than 5 years

Community-based efficacy trials

Community-based efficacy trials with a high degree of control over the intervention have shown significant effects of food supplementation on physical growth. In Indonesia, 90 days of supplementary feeding of infants aged 6–20 months produced significant improvements in children's weight-for-age (Husaini et al., 1991). A supplementation trial in Jamaica found significant effects on increments in weight and length (Walker et al., 1991). This study is discussed further in the chapter on the efficacy of combined nutrition and ECCD interventions.

Supplemental feeding of young children significantly improves weight- and height-for-age.

Evidence of both short and long-term effects of supplementation on physical growth comes from follow-up studies of the supplementation trials in Guatemala. Rivera et al. (1995) reported that children from villages in which a high protein-energy supplement (atole plus milk) was provided to children from birth to 3 years of age were taller and heavier both in childhood and adolescence than children from villages that received a low-energy, no protein supplement (fresco). The growth advantage was statistically significant for adolescent girls but not for boys. Differences between treatment groups at adolescence were greater than differences at age 3 for weight, but less than differences at age 3 for height. When height at age 3 was included in the model, differences in height at adolescence disappeared, demonstrating that the growth advantage in later years was accounted for by growth gains during the period of supplementation in early childhood.

Supplementation appears to reduce the harmful effects of infection on physical growth. Analyses of data from a supplementation trial in Bogota, Colombia, found a negative impact on length among unsupplemented children, but there was no impact of diarrhoea on growth among the supplemented children (Lutter et al., 1989). The impact of supplementation was small and not statistically significant among children with the lowest rate of episodes of diarrhoea. For children with the highest rate of diarrhoea, supplementation resulted in nearly a 5cm increment in height compared to the control group. Similar findings from Guatemala and Peru support the view that inadequate nutritional intake and diarrhoeal disease work together in negatively affecting child growth (Lutter et al., 1992). In Jamaica, Walker et al. (1992) found that reductions in linear growth associated with fever and lower respiratory tract infections occurred only among the unsupplemented children.

Even in a carefully designed supplementation trial for physical growth, full control over the intervention is not possible. The lack of control over the net increase in consumption is a key factor limiting the impact of food supplementation on growth in field-based efficacy trials. Due to substitution for the usual diet (for on-site feeding) and sharing or other uses of the supplement (for take-home supplementation), the actual increase in intake is always less than the amount of supplement provided. Other factors limit the ability to demonstrate an impact of supplementary feed-

ing. These include the prevalence of undernutrition among the participants, the children's age, the incidence of illness, and the potential for the additional energy intake to be used in increased activity rather than for growth.

Food supplementation programmes

Although provision of supplementary foods has been a component of numerous nutrition programmes, relatively few of these have been designed in a way that permits an assessment of the direct impact on physical growth. Reviews of the extensive literature on the subject have not always distinguished between evaluations of efficacy and effectiveness (Beaton and Ghassemi, 1982).

Habicht and Butz (1979) reviewed early large-scale supplementation trials to identify indicators for evaluating nutrition programmes. Of the nine trials reviewed, four showed significant impacts on physical growth, and the remaining five did not include information to verify that the supplement actually reached the target children. On the other hand, not all of those showing an impact included adequate controls for other potentially causal factors. This illustrates the difficulty in finding well-controlled efficacy trials of food supplementation, and the need for cautious interpretation of existing data. However, the authors concluded that there was some evidence that supplementation improved physical growth in populations with poor growth rates.

A recent review (Pinstrup-Anderson et al., 1993) restricted its scope to three studies in India, Colombia, and Guatemala that allowed estimations of the effect of food supplementation on physical growth. Comparison across studies was difficult due to variation in the age of children, degree of deficiency, and duration of supplementation. However, the effect on height was estimated to range from 0.8 cm to 5.0 cm per 100 000 kcal ingested, and the impact on weight from 40 to 800 grams per 100 000 kcal ingested. The authors concluded that supplementation significantly improved growth in weight and height.

Rehabilitation and feeding of undernourished children

Typically, community-based supplementary feeding programmes recruit children into a trial without regard to their initial height and weight. Thus, the samples include both well-nourished and malnourished children. On the other hand, studies of rehabilitation programmes provide evidence of the impact of supplementary feeding on children identified as malnourished. Much of what has been reported about nutritional rehabilitation is based on programmes in hospitals or special feeding centres for malnourished children and their mothers. Early evaluations, including the studies reviewed by Beaton and Ghassemi (1982), often suffered from a lack of an appropriate control group. This design flaw makes it impossible to distinguish the effect of treatment from changes that would have occurred anyway as most measures tend to move closer to the average over time (Kirkwood, 1988).

More recently, Rivera et al (1991) have demonstrated the efficacy of providing supplementary food to promote recovery from undernutrition. Guatemalan children aged 6–24 months who were moderately wasted[2] and consumed more than 10 percent of the daily recommended intake of energy from supplements recovered over a three month period, and much of this recovery was attributable to the supplement. Children receiving a low-energy supplement were significantly less likely to recover.

Rehabilitation programmes address only acute cases and do not prevent the incidence of mild to moderate malnutrition, as these children are not selected in screening procedures. However, if the rehabilitation programmes include nutrition education and other support for improved caregiving, they may prevent reoccurrence and may also protect other siblings.

Correction of micronutrient deficiencies

Improvement of physical growth is not the primary objective of most interventions to improve micronutrient status, but there is evidence that deficiencies of iodine, iron, zinc, and possibly vitamin A can contribute to poor growth. Demonstration of the efficacy of a micronutrient intervention should be based on (1) evidence that improvement of status does improve physical growth, and (2) evidence that interventions do correct the deficiency.[3] Most micronutrient inter-

[2] Moderately wasted at beginning of 3 month interval if < 90% weight-for-length, according to NCHS and WHO standards, recovered at end of interval if > 90% weight-for-length.

[3] Micronutrient deficiencies may also be corrected or prevented by encouraging greater dietary diversity; however, such efforts will not be covered here due to the lack of efficacy trials.

ventions represent both preventive and curative therapies (Levin et al., 1993) and impact may be demonstrated by recovery of deficient individuals or by reduced prevalence of poor micronutrient status in the population.

Iodine

Iodine deficiency diseases include a spectrum of disorders of which dwarfism, associated with mental retardation, is one of the most readily recognized. The effects of mild iodine deficiency are less well understood, but potentially affect a broader population. Although retarded physical growth is recognized as an outcome of iodine deficiency, the focus of most studies has been on the significant impacts on psychological development (as discussed earlier). In conditions where distribution and utilization of iodine-fortified salt is practical, the effectiveness of programmes that promote fortification and consumption of iodized salt is well established. Elsewhere, iodine regulation through injection or oral dosing has also been shown to be effective (Hetzel et al., 1987).

Iron

Maternal iron-deficiency anaemia (IDA) and pregnancy outcome

There is some evidence that iron-deficiency anaemia increases the risk of pre-term delivery and low birthweight, but not small-for-gestational age births (Scholl et al., 1992). We were not able to find efficacy trials, however, that demonstrated that iron supplementation during pregnancy prevents low birthweight. Two reviews of the literature on the factors that affect foetal growth identified only two trials of routine iron supplementation. Neither trial demonstrated an impact on birth size or gestational age, despite the effect of supplementation in increasing maternal serum ferritin and haemoglobin levels (Gülmezoglu et al., 1997; de Onis et al., 1998).

Childhood iron-deficiency anaemia (IDA) and physical growth

Iron deficiency anaemia in children is associated with mild growth retardation, which may be related to the role of iron in metabolism, immunocompetence (Chwang et al., 1988), or an effect of IDA on appetite (Levin et al., 1993). Several studies have found a positive effect of iron supplementation on growth of schoolchildren (Lawless et al., 1991; Chwang et al., 1988), but only one published study with pre-school-aged children was identified. Aukett et al. (1986) supplemented anaemic children age 17–19 months for two months and found a significantly higher rate of weight gain among treated children, as compared with controls.

Iron supplementation in infants and pre-schoolers for 2-4 months can virtually eliminate iron deficiency anaemia.

Numerous studies of the impact of iron supplementation on IDA in infants and pre-schoolers have found that two to four months of supervised supplementation virtually eliminates IDA in the treatment groups (Pollitt, 1993a; Lozoff et al., 1991; Soewondo et al., 1989). Shorter periods of supplementation were less effective. There is also evidence of the efficacy of food fortification. In past decades, when IDA was a more common problem among the paediatric population in the U.S., numerous studies demonstrated the effectiveness of iron-fortified formula in correcting or preventing iron deficiency among infants (Andelman and Sered, 1966; Gorten and Cross, 1964; Marsh et al., 1959; Ross Laboratories, 1970). Similar effects of iron-fortified formula and cereals have been confirmed more recently in a Chilean study (Walter et al., 1993; Pizarro et al., 1991).

Vitamin A

Vitamin A deficiency in experimental animals results in cessation of bone growth, weight loss, and loss of appetite (various references cited in Levin et al., 1993; West et al., 1988). Recent interest in the effects of vitamin A deficiency on morbidity and mortality have led to numerous controlled intervention trials of vitamin A supplementation of pre-schoolers, some of which have measured physical growth as an outcome.

A field trial of vitamin A fortification of monosodium glutamate (MSG) in five programme and five control villages in Indonesia found no effect on weight gain but a strong and consistent trend of increased linear growth among programme children (Muhilal et al., 1988). The mean increment in height between baseline and final exam (after 11 months) was significantly greater among programme versus control children ages 1 and 2 (about 1 cm), with a consistent trend among children aged 3, 4 and 5 years.

In contrast, a randomized (no placebo) community trial of vitamin A supplementation of children in Aceh, Indonesia, found an effect on weight gain among boys but no significant effect on linear growth. Mean annual weight increment was greater among boys in programme villages than in control villages and the differences were largest and statistically significant among boys aged 4 and 5 years, with similar effects on arm circumference. There were no consistent statistically significant differences in ponderal growth among girls, nor an impact on linear growth among either boys or girls. The authors note that these gender-specific results are internally consistent with findings of a greater impact of vitamin A supplementation on mortality among boys (West et al., 1988).

Three randomized double-blind (placebo-controlled) vitamin A supplementation trials have found no consistent effects on physical growth, despite achieving improved serum retinol levels. In India, mean annual growth increments for height, weight, and arm circumference did not differ between vitamin A-treated and control groups of pre-schoolers (Ramakrishnan et al., 1995). Trials in Ghana designed to assess effect on morbidity and mortality also included height and weight measures. Effects on linear and ponderal growth were inconsistent, and the only statistically significant finding was a mean weight gain of 3 grams per month less among the supplemented children aged > 36 months, not considered to be of functional significance (Kirkwood et al., 1996). Similarly, no significant effects on growth were seen in a vitamin A supplementation trial with infants and pre-schoolers in China (Lie et al., 1993).

Interventions to improve vitamin A status reduce the prevalence of xerophthalmia, decrease child mortality, and reduce the risk of severe illness.

Although both direct and indirect (via morbidity) mechanisms can be proposed to explain how the vitamin A status of children could affect physical growth, evidence to date does not show a consistent impact. It should be noted that these supplementation trials generally have excluded severely malnourished or vitamin A deficient children.

The studies cited above, as well as other vitamin A trials, have demonstrated the efficacy of supplementation in improving vitamin A status, even when no impact on growth was seen. There are many important benefits to justify widespread implementation of interventions to improve vitamin A status including reductions in prevalence of xerophthalmia, decreased child mortality, and reductions in risk of severe illness. Whereas it is not possible at this time to advocate vitamin A interventions as a means to improve growth, this does not imply that such programmes are not a worthwhile investment to improve child health and survival.

Zinc

A recent meta-analysis of the results of intervention trials of zinc supplementation in children (Brown et al., 1998) found small but highly significant effects on height (0.22 standard deviation, or SD) and weight (0.26 SD) with supplementation. The 25 studies included in the analysis were community and clinical trials with adequate intervention designs, in developed and developing countries, including studies of low birthweight infants, pre-schoolers and school children, but excluding adolescents.

Zinc supplementation can result in small, but highly significant, effects on height and weight.

An effect of zinc supplementation on height was found only for interventions with groups of children whose initial mean Z-score for height was less than -2.0, ie., moderately malnourished. In these subsets of stunted children the average improvement in height was considerable (0.49 SD). The effect on weight was found to be greatest in groups with low initial plasma zinc concentrations. The authors concluded that "there is now sufficient information to indicate that programmes to enhance zinc status should be considered as a potential intervention to improve children's growth in those settings with high rates of stunting and/or low plasma zinc concentrations" (Brown et al., 1988). UNICEF (1993) also concluded that zinc supplementation can improve growth among children with low zinc intakes or status.

The effects of zinc supplementation in pregnancy have also been examined. There are four randomized trials, involving a total of 1 400 women. The available data provide no convincing case for routine zinc supplementation during pregnancy (de Onis et al., 1998). More trials are

needed in selected communities at high risk of zinc deficiency, as well as in populations in developing countries where poor foetal growth is prevalent.

Supplementation is efficacious for increasing zinc intakes among vulnerable groups, although the best form (a number of zinc salts are available) and frequency are yet to be determined. Little information is available on the efficacy of zinc fortification or the most appropriate food vehicles. There are important issues that must be resolved related to the bioavailability of zinc and of other micronutrients whose bioavailability may be affected by zinc (UNICEF, 1993).

In summary, the evidence on how well physical growth is impacted by correcting micronutrient deficiencies is mixed. The prevention of cretinic dwarfism through iodine supplementation prenatally is incontrovertible. Evidence of an effect on growth is strong for zinc, in settings with high rates of stunting and/or low plasma zinc concentrations. It is also likely that iron supplementation may have an effect, possibly through improving appetite. Allen (1994), however, reviewed the literature on nutritional influences on linear growth and concluded that no single nutrient supplement (including energy, protein, or various micronutrients) had a major, consistent effect on linear growth. She identifies several issues related to design and sample selection that may help to explain the lack of clear results, but notes that supplementation should have had an effect if a particular nutrient was growth limiting. She concludes with the suggestion that poor growth may be a consequence of the multiple deficiencies that result when children consume diets of poor quality.

Poor growth may be a consequence of the multiple deficiencies that result when children consume diets of poor quality.

Nutrition education to improve breastfeeding and complementary feeding

Since the early 1960s, there has been a major evolution in thinking about nutrition education interventions for young children. Earlier nutrition education emphasized information about appropriate foods, and communication about feeding practices was generally limited to hygienic food preparation techniques. More recently, nutrition education has also included a greater focus on feeding practices because of the increasing evidence about the importance of feeding practices for nutrient intake.

Nutrition education and physical growth

Evidence from nutrition education trials, including the promotion of breastfeeding and improved complementary feeding practices, shows that education interventions can affect physical growth. For example, a study in Bangladesh evaluated how nutrition education provided by community volunteers affected diet and growth of infants (Brown et al., 1992). Over a five-month period, children in the intervention villages gained an average of 460 grams (0.46 SD) more weight for age than children in the control villages. A significantly greater percentage of the children in the control group became severely malnourished, demonstrating a preventive effect of the nutrition education. The energy and protein adequacy of foods given to children improved among intervention children and declined among controls. Although the unit of randomization was the village, the unit of analysis was the individual. This design feature of the study makes it more difficult to attribute benefits to the effect of the intervention. However, the study provides important evidence that nutrition education can positively affect physical growth, even in the context of chronic poverty, undernutrition, and infection.

Evaluations of nutrition education interventions often measure their impact on caregivers' knowledge and practices related to child feeding, but provide little information on impact on physical growth. However, Ashworth and Feachem (1985) reviewed data from twelve developing countries and found promising indications that well-designed and implemented nutrition education can improve young children's nutritional status even in poor communities. They suggest that, in spite of flaws in the evaluation designs, the evidence shows that nutrition education can be effective, especially when the approach to delivering appropriate messages is through interpersonal communication by local workers, with reinforcement through mass media.

Highly effective nutrition education uses interpersonal communication by local workers that is subsequently reinforced through mass media.

The conclusions reached by Ashworth and Feachem are supported in a recent review by Caulfield et al., (1998). The authors examined the results of five efficacy trials, and 16 effectiveness evaluations of nutrition education programmes for children from age 0–3 years, most of which occurred after 1985. Two questions were addressed: (1) Under highly controlled research conditions, what improvements in dietary intakes and growth of infants have been made? and (2) What improvements in dietary intakes and growth of infants have been achieved with programmes in developing countries? They concluded "despite variability in the results, the majority of research and programmatic efforts improved growth rates by 0.10 to 0.50 SDs" (Caulfield et al., 1998). The five efficacy trials (Guatemala, Colombia, Jamaica, Indonesia, and Bangladesh) were able to increase energy intakes from non-breastmilk foods by 70–300 kcal/d. The total improvement in intake was lower because breastmilk declined as nutrient intake increased (Caulfield et al., 1998). At the end of the interventions, improvements in nutritional status ranged from .25 to .46 SD for weight-for-age and .04 to .35 SD for height-for-age. Similar improvements were seen in the effectiveness trials, both in intake and in changes in height and weight.

Nutrition education and feeding practices

Breastfeeding is the most widely and intensely promoted feeding practice. Interventions to promote breastfeeding have been evaluated primarily in terms of their effectiveness in improving breastfeeding behaviour rather than on physical growth (Pinstrup-Anderson et al., 1993; Huffman and Steel, 1995; Feachem and Koblinsky, 1984). Zeitlin (1996) cites descriptive studies in which specific breastfeeding behaviours (such as frequency of breastfeeding, halting other activities in order to breastfeed, and coaxing and active involvement with the child during a breastfeed) are positively correlated with measures of infant growth. The benefits of exclusive breastfeeding in early infancy on reducing mortality and morbidity have been clearly demonstrated (Huffman and Steel, 1995). An impact of breastfeeding promotion on infant growth is therefore likely.

In their review of nutrition education programmes, Caulfield et al. (1998) identify some of the key factors that appear to contribute to programme success. First, successful programmes are comprehensive and address the changing needs of the infant and young child. Second, they build on current local practices. Third, they describe not only what but also how to feed infants. Although the design of the studies does not permit one to distinguish the effects of behavioural changes in practices from changes in foods, a number of successful projects identified practices that may have served as barriers to adequate intake. Messages developed to address these practices focused on parental aspirations for children as a motivator, feeding frequency, using a separate feeding bowl, supervising feeding, feeding patiently and persistently, and continuing to feed even when the child appeared to be full.

Successful nutrition education programmes address the changing needs of the infant and young child, build on current local practices, and describe not only *what* but also *how* to feed infants.

Successful nutrition education programmes involve a multifaceted approach including breastfeeding promotion, education about complementary foods, and recommendations on how to feed children. In sum, it appears that nutrition education can be effective in improving nutrient intakes and physical growth of young children, and a focus on feeding practices as well as foods seems to be an important component of these programmes.

Production of complementary foods for young children

The concept of *complementary foods, weaning foods* or *specially formulated foods* refers to a class of foods for infants and young children that are not part of the regular family diet. These foods may be prepared at home, in the local community or commercially manufactured (Mitzner et al., 1984). The use of specially formulated mixtures in the rehabilitation of malnourished children has been documented through clinical efficacy trials (Scrimshaw, 1980). However, less systematic attention has been given to assessment of the conditions under which different types of formulated foods are appropriate. For example, commercially produced complementary foods have been criticized as a viable solution for complementary feeding in poor countries because they cannot be purchased by the neediest families (Orr, 1977; Wise, 1980; Heimendinger et al., 1981). On the other hand, Scrimshaw (1980) notes that *Incaparina*, one of the better-known formulated

foods, was intended to "provide a beverage with the nutritional equivalent of milk in a culturally acceptable form at as low a cost as possible for the benefit of a sector of the population with modest purchasing power, leaving to other programmes the problem of reaching that part of the population unable to purchase weaning foods."

The evaluation of commercially produced complementary foods should be assessed in two steps: first, in terms of its success in making the product available, and second, by indicators of decreased prevalence of undernutrition among proposed users. We were not able to identify studies of such foods that included both of these steps.

A number of the successful nutrition education interventions summarized by Caulfield et al. (1998) developed new recipes based on locally available foods, using a technique of formative research and recipe trials with the potential programme beneficiaries (Dickin et al., 1997). These projects identified foods within the local area that would provide a more nutrient dense food and were affordable. According to project reports, mothers were usually willing to try these new foods as long as their children responded positively to them. The factors that were identified as constraints to continued use were time availability to prepare the food and affordability (Caulfield et al., 1998).

Physical growth monitoring and promotion

Growth monitoring and promotion (GMP) refers to nutrition interventions that not only measure and chart the weight of children, but use the information on physical growth to counsel the parent in order to motivate actions that improve growth. Growth monitoring *without the counselling component* could not be expected to have a direct impact on growth. The total package of growth monitoring *and promotion* should be assessed. Unfortunately, most GMP programmes have focused on the weighing and charting functions; and, not surprisingly, evaluations have found little impact on physical growth. Growth monitoring is a tool for decision-making related to interventions and can be expected to affect child growth only to the extent that it improves communication and actions to improve physical growth (Griffiths et al., 1996).

Ruel (1995) laid out the theoretical framework, multiple purposes, and evidence of impact of GMP. She found that GMP can be effective as an educational tool, particularly in community-based rather than clinic-based settings, but that there was little evidence that screening through growth monitoring was cost-effective or that growth monitoring was appropriate for assessing the prevalence of undernutrition or for programme evaluation. As a public health intervention, growth monitoring was generally implemented without first being subjected to testing through efficacy trials (Step 7 in the research sequence identified by de Zoysa et al., 1998, and presented in Chapter 2). Consequently, Ruel's conclusions are based mainly on assessments of programme effectiveness. It is difficult, therefore, to determine whether the problems are in the basic concepts or in the ways these concepts have been implemented.

As an educational tool, growth monitoring and promotion (GMP) activities can:

- **Raise mothers' and health workers' awareness and knowledge of the importance of physical growth and practices that promote physical growth—hence motivating behaviour change.**
- **Improve the efficiency of programmes via targeting and by providing a focal point for interventions.**

Studies to test the first mechanism have shown that growth monitoring facilitates awareness among health workers of the importance of physical growth as an indicator of child well-being. It also facilitates awareness among mothers (Ruel et al., 1990) when appropriate growth charts are used and growth monitoring is accompanied by appropriate nutrition education. In Lesotho, the mothers with the lowest level of initial knowledge benefited most from adding nutrition education to growth monitoring (Ruel and Habicht, 1992). Given the magnitude of investment in growth monitoring programmes, it is surprising that so little research has been devoted to how growth monitoring affects parents' knowledge.

Only one study has examined the issue of GMP improving the efficiency of programmes via targeting and providing a focal point for interventions (George et al., 1993). Unfortunately, both the GMP and control groups improved, and the role of GMP as an intervention to improve services in usual circumstances was not able to be tested.

Impact of other types of interventions on physical growth

In addition to the interventions that primarily focus on nutrition and physical growth, there are other types of interventions that may have an impact on child physical growth and/or psychological development. Often the effects on physical growth and psychological development are less direct and may not be viewed as priority goals of these interventions. As a result, individual child outcomes may not be measured, although positive effects are assumed to follow from improvements in food security, health care, sanitation, or income of caregivers.

Because the effects of these interventions are less direct, their discussion here is much briefer. Detailed reviews have been prepared concerning a range of interventions and approaches related to child nutrition, physical growth and psychological development (ACC/SCN, 1991b; Pinstrup-Anderson et al., 1993; Pinstrup-Anderson et al., 1995; Kennedy and Alderman, 1987; Myers, 1992; Young, 1996). What follows is a sampling of available information on the impact of a variety of interventions that are intersectoral or outside the usual domains of nutrition or child development sectors and that have been evaluated for their effect on physical growth and/or psychological development outcomes. Evaluations of efficacy and programme effectiveness are combined in this discussion. Some interventions are directed to families, while others occur at the community level.

Interventions to control disease

Improved water and sanitation

Improved water supplies are expected to affect physical growth through a decreased incidence of diarrhoeal disease. However, few studies have actually measured this impact. Of those that have, two studies found no impact of improved water supply on child nutritional status. In Malawi, child growth in families that used piped water was not better than in families using traditional sources, according to a study that evaluated child anthropometry one year before and one year after the introduction of a piped water supply (Lindskog et al., 1987). In Bangladesh, a water and sani-tation intervention (hand pumps, latrines, hygiene education) reduced the incidence of diarrhoea among children under age 5 but had no impact on physical growth (Hasan et al., 1989). Indicators of water and latrine use were not significantly related to child nutritional status.

On the other hand, Esrey et al (1988) compared children in families that exclusively used improved water supplies to those in families that used mixed sources, in a plausibility study conducted in villages in Lesotho with access to improved water sources. Differences in water use had little impact on the physical growth of infants, likely due to breastfeeding. Among children age 13 to 60 months, the exclusive improved water users gained on average 235 grams more in weight and 0.4 cm more in height than the mixed users over a six-month period. The authors estimated an expected improvement in physical growth over the first five years of life of 4.4 cm and 2.3 kg, and showed that improved water supplies must be coupled with health education to encourage exclusive use of clean water for drinking and cooking, and maintenance strategies to ensure continuous functioning of the water supplies.

An extensive review of hygiene interventions through the early 1980s concluded that most evaluations found little effect on diarrhoea or related outcomes (Feachem and Koblinsky, 1984). However, more recently, a community-based intervention to improve hygiene practices in rural Bangladesh was successful in reducing rates of diarrhoea and prevalence of severe underweight in the intervention village (Ahmed et al., 1993). A community intervention trial in Kenya, using a simple method of solar disinfection of drinking water, demonstrated a significant reduction in diarrhoea morbidity (Conroy et al., 1996).

Control of disease through medical services and immunization

An intervention trial in Narangwal, India, compared the impact of nutrition services and medical care (immunization and treatment of illness) singly and in combination, on child growth, morbidity and mortality (Kielmann et al., 1978). Interventions were assigned at the community level, apparently not randomly, so results must be interpreted in light of potential selection bias.

Children's weights at 17 months and above were significantly greater among children receiving nutritional services (with or without medical care) than among children receiving only medical care. However, medical care alone also had a significant impact on change in weight relative to controls. Findings on height were similar, with the effect of the nutrition intervention significantly greater than the control, and an intermediate effect of medical care. These findings indicate that

medical efforts to control infection can have a positive influence on physical growth.

Huffman and Steel (1995) reviewed evidence related to the impact of child survival interventions on nutrition. There is some evidence that dietary management of disease interventions can improve breastfeeding and feeding practices during and after illness, but no full-scale programme evaluations measuring an impact on physical growth were identified. Despite the relationship of diarrhoeal and acute respiratory infections to poor growth, no studies were found that assessed interventions to prevent or treat these illnesses in terms of their impact on child nutritional status or growth.

Three studies have examined immunization for measles and nutrition or anthropometric status. Children in Gambia, Zaire, and Haiti, were assessed before and after immunization, and immunized children were compared with children who had not received immunization on schedule. Although measles immunization might appear likely as an intervention to improve physical growth, given the magnitude of weight loss associated with measles, the proportion of children who contracted measles was too low to permit the demonstration of a significant difference in weight. Therefore, it is not surprising that no effect was found (Huffman and Steel, 1995).

Interventions to increase maternal education

There are numerous studies that show a significant association between women's education and child health and nutritional status. This effect may be greater under certain conditions. One epidemiological study showed that maternal education had a strong positive association with child growth when household economic resources were low, but not precarious. When household food resources were precarious, however, mothers' schooling was no longer associated with better physical growth (Reed et al. 1996). However, there are no prospective studies that examine the effects of education for girls on health and nutrition status of their children.

Interventions to increase household food security

As noted above, interventions to change the food supply to families may show smaller effects on growth than direct food supplementation because the causal links to intake and growth are more distant. However, there is some evidence that positive effects of family or community-level interventions can be found. A few illustrations follow.

Food subsidies

Positive impacts on weight-for-age and energy and protein intakes of pre-school children have been reported for food subsidies in the Philippines (Garcia and Pinstrup-Anderson, 1987), and there is evidence that a subsidized food ration improved weight-for-age of children in Kerala State, India (Kumar, 1979, as cited in Pinstrup-Anderson et al., 1993). Kennedy and Alderman (1987) mention several examples of positive effects of subsidies on increasing food and calorie consumption of households, but found little information on impact on individuals.

Food for work

Kennedy and Alderman (1987) reviewed evidence on the impact of food-for-work programmes, noting that the primary objectives have often been the creation of employment and the development of rural infrastructure, rather than improvement in nutrition. The review found limited data on impacts on household food consumption and cited only one study that found a positive impact on child anthropometric status. Lack of impact may be related to the short duration of most food-for-work programmes and the fact that the food may be sold by participants rather than consumed, often at a price lower than the usual wage for the labour. Kennedy and Alderman conclude that while such programmes may be effective in addressing seasonal shortages of work and food, they do not represent a long-term solution, and there is no evidence to prove that payment in food rather than cash is more effective in addressing nutrition problems.

Agricultural production

The nutritional impact of agriculture-based interventions is discussed in reviews by Pinstrup-Anderson et al. (1993) and Kennedy and Alderman (1987). In general, studies that evaluated child nutritional status show that the effects tend to be limited. The results of programmes to increase cash cropping are mixed; some have reported a positive impact on nutritional status of children, while others are have reported negative or neutral effects (Kennedy and Garcia, 1993). A

major factor in the differential outcomes is the context of the intervention. When the profits from cash cropping go the owners or managers of plantations, one would expect little benefit to the labourers. In contrast, when the profits go to the families who work the land, the results are more positive, but may still be limited if funds that had previously gone to women are redirected to the men in the families (Engle, 1993).

There are few systematic evaluations of the effect of home-gardening interventions on food consumption by, or nutritional status of, children in low-income households (Kennedy and Alderman, citing unpublished review by Brownrigg, 1987). Home gardening, combined with a diversified nutrition education campaign, produced significant differences in vitamin A status of young children (Smitasiri and Dhanamitta, 1996). Some reports claim an impact on dietary variety and micronutrient intake, but none was identified in which an impact on child physical growth is reported.

Credit programmes

Micro-enterprise and credit programmes, especially those that target women, are often assumed to have a positive effect on children's health and nutrition through increasing maternal income. The only study found that measured anthropometry as an outcome used an econometric plausibility design to analyse data from three credit programmes in Bangladesh, including the Grameen Bank (Pitt and Khandker, 1996). Despite finding positive effects on indicators related to income, assets, and consumption, no impact was seen on the anthropometric status of boys or girls (under 10 years of age). The authors note that anthropometric measurements were made on a sub-sample such that the design was less able to identify differences. Credit to women tended to have a greater impact on household behaviour than did credit to men, except in relation to contraceptive use and fertility. There was a strong positive effect of Grameen Bank credit to women on girl's schooling.

Evidence also suggests a positive impact of programmes that integrate credit with health and nutrition education but no reports were found of evaluations with adequate designs to demonstrate this relationship.

Effectiveness of nutrition programmes

Since several extensive reviews of evaluations of nutrition programmes are available (Gwatkin et al., 1980; USAID, 1989; ACC/SCN, 1991; ACC/SCN, 1996), only the key findings will be summarized here. Effectiveness in improving child nutrition has been demonstrated in a large number of full-scale government and non-governmental organization (NGO) nutrition programmes, including the Tamil Nadu Integrated Nutrition Programme in India, the Iringa Nutrition Programme in Tanzania, the National Family Improvement Programme (UPGK) in Indonesia, the Nutrition and Primary Health Care Programme in Thailand, and the Applied Nutrition Education Programme in the Dominican Republic (ACC/SCN, 1991; USAID, 1989; Pelletier and Shrimpton, 1994). While some successful nutrition programmes are relatively small in scale, others are large state-wide or national programmes that have endured for many years. Micronutrient supplementation and/or fortification programmes, such as those in India, Bolivia, China, Indonesia, and Nepal, have also been found to be effective (Hetzel, 1989; USAID, 1989).

Although few evaluations demonstrated effects that were clearly attributable to specific nutrition activities, an ACC/SCN report (1996) recognized that most full-scale nutrition programmes can reduce the prevalence of moderate and severe undernutrition in large populations by at least 1–2 percentage points per year.

The processes of planning and implementation and the quality of personnel are more critical to programme effectiveness than the specific content or type of intervention.

The components of full-scale nutrition programmes are relatively consistent across countries, and usually include some combination of nutrition education, health services, and food supplementation or home gardening to improve the household food supply (ACC/SCN, 1991). The basic nutrition intervention strategies are now relatively well delineated, and while no single set of interventions is best in all situations, the known approaches can be adapted to various contexts. Comparisons across programmes suggest that the processes of planning and implementation and the quality of personnel are more critical to effec-

tiveness than the specific content or type of intervention (USAID, 1989; ACC/SCN, 1991). This conclusion should be tempered by the recognition that there is an insufficient number of well-managed programmes to permit comparisons of the relative effectiveness of different types of interventions.

Key characteristics related to programme effectiveness include:

- Awareness of the importance and magnitude of nutrition problems.
- Use of information for advocacy and planning.
- Community mobilization and participation.
- Training and support of staff, including community-based nutrition workers.
- Needs assessment.
- Programmatic goals (involving all stakeholders) to guide planning and implementation.
- Effective management and supervision (USAID, 1989; ACC/SCN, 1991; Jonsson, 1995, as cited in ACC/SCN, 1996).

The importance of genuine community ownership and involvement in decision-making, planning, and implementation is considered paramount by most reviewers (ACC/SCN, 1996; Jonsson, 1995; ACC/SCN, 1991; USAID, 1989). As a result of increasing experience with and analysis of its importance, there is now a greater understanding of strategies for increasing the role of the community. It is also recognized that both community-based and centrally-implemented activities have different and complementary merits, and a combination of approaches is likely to be most effective (ACC/SCN, 1996).

More specific issues related to personnel, supervision, and management include:

- Clear definition of tasks.
- Manageable workloads for front-line staff and supervisors.
- Reasonable worker-to-client and supervisor-to-worker ratios.
- A mix of existing staff, new staff, and locally-recruited community workers.
- A management information system to provide information at all levels for monitoring, evaluation, and decision-making (ACC/SCN, 1991; Pelletier and Shrimpton, 1994).

In addition to the characteristics already noted, flexibility and attention to availability of local resources (human and material) and existing administrative structures have been identified as critical to sustainability and replicability (USAID, 1989; ACC/SCN, 1991).

Different contextual factors affect the relative importance of particular programme characteristics. For example, targeting is more important where prevalence of undernutrition is low. These contextual factors also affect the feasibility of implementing preferred approaches. For example, cultural and political considerations affect the success of encouraging greater roles for community members, especially women. Thus, the fit of a style of implementation with the context is also critical. In a review of nutrition programmes in South Asia, Jonsson (1995) identified contextual issues related to success, including political commitment, the presence of community organizations and charismatic community leaders, low gender discrimination as indicated by women being literate, empowered and involved in decision-making, and cultural norms for favourable child care practices.

Programme success depends on contextual issues such as political commitment, the presence of community organizations and charismatic community leaders, low gender discrimination, and cultural norms for favourable child care practices.

There is now sufficient evidence to conclude that large-scale nutrition programmes can be effective in improving child physical growth and nutritional status. Many nutrition interventions that were first demonstrated to be efficacious in pilot projects or research trials are now full-scale nutrition programmes. Although there has been little systematic attention to identifying the determinants of programme success (Schilling, 1990; Pelto and Tuomainen, 1996), it appears that the factors that contribute to success reflect approaches to decision-making, implementation, and management that are relevant to many types of development programmes, rather than being specific to nutrition.

Chapter 5

Combined physical growth and psychological development interventions

Several different strategies for combining interventions for physical growth and psychological development have been instituted in the past few decades. This chapter examines intervention models that have been systematically evaluated, as well as other programme models that have yet to be scientifically assessed. We begin with a discussion of the only three efficacy trials of combined interventions in developing countries that we have been able to identify. Two other relevant interventions—one for severely malnourished children and one for children in the U.S. with non-organic failure-to-thrive (NOFTT)—are also described. We then examine the evidence from effectiveness evaluations. The chapter concludes with a discussion of programmatic and policy issues affecting the feasibility of combined programmes.

Efficacy trials of combined physical growth and psychological development interventions

The scientific basis for combining nutritional and psychosocial interventions is that common mechanisms underlie both physical growth and psychological development. Second, physical growth influences the course of psychological development, and variations in psychological development can affect growth. Improvements in both children's nutritional intake and psychosocial stimulation should have a greater effect on psychological development then either improvement alone.

As discussed in Chapter 1, there are three levels where combined programmes interact and can have greater, or additive, impact. The first is at *the level of the child*. A better-nourished child should be more able to benefit from a stimulating environment. A better-nourished child should also be more able to elicit more responsive caregiving through increased energy, verbal interaction, or happiness. Second, additional effects can occur *between the child and family*. For example, improving practices related to nutrition and feeding should also have an impact on practices related to psychosocial care, and vice versa. Both changes in parental practice involve increased attention and ability or willingness to respond to children's needs. Third, in the *design and delivery of programmes*, combined interventions should facilitate both greater efficiency and better quality of services, and increased use of all services by parents (Erkel et al., 1994; Scott et al., 1998).

Three intervention trials have assessed the impact of the combination of nutritional and early childhood psychosocial interventions in populations with a high prevalence of undernutrition. All provided nutritional supplementation, usually containing energy, protein and some micronutrients. Psychosocial activities were implemented either through home-visits or centre-based programmes. A combined group was included in each. The trials tested whether the effect of the combined group was greater than either of the other two groups alone. Outcomes related to both physical growth and psychological development were assessed. Table 2 shows the characteristics of the projects.

Cali, Colombia

A study in Cali, Colombia, compared three types of groups: food supplementation alone followed by a year of pre-school and health care; a combined programme of nutritional supplementation, health interventions, and pre-school; and a middle-class control group. The study was designed to test whether age of participation and duration of participation in pre-schools affected impact. For the nutrition intervention, children were enrolled at ages 3, 4, or 5, followed by a year of pre-school and feeding (about 17 per group). For the combined intervention, groups of children were enrolled at ages 3, 4, 5, and 6 years (about 50 per group). All of the children had some pre-school experience in their final year,

Table 2. Three combined physical growth and psychological development interventions

	Location of Interventions		
	Cali	**Bogota**	**Jamaica**
Age of participants at enrolment	3, 4, 5 or 6 years of age	Prenatally (third trimester)	9–24 months of age
Nutrition component	Daily energy and protein requirement (75%), provided at centre, plus vitamin and mineral supplements	Milk and protein mix for infants, plus vitamin and mineral supplements; 623 kcal and 20 g protein for all children > 1 year	Milk-based formula, home delivered, 750 kcal and 20g protein/day (expected sharing); cornmeal for rest of family
Child psychological development component	Centre-based pre-school, 6 hours/day, 5 days/week; activities to stimulate psychological development	Home visits twice weekly; activities to stimulate psychological development, with teaching of parents and direct to child	Home visits weekly to demonstrate toys and activities, with teaching of parents and direct to child
Other intervention	Medical care	Medical care	Medical care
Duration of intervention	Minimum of 1 up to maximum of 4 six-month intervention periods	Until 3 years of age	24 months

a minimum of 1 six-month period up a maximum of 4 six-month periods.

Positive effects were seen on a variety of measures of psychological development, and differences persisted at follow-up, one year after the intervention ended. The longer the duration of the intervention, the greater the gains, and these cognitive gains were more evident at younger ages (McKay et al., 1978). Unfortunately, it is not possible to separate the effects of age of entry into the programme and duration of exposure since age and duration were confounded in the design. Effects of the intervention on physical growth showed a similar pattern. Children exposed earlier and for a longer duration showed the greatest changes in linear growth and weight during the pre-school years (Pollitt and Perez-Escamilla, 1995). The combined supplementation and stimulation had the greatest effects on psychological development. Supplementation alone, before initiating the pre-school, had no effect on psychological development.

Combined programmes have greater impact on psychological development when children enter them at an earlier age and participate for longer periods.

Differences in psychological performance were still evident when children reached age 9, although the magnitude of effect was smaller (Sinisterra et al., 1979). However, no differences in physical growth remained (Pollitt and Perez-Escamilla, 1995).

Bogota, Colombia

A study in Bogota was expressly designed to examine the independent and combined effects of food supplementation and psychosocial stimulation (called maternal education) on physical growth and psychological development. Four groups relevant to this discussion were defined: supplementation only, stimulation only, supplementation and stimulation, and no intervention. Treatment continued from the prenatal period until age 3 years.

The study began with a nutrition component, and a home-based stimulation intervention was added later. Mothers were recruited in the last trimester of pregnancy. Children were randomly assigned to intervention or control groups, based on the city block in which they resided. The nutrition component consisted of a package of foods delivered to the home as well as micronutrient supplements. The stimulation intervention consisted of home visits twice weekly for three years to provide stimulation to children and education to the mothers (Waber et al., 1981).

A total of 187 children were available for analysis at age 3 years. Psychological development was

measured with the Griffiths test, a widely recognized measure of cognitive ability. Supplementation had a clear effect on five subscales of the Griffiths test and the overall scale, and appeared to have a stronger effect than the stimulation intervention. There was no added benefit of the combined supplementation-stimulation interventions on psychological development. The two different intervention modalities apparently affected different aspects of psychological development (Waber et al., 1981).

Scores declined with age, following the pattern that is typical for children raised in impoverished environments (see Chapter 3). Home visiting with stimulation activities appeared to have a stronger effect on psychological development in the initial period (Waber et al., 1981). Behavioural changes in both mothers and children were an outcome of the home stimulation visits. For example, the mothers who received home visits became more responsive to their infants. Supplementation affected behaviour as well. Infants who received food supplementation were more active (Super et al., 1981).

The combination of supplementation and stimulation interventions has a greater effect on physical growth than supplementation alone.

Supplementation had an effect on physical growth, but stimulation did not. However, the combination of supplementation and stimulation had a greater effect on physical growth than supplementation alone (Super, Herrera and Mora, 1990). An even larger effect was found three years later, with no additional intervention. In a follow-up study conducted when children reached age 6, children who had received both stimulation and supplementation were significantly taller than the other groups, suggesting that the interventions may have resulted in enduring changes in caregiving behaviours (Super, Herrera, and Mora, 1990).

As in many studies, children who were the most malnourished were most likely to benefit from the intervention. For the children who were most malnourished at birth, the combined supplementation-stimulation intervention significantly reduced the probability of low weight-for-age, while the nutrition supplementation alone significantly reduced the probability of stunting. For less malnourished children, supplementation positively affected physical growth, but there were no additional effects of stimulation on their physical growth (Super et al., 1990).

The Jamaica Study

A third study also examined the possible effects of combined nutritional and psychosocial stimulation interventions on physical growth and psychological development. The study was conducted with 129 stunted (low height-for-age) 9- to 24-month-old children in Jamaica. Children identified as stunted were randomly assigned to control, supplementation, stimulation, or combined intervention groups (Grantham-McGregor et al., 1991; Walker et al., 1991). There was also a non-stunted control group. The supplemented families were provided with 1 kg of milk-based formula per week, plus other food for family members, and the stimulation consisted of weekly home-visits with structured play sessions for children and caregivers.

Supplementation, with or without stimulation, had positive effects on weight and length increments in the first six months that children were receiving the intervention. Gains were sustained in the second six months. Children who were younger and thinner benefited most from the supplementation.

All three treatment groups showed consistent improvement each time they were tested across the two-year period of the study. Children receiving stimulation showed significant improvements on all subscales and total development quotient (DQ, a measure of the rate of the child's development), with the largest impact of stimulation occurring at younger ages. The effects of supplementation were mainly on locomotor skills in the first year, and then became apparent on overall DQ (Grantham-McGregor et al., 1991). The stimulation and nutrition interventions independently benefited children's developmental quotients (DQ), preventing much of the decline seen in stunted controls.

The combined intervention resulted in the greatest benefit to DQ (Grantham-McGregor et al., 1991). The children who received both stimulation and nutrition interventions performed the best, and approached the level of the non-stunted group (although still below the level of middle-class Jamaicans). The children who received either supplementation or stimulation performed better than the controls but worse than the combined group. In contrast, the scores of the children in the control group declined initially, after which they began to improve somewhat. The authors concluded that the effects of the combined treatments were additive, but not synergistic.

At a follow-up four years after the study ended,

Table 3. Three efficacy studies of combined interventions

Project and sample	Design	Nutrition intervention	Psycho-social intervention	Was there an effect on physical growth?	Was there an effect on psychological development?	Adequacy of intervention	Effects of combined programmes
Cali, Colombia[a] 333 low-income urban families; age 3 to 6 years; followed to age 10 years.	*8 groups:* 4 with food and centre attendance, each starting a subsequent year (ages 3,4,5,6); 3 with food only at 3, 4, 5, with 1 year centre attendance for each; 1 middle class group.	Centre feeding	Centre programme	Yes, for children exposed for longest and starting earliest (3 years); largest increase in height and weight during pre-school period. No effects 3 years later.	Yes, for number of years in pre-school; greater effects with earlier entry and duration. Effects still seen at age 9. No effects of food without pre-school on psychological development.	Very good	Combined supplementation and stimulation had greatest effect on cognition. No effects of supplementation on psychological development without pre-school. Age of treatment and duration of treatment are confounded in the design.
Jamaica[a] 129 stunted children, 32 non-stunted controls; age 9–24 months. to 21–36 months; followed to age 7 years.	*5 groups:* supplementation, stimulation, both, control, and non-stunted control; intervention for two years.	Foods delivered at home	Weekly home visits	Yes, for supplementation. No, for stimulation alone.	Yes, for stimulation groups; yes, for supplementation; greatest effect with both.	Very good	Additive effects were seen on cognition. Only supplementation affected physical growth.
Bogota, Colombia[a] 187 poor urban families; age prenatal to 36 months; followed to age 6 years.	*4 groups:* stimulation, supplementation, both, and neither; intervention for 3 years.	Foods delivered at home	Twice-weekly home visits for child stimulation	Yes, for supplementation. Greatest effect for combined supplementation and stimulation.	Yes, for stimulation and for both stimulation and supplementation. Supplementation affected motor and overall score; stimulation affected language.	Very good	No additive effects seen on cognition. Additive effects on growth seen at ages 3 and 6. Stimulation plus supplementation had larger effect on growth than supplementation alone.

[a] *References are in Table 4.*

small global benefits in psychological development remained for the subjects who had received stimulation. However, the control group as well as the supplemented groups had increased in height relative to standards, suggesting a general improvement in nutritional status of children in Jamaica during this period (Grantham-McGregor et al., 1997).

A combined intervention for severely malnourished children

Although not a community-based efficacy study, the results of another controlled study in Jamaica are relevant to the discussion (Grantham-McGregor et al., 1987). Children hospitalized for severe undernutrition were enrolled in the study. This was not a combined intervention in the usual sense, but provided stimulating play experiences for children while in the hospital receiving nutritional and medical treatment, and afterwards. After hospitalization, the intervention continued with home visits for three years, during which time parents were provided with instruction and support on how to interact with their children in ways to stimulate psychological development, but received no additional nutritional support. It was considered unethical to assign treatment randomly within a hospital ward, so a non-intervention group was recruited from children hospitalized in the previous year and followed during that time. Thus, the two malnourished groups were recruited during different periods. A second control group was composed of adequately nourished children who were hospitalized for other, serious illness.

Psychological development indicators of the treated children improved greatly (Grantham-McGregor et al., 1987). After two years, the children in the intervention group caught up to children from higher socioeconomic status homes who were not malnourished (but had been hospitalized for other illness). Performance then declined until a plateau was reached at about age 7. The non-intervention group of malnourished children did not improve, and the gap between their performance and that of well-nourished controls did not reduce. There were few impacts of the home-visiting intervention on mothers' child-rearing behaviour (Grantham-McGregor et al., 1994).

In a follow-up evaluation conducted 14 years after the children had been hospitalized, significant differences in performance were still found (Grantham-McGregor et al., 1994). The intervention group scored at a level midway between the well-nourished controls and the non-intervention group. The children who had participated in the stimulation programme performed significantly better than the non-intervention children on an IQ test (the Wechsler Intelligence Scale for Children, WISC) and differences approached significance on the Wide Range Achievement Test. Moreover, differences in IQ and achievement test scores between the intervention group and the well-nourished controls were not significant. On the other hand, there were no differences between the two previously malnourished groups in body mass index or height-for-age at the 14-year follow-up, which indicates that the damage to physical growth incurred during the period of severe malnutrition was not recoverable with the home visiting intervention. As would be expected, the well-nourished controls were significantly taller. The authors conclude that the stimulation programme resulted in marked improvements in psychological development, which were sustained into adolescence.

A combined intervention for children with non-organic failure-to-thrive (NOFTT)

In an efficacy trial of a home-based intervention, Black et al. (1995) randomly assigned NOFTT children from low-income, inner city neighbourhoods in Baltimore, Maryland (U.S.A.), to intervention and control groups. Over the 12-month trial, both groups received multi-disciplinary clinic services and nutrition counselling. The treatment group also received home visits, which included general family support, such as helping parents access welfare services or providing support or advice on relationship issues. As these children were already falling far behind in physical growth, it was expected that they would continue to decline developmentally. However, the children in the intervention group, who began treatment prior to 12 months, showed less decline in psychological development in infancy and less decline in language development than controls. Physical growth improved for both groups, independent of the home-visiting intervention. There were no significant effects of the intervention on parent-child interaction, but the home environments of children in the home-visiting group were more *child-centred*, according to a standardized measurement tool.

Summary of evidence for combined effects from efficacy trials

Table 3 summarizes the results from the three efficacy trials. All three studies found that a psychosocial intervention significantly affected psychological development, and that nutrition intervention significantly affected physical growth. Two of the three studies found that the combination of the nutritional and psychosocial interventions had a greater effect on psychological development than either intervention alone. The third study reported that supplementation and stimulation affected different domains of psychological development. Surprisingly, the third study reported that the combination of interventions had a greater effect on *physical growth* than either one alone.

In almost all cases, effects were greater for children who were the most malnourished. Effects also tended to be greater for younger children; both the psychosocial intervention and the nutritional intervention were more effective when the children were under age 3 years. Several of the studies also found that the impact of the psychosocial intervention on parenting behaviour might have long-term implications for these children and for others in the same family.

The effects of combined programmes to improve physical growth and psychological development are often greatest for children under 3 years old, and those who are the most malnourished.

Effectiveness evaluations of combined physical growth and psychological development programmes

Effectiveness evaluations examine the implementation and impact of interventions under usual conditions, such as in full-scale or national programmes. Effectiveness evaluations provide valuable information about the impact of interventions in specific contexts and help pinpoint problems. These assess not only programme outcomes, but also how well the intervention was delivered, sometimes called process evaluations. In contrast to efficacy trials, these evaluations are designed to maximise inferences about causal relationships between interventions and outcomes.

Our original intent was to review a range of programmes that illustrated differences in design, implementation, effectiveness and context. For example, programme components may differ in terms of the provision of food supplementation versus nutrition education, or in terms of educational experiences for children through parenting education or centre-based activities. There are also variations in the ages of children to which services are directed, in staff characteristics such as professionals or community members, in linkages to health services and other programmes, and in the relative emphasis on nutrition or psychological development. Initially, the criteria for selection were:

- Explicit inclusion of activities aimed at promoting *both* physical growth (or other aspects of nutritional status) and psychological development.
- Full-scale implementation, defined as a programme that covers a substantial population, has been implemented over a sustained period of time, and is not a pilot or research project.
- Availability of evaluation data on physical growth and/or psychological development outcomes.
- Availability of cost and cost-effectiveness data.

Programmes designed to promote both physical growth and psychological development have increased with the increasing world-wide interest in early childhood psychological development (Young, 1996). However, the third criterion severely limited our choices of programmes to review. We were able to identify only seven programmes that evaluated impact on physical growth and psychological development. There were so little data on the cost-effectiveness of programmes in developing countries that this criterion had to be dropped.

The specific form of the combined interventions differs depending on the delivery mechanism. Table 4 shows the programmes that were identified, classified by their delivery mechanisms for the nutrition and psychosocial components. To facilitate comparison with the efficacy studies, described earlier, these projects are also included in this and subsequent tables.

Five of the evaluated combined programmes are delivered in childcare centres and are designed primarily for children ages 3–5. In three of these programmes, the food supplementation component was quite limited. Two of the seven programmes include home visits, although one is

Table 4. Delivery mechanisms of combined nutrition and psychological development programme models in the review

	Child-focused		Family- or Parent-focused
Psychosocial component	Formal childcare centre	Informal, home daycare	Home visiting from community-based health or nutrition workers
Nutrition component			
Supplementary food delivered to house			Jamaica, Bogota
Supplementary food in feeding site	ICDS, Head Start, Cali	PRONEI, PROAPE, HWB	
Nutrition education			PANDAI, IFBECD

Efficacy Trials: Cali, Colombia (McKay et al., 1978); Bogota, Colombia (Waber et al., 1981); Jamaica (Grantham-McGregor et al., 1991)

Effectiveness Trials: ICDS India (ICDS, 1995); Head Start, USA (Currie and Thomas, 1995); HWB [Homes of Well-Being, Colombia] (ICBF, 1997); PANDAI, Indonesia (Satoto, 1996); PRONOEI, Peru (Myers et al., 1985); IFBECD, Thailand (Herscovitch, 1997); PROAPE, Brazil (Myers, 1992)

primarily a centre-based approach. Only one focuses on parent education for child psychological development, and the evaluation data is from a small-scale pilot project.

The programme descriptions shown in the Annex are brief summaries that describe objectives, components, personnel, training, supervision and management, implementing or co-ordinating agencies, coverage, limited data on cost, and effectiveness measured by impact on physical growth, psychological development, and other relevant indicators. As these are short summaries, the reader is referred to the primary sources of information for details. In large-scale programmes, implementation often varies over time and across sites because adaptations are made to local conditions and needs, and approaches are refined based on what is effective. Although this flexibility and evolution probably contribute to programme effectiveness, evaluation is difficult when making comparisons across time and location.

Summary of additive effects from effectiveness and efficacy trials

Table 5 summarizes the results from the effectiveness evaluations. In each case, benefits and disadvantages of the combined intervention methods are noted. Unlike efficacy trials, it is usually not possible to separate out the effects of nutritional and psychosocial interventions on physical growth and psychological development. However, these evaluations allow us to determine what kinds of impacts are seen.

In the seven programmes summarized, six reported significant effects on various measures of psychological development. On the other hand, only two reported clear effects on physical growth, and two found what could be interpreted as effects on physical growth. There are several reasons for failure to find effects on physical growth: children were older than 3 years when enrolled, at which point nutritional inputs are unlikely to have an effect; children were not at risk of malnutrition; or the programmes were primarily focused on early childhood stimulation.

Levels where interventions have an additive effect

The results from the seven effectiveness evaluations and the three efficacy studies provide some information on the three levels where interventions have an additive effect: the child, the child and the family, and the design and delivery of programmes.

The child

Of the three efficacy studies, two found evidence for additive effects of the combined interventions

on psychological development, and the third found evidence for an additive effect on physical growth. These findings suggest that combining the two interventions will have a greater effect than either alone in a population at risk of malnutrition and poverty.

The child and the family

The evaluations show that caregiving was positively influenced by the interventions. The positive effects of stimulation on physical growth in the Bogota study were attributed to changing family practices, such as how food was used within the family. Programme evaluations generally reported that the more involved the parents, the greater the impact on children, but self-selection may contribute to these effects. A number of programmes found effects on the quality of the home environment (e.g. Black et al., 1995) or on parental perceptions and attitudes (PRONOEI, PANDAI), but the analyses did not link these changes with child outcomes.

Design and delivery of programmes

An important benefit of combined programmes is at the level of the delivery of the intervention, or its use by families. For example, qualitative data from programme evaluations noted an increased parental interest, positive effects on the communities, and a greater knowledge by staff who work with families of malnourished children. Programme administrators also commented on how combined programmes benefited parents (e.g. PANDAI). On the other hand, problems of increased workload, failure to focus equally on the nutrition and psychosocial components, and a lack of understanding of the psychosocial component by general health staff were also noted. As is the case with most programmes, the most difficult problem is the training and supervision of workers so that the planned programme is actually implemented. Thus, combining interventions requires commitment and patience.

Although classified as *combined programmes*, most of these interventions present the nutritional or health component and the psychological component separately. The links between nutrition and psychological development are not specified, and are often not even mentioned in the programmes. There is usually a nutrition component that provides food or recommends certain foods and the timing of feeding, and a psychosocial component or pre-school intervention that describes developmental stages, activities that children need for learning, and strategies for stimulation. The psychological aspects of feeding and nutrition, or the health and nutritional aspects of psychological development, are infrequently mentioned.

However, this review clearly demonstrates linkages. Nutrition and psychosocial interventions have an additive effect for the child's psychological development. The skills required for feeding and psychosocial care are similar. In the first two years of the child's life, both feeding and psychosocial stimulation are improved by warmth, responsiveness to children's attempts to communicate, and awareness of developmental changes by the parents. A combined approach would focus on responsive parenting and its relationship to feeding and psychosocial support. These interventions would be more consistent with the parent's holistic perception of the child than the current approach of dividing the child into discrete domains of health, nutrition, and psychological development. For example, parents tend to use children's emotional condition as an indication of health. A combined programme should also be more accessible to parents, easier to put into practice, and more effective.

Because the skills required for feeding and psychosocial care are similar, nutrition and psychosocial interventions have an additive effect for a child's psychological development. A combined approach would focus on responsive parenting and its relationship to feeding and psychosocial support.

Implications for models of combined programmes

Evidence from programmes discussed in the last section demonstrates that it is feasible to combine interventions to improve physical growth and child psychological development in large-scale programmes. However, there are implementation problems that need to be resolved.

These combined approaches are still relatively new, and many existing programmes give greater emphasis to one component over another, rather than being truly integrated. Further systematic evaluations are needed to provide the knowledge necessary for informed planning and expansion of programmes. This is critical for the design and

Table 5. Evaluations of Effectiveness of Combined Programmes

Project and sample	Design	Nutrition intervention	Psychosocial intervention	Was there an effect on physical growth?	Was there an effect on psychological development?	Adequacy of intervention	Effects of combined programmes
CDS (3–6 years) India, various small studies in different areas	Compared ICDS and non-ICDS villages in one study; compared participants and non-participants in others.	Centre feeding	Informal ECCD centre	Yes, in over 30 small studies.	Yes, lower school dropout and IQ in village comparisons. Yes, in within-village comparisons, but these studies could not control for self-selection.	Variable	Workers reported being overtaxed; spent so much time on food preparation that there was insufficient time for home visits or ECCD programme. However, workers knew which families had malnourished children, permitting better targeting.
Head Start (3–5 years) USA, national sample	Compared siblings who attended to those who did not; retrospective.	Centre feeding	Formal centre	No, but children were not at risk of malnutrition.	Yes, with a greater benefit when mothers had higher IQ scores.	Not reported	Programme improved immunization status in Head Start children.
PANDAI (0–3 years) Indonesia	Compared participants before and after pilot study.	Growth monitoring and promotion	Home visits and community sessions	No effect on growth, but feeding practices improved.	Yes	Pilot project	Increased parent interest and participation in GMP programme.
PRONOEI (3–6 years) Peru, rural and urban areas	Matched PRONOEI and control communities selected in 3 regions. Children followed through first grade.	Centre feeding (mothers prepared donated food)	Informal centre	No effect on growth.	Yes, in 1 out of 3 regions. No effects on school repetition, but effects seen on earlier age of school entry.	Poor quality in many cases	Positive effects on community development reported, since school construction, materials, food preparation and teacher support were part of a community project.
PROAPE (3–6 years) Brazil, national	Compared participants to non-participants.	Centre feeding	Informal centre	Marginal	Yes, in rates of first grade repetition.	Not reported	Evidence of programme convergence since sponsored by both ministries of health and of education.
IFBECD (0–6 years) Thailand, initial study in selected districts	Compared communities selected in two regions.	MoH clinics, centre feeding	Home visits by child development volunteers	Yes, but both programme and control groups improved; most improvement in poorest villages.	Yes, increased % of average and bright children in programme communities only.	Much stronger in one area (with an NGO) than the other	Changes in parental perceptions reported. Pilot project judged successful, child development workers gained credibility, and demand was created . National scale-up was much less successful because of too many goals and rapid implementation.
HWB (Homes of Well-Being) (2–6 years) Colombia, national	Sampled only children in centres, and compared outcomes with length of exposure to the centre, and with quality of centre.	Centre feeding	Family home daycare centres run by community volunteers	Yes, in poorest groups, but used duration of exposure to programme as independent variable.	Not as a function of duration of exposure to programme.	Variable, and in many cases poor	Better quality of day care programmes was associated with better global well-being of children (health, nutrition, and psychological development combined). Lack of involvement of parents in day care programme and expectations of programme were too high.

References: ICDS India (ICDS, 1995); Head Start, USA (Currie and Thomas, 1995); PANDAI, Indonesia (Satoto, 1996); PRONOEI, Peru (Myers et al., 1985); PROAPE, Brazil (Myers, 1992); IFBECD, Thailand (Herscovitch, 1997); HWB, Colombia (ICBF, 1997)

Systematic evaluations are needed to provide the knowledge necessary for informed planning and expansion of programmes.

implementation of combined interventions that are feasible, cost-effective, and appropriate to the context and communities for which they are intended. The objective of this section, then, is to review the models or approaches to programme design, and to discuss factors that affect their suitability in different contexts.

Programmes that provide centre-based pre-school education plus feeding

A centre-based approach to providing pre-school education plus feeding is illustrated by the examples of ICDS, Head Start, PRONOEI, Homes of Well-Being, and PROAPE. The emphasis in these programmes is on pre-school education—the nutrition-related goals are secondary. This model has strong advantages in terms of psychological development and school readiness of children, given the evidence that well-implemented pre-school education programmes improve these outcomes. Centre-based programmes also offer parents the advantage of childcare, although many do not provide care for the full day. Various community-based projects, such as the nutrition programme in Iringa, Tanzania, have developed group childcare and child feeding programmes at the request of participating families, an indication that this approach is appropriate to local needs (Jonsson et al., 1993).

The agencies and local committees that are formed to oversee implementation may share management responsibilities. The staff of centres are typically recruited locally. To achieve significant developmental gains in children, these workers need to be well trained and supervised in the implementation of appropriate activities. Systems for remuneration of workers vary from government or agency stipends to community support to use of community volunteers, or a combination of these. High staff turnover can be a problem, probably due to low pay and lack of advancement opportunities.

It is important to be clear about the role of the feeding component of centre-based programmes. If the children are ages 3 and 4, and are stunted, but not acutely undernourished, then substantial impacts on nutritional status cannot be expected. However, there are other important rationales for providing meals and snacks in pre-school settings. First, feeding may be required simply because of the amount of time children spend in the centre. Second, the provision of nutritious meals and snacks improves the quality of the children's diet. Third, mothers' participation in food preparation introduces and reinforces nutrition education for caregivers. Finally, learning activities for children can be built around food and feeding. On the other hand, costs for food tend to make up a large proportion of recurrent costs of programmes that provide substantial supplementary feeding. This fact may constrain plans to add a feeding component to an existing early childhood care and development (ECCD) programme. The staff time needed for food preparation is another constraint. One approach to overcome this problem is to ask parents to contribute time for this activity, as is the case with PRONOEI. The use of in-kind food contributions from families may also help to defray costs, but may reduce the amount and quality of food available or discourage attendance of children from the poorest families.

Conditions that support centre-based pre-school education plus feeding programmes*

- **Concentration within a delimited area of sufficient numbers of children so that participation in the activities will be convenient and feasible.**
- **Parental interest in group activities for children and goals (e.g. school readiness), such that families are motivated to bring children regularly.**
- **Perceived need (on the part of potentially supportive institutions) for a focal point around which to organize and combine other types of service delivery for families.**
- **Suitable local programme staff, and adequate numbers of trained personnel to supervise the sites.**
- **An appropriate curriculum for centre-based education, or resources to develop one, and the means to train teachers.**
- **An appropriate, safe, and convenient site for the pre-school activities or the resources to build and furnish a site.**
- **Low-cost nutritious foods (local or donated) appropriate for child feeding, and cooking and serving facilities.**

* *The authors suggest that these are* **supportive conditions** *because they are neither necessary nor sufficient, but can be regarded as issues to consider in the selection of approaches for combined programmes.*

Programmes that provide food and stimulation to children, and education on nutrition and responsive parenting for parents

Two examples of this approach are the studies in Jamaica and Bogota, Colombia. Both interventions improved physical growth and psychological development of participants. The effectiveness of full-scale programmes based on this model is not known as these models have only been used in efficacy trials. However, there are full-scale programmes that include a home-visiting component. The example of the ICDS Anganwadi programme is relevant here in that children received some food while attending the group activities, and additional supplementary food was targeted specifically to undernourished children and mothers. In the ICDS programme, home visits are not routine for all families, but are specifically targeted to needy families. Another example of targeted home visits is the Iringa nutrition programme in Tanzania, in which growth-monitoring data are used to select families for home visits to deliver nutrition education.

A home-based approach is preferred in many circumstances. In some cultures, it is not considered appropriate to take infants and young children out of the home, except under unusual circumstances, such as caregiver illness or the abrupt weaning of a child when the mother is pregnant. Also, including very young children in centre-based programmes requires much higher staff-to-child ratios. Home visits are a useful strategy for very early intervention and a way to reach families who may be in great need but less likely to attend centre-based interventions. The focus on parents and improving caregiving may have sustainable benefits and affect other children in the family.

Programmes that combine nutrition and education on responsive parenting

Models that combine nutrition and education on responsive parenting are a variant on the previous one, but do not include the provision of food or direct stimulation to children. Project PANDAI in Indonesia is an example of a parenting education programme that combines nutrition education with demonstration or training in childcare and psychological development. ICDS in India also includes these components. The limiting factor for this review, however, was the lack of evaluation data on such programmes.

Conditions that support home-based programmes that provide food and stimulation to children, and education on nutrition and responsive parenting for parents

- **Intent to target infants and toddlers rather than 3–5 year olds.**
- **Intent to reach poor families who may not use services due to constraints on time, income, or perceived need.**
- **A dispersed population or cultural factors that do not favour children's participation in centre-based activities.**
- **Young children often found at home with a primary care-giver; low rates of female employment outside of the home.**
- **Existence of a home-visiting health delivery system that could be expanded to include nutrition and/or ECCD components.**
- **Lack of suitable spaces for groups of children to be cared for.**
- **Significant incidence of family food insecurity that necessitates food supplementation to improve child nutrition.**

In Project PANDAI, the parental education component was added to a growth monitoring and nutrition education programme that was already being implemented at the community level. One advantage of an approach that emphasizes parental education is the feasibility of combining it with existing nutrition education and growth monitoring programmes just by adding new educational components. The costs for development or adaptation of a curriculum and materials, for training staff, and for the additional staff time needed for implementation, monitoring, and supervision should not be underestimated. Adding new information and activities to an ongoing programme may be a more feasible approach to integration than creating centre-based pre-schools or significantly expanding the parental education of such programmes. In fact, the PANDAI project suggests that broadening the scope of a programme may be motivating for parents, staff, and communities.

Educational components on psychosocial stimulation can be added to existing nutrition education and growth monitoring programmes.

Conditions that support programmes that combine nutrition and responsive parenting education for parents

- **Nutrition education would be appropriate given the existing nutritional situation (i.e. undernutrition is related to non-optimal feeding practices in conditions where household food security is poor but not limiting).**
- **Parental behaviours related to child psychological development and parent-child interaction could be improved.**
- **Parental interest in investing time and effort in child psychological development activities, but conditions are not conducive for a centre-based approach.**
- **Children at highest risk are younger than pre-school age.**
- **Existence of a community-based nutrition, health, or child psychological development programme with the potential to take on new activities.**

Other approaches

The three models presented above are examples of possible combined approaches based on programmes that we have reviewed. Several other models were not reviewed because of lack of information on their implementation and evaluation. They may, however, represent appropriate and effective approaches. There are many non-evaluated projects whose aim is to increase the resources or support systems for families through activities such as mothers' groups, credit and micro-enterprise development, or systems to link health, educational, and community services.

A child development programme in Chile, for example, which has introduced formal pre-school and parental education in urban areas, implements a different model in rural areas using mothers' groups and a special curriculum to reach children who could not attend regular pre-school (Young, 1996). Centre-based programmes, such as the network of pre-schools in Kenya and the Initial Education Project in Mexico, are starting to include nutrition components and reach out to parents and communities through activities such as cooking demonstrations and nutrition messages. Child-to-child activities can be implemented through local schools. Incorporating teaching on health, nutrition and childcare into the school curriculum can reach an important audience of school children who often care for their younger siblings and may soon become parents themselves. The Little Teachers programme in Botswana is an example of such a model.

A number of organizations that support women's employment have also developed childcare programmes, many of which are targeted to children from birth to age 3. The effect of these programmes on children's nutrition was summarized by Mehra, Kurz and Paolisso (1992). Programmes reviewed included India's Mobile Crèches, Senegal's seasonal day care centres, and Ghana's Accra Market Women's Association. These programmes tend to be closely connected to the women's workplace, and are under the governance of the women. According to project reports, there were significant improvements in nutritional status in over half of the projects. Children in day care homes or pre-schools also had lower rates of mortality and morbidity than their non-schooled mates. The authors conclude that the food itself, as well as the cleanliness and safety of the child care locations, caused these significant effects on children's health.

The psychological and educational interventions of the programmes reviewed by Mehra and colleagues were not specifically evaluated. However, the authors observed that this component of the institutional programmes was not nearly as strong as the health and nutrition component. The ratio of caregiver to child was about 1:15 in both institutional and home day care. This ratio contrasts with the recommendation in the U.S.A. of 1:3 for children under age 3 year. Kits for educational instruction were sometimes available but were not always used because workers lacked knowledge on their use, or feared that the children would harm the materials.

Centre-based programmes, such as pre-schools, can add nutrition components and reach out to parents and communities through activities such as cooking demonstrations and dissemination of nutrition messages.

The lessons that Mehra and colleagues drew from their review are that:

- Easy access to centres is a key determinant in the use of day care programmes.
- There is a need for quality control and training of caregivers in child psychological development, nutrition, health and hygiene.

Table 6. Options for combined health, nutrition, and psychological development programmes for children from birth to age 3 years

Type of programme (primary focus)	Specific programme	Delivery mechanism for nutrition	Delivery mechanism for psychological development	Examples
Health services	Primary health care and preventative care	Nutrition information and counselling	Health centre staff provide information on development; milestones on health cards	IFBECD in Thailand (Herscovitch, 1997); Health Cards in Malaysia (Shah, 1995)
	Primary health care screening	Screening for nutritional delay	Screening for developmental delays	
	Maternity care, safe motherhood promotion	Nutrition information and counselling	Parent support groups provide information on development in hospital or during prenatal care	Brazelton training (Widmeyer and Field, 1981) (experimental only)
Nutrition programmes	Growth promotion, nutrition education	Community based weighing and counselling	Community based assessment of child psychological development	PANDAI in Indonesia (Satoto, 1996)
	Food supplementation	Food delivered at home	Home visiting for stimulation	Grantham-McGregor, 1991; Waber et al., 1981 (experimental only)
	Breastfeeding support groups, mother support groups for child health and survival	Information in mother support groups	Information on psychological development, support groups	
Child care for working mothers	Child care facilities for working mothers	Food supplied during attendance at centre	Curriculum provided by trained community day care provider; parent education or parent involvement programmes	Homes for Well-Being, Colombia (ICBF, 1997), WHO/DFH Child Care Programmes (1995)
Early child psychological development programmes	Community child centre programmes	Food provided at centre	ECCD centre-based programmes	ICDS (1995), PRONOEI (Myers et al., 1985)
	Parent support groups	Nutrition education either in groups or in home visits with community workers	Parenting education either in groups or in home visits with community workers	Philippines Parent Effectiveness Programme; Honduras CCF Guide Mothers Programme; Chile Parents and Children Programme
Community development	PVO/NGO community development Programmes	Nutrition education based on local knowledge, participative methods	Informal pre-school, home visits, parent-derived curriculum using participative techniques	Golf project in Philippines; Laos ECFD Project (Arnold, 1998)
Micro-credit for women	Savings or income-generating projects for women	Nutrition education within women's groups	Women's groups discuss children's psychosocial needs, establish child care centres	Save the Children in Bangladesh (Arnold, 1998)
School-based	School curricula and teachers, or child-to-child programmes	Nutrition education	Psychosocial education	PROAPE in Brazil (Myers, 1992)
High-risk children	Rehabilitation programmes for severe malnutrition	Nutrition rehabilitation in health centres	Stimulation provided by home visits	Grantham-McGregor et al., (1987); Black et al., (1995)
	Hospital or TBA care for low birth weight infants; Kangaroo methods	Nutrition, breast-feeding education	Home visits for psychological development	Combined Health and Development Programme in U.S.A. (IHDP, 1990)
	Other child risks: AIDS, chronic illness, etc.			Richter et al.(1990, 1994)
General information	Mass media, videos	Information	Information	Kotchabhakdi et al. (1987); Black and Teti, (1997)

- Such programmes can significantly improve nutrition.

Other arenas for promoting combined physical growth and psychological development are programmes with agriculture, sanitation, health, and environmental activities. Combined programmes to improve nutritional, health, and psychological outcomes are now being planned at the national level in countries such as Uganda and the Philippines. Designs include a strong emphasis on community initiatives and building on existing programmes and institutions. Momentum is mounting for projects that combine interventions aimed at the whole development of the child, in the context of family and community. A summary of programme approaches is shown in Table 6.

Programmatic issues

So far this section of the review has addressed the benefits of combining physical growth and psychological development interventions from biological and psychosocial perspectives. There is also a practical rationale for integration. A combined programme should achieve cost efficiencies over two separate programmes. Multiple use of facilities and transportation, for example, as well as training and co-ordination of personnel to cover a broader range of needs, should contribute to more efficient resource utilization. Parental time costs to use combined services should also be lower, resulting in greater coverage.

Initially, we intended to examine whether the theoretical rationale for cost efficiencies was borne out in practice. Ideally, one would assess the advantages of combined programmes, and of one programmatic model relative to another, by comparing data on cost-effectiveness. The standard methodology for doing so would compare the cost of reducing child malnutrition by a given amount (e.g. a decrease in the prevalence of 10 percentage points) across programmes with different inputs.

The standard methodology is not adequate in this case, however, because of our dual interest in nutritional outcomes *and* psychological development outcomes. These two outcomes are measured in different units (e.g. kilograms versus IQ points) and are valued differently by society, thereby precluding a simple method for combining them. The method most commonly applied in this situation is to convert both outcomes to a common unit of benefit (monetary units) in the form of *cost-benefit analysis* (CBA). The CBA not only resolves the problem of mixed units of measurements; it also provides an estimate of the long-term returns to society for investment in such programmes. Such analyses have not yet been carried out for combined nutrition and ECCD interventions.

Marginal costs associated specifically with a nutrition or ECCD *component* are of particular interest when considering the advisability of combining interventions. We could not obtain the data from combined interventions needed to estimate marginal costs, but we consider this to be a high priority for future research. Much of the marginal cost of an added intervention will be related to staff time for training, implementing, supervising and monitoring the new activities. Studies of time spent on different activities in pilot programmes, such as those conducted as part of the Narangwal Nutrition Study in India (Kielmann et al., 1978) would provide valuable insights into relative and marginal costs of programme components. Costs reported in terms of time requirements are more directly comparable than monetary values and are useful for programme planning in other contexts. Thus, there would be no need to convert time requirements to currency values. Methodologies for cost analysis are beyond the scope of this discussion, but it is worth noting that even without complete information on programme costs, estimates of inputs such as time use would be valuable for planning purposes.

Potential programmatic advantages

Delivering interventions to those who are most likely to benefit

Underlying the argument for combined programmes is the recognition that the children who are most vulnerable to growth-faltering are also at highest risk of disruptions in psychological development, and that efficient targeting of programmes requires reaching these children and their care-givers. Parallel periods of rapid physical growth and psychological development during the first two to three years of life, and the broad effects of poverty on psychological development, mean that the same children in the same families are the most likely to be at risk of poor outcomes, and most likely to benefit from services or improved care-giving behaviours.

Reviewers of both nutrition and child psychological development programmes frequently note that potential impacts have not been achieved

because the youngest children are usually not reached (Beaton and Ghassemi, 1982; Gomby et al., 1995). The same could be said of failure to reach the poorest. It makes sense to provide combined services once the effort has been made to establish contact and motivate participation among those most in need or those families with infants and young children. It also reduces the time costs to the family.

Children who are most vulnerable to growth-faltering are also at highest risk of disruptions in psychological development. The dual focus of combined programmes can address both needs.

Combined programmes could also simplify screening procedures. For example, the association of poor physical growth with poor developmental outcomes indicates that monitoring of physical growth could be used to identify children in need of ECCD programmes, and measurement of physical growth is generally more feasible than assessment of cognitive functioning. Zeskind and Ramey (1979) found that low ponderal index (PI, height and weight) at birth predicted poor performance on infant mental scales at three months and again at 18 months for control children, whereas the low PI babies who received an instructional day care programme achieved normal scores at 18 months. This suggests that foetal malnourishment is an indicator of infants likely to benefit from intervention.

ECCD as an entry point and/or motivating factor for programme participation

A key principle underlying successful behaviour change programmes is that they must address the *felt needs* of the participants, and include the vital concerns that can motivate people to take action. Parents are generally very interested in promoting the psychological development of their children, particularly as societies become more technologically developed and school success gains importance (Richter, 1994). In contrast, chronic undernutrition is often not recognized, in part because often the norms for child size are far below those that exist in better-nourished populations.

Evidence suggests that caregivers may be more motivated to participate in combined programmes that provide information and activities related to child psychological development. For example, a child development chart designed as an assessment and education tool to be used in conjunction with growth assessment in Indonesia proved so popular with mothers that attendance at growth monitoring and promotion sessions increased (Zeitlin, 1996). Comments from mothers who participated in home trials of improved feeding practices in Tanzania and Ghana showed that the positive impact of the new practices include their perceptions about the effects on child behaviour. Mothers said that their children were more active and playful, cried less, and enjoyed eating more (Dickin et al., 1997). Similar comments were made in the evaluation of the HEARTH programme in Haiti. As a result of two weeks of supplementary feeding, parents reported that their children were happier and more energetic (Basics, 1997). Caulfield (1998), in her survey of nutrition programmes, reported that one of the messages linked to programme success was involving parents' aspirations for their children. The connection between adequate feeding and subsequent behaviour could motivate parents as much or more than the effects on physical growth and health that are usually assumed to be motivational for parents.

Co-ordination of messages, materials and approaches

Nutrition education programme materials, personnel, and contacts with families create excellent opportunities for discussing appropriate ways of interacting with and responding to children. Materials that deal simultaneously with child feeding, care, and educational practices have been developed by various programmes, and personnel have been trained to use them and to work with care-givers to facilitate the overall psychological development of the child. However, many of these are small-scale programmes and not evaluated.

Planners and personnel who are aware of both nutritional and developmental needs are also better equipped to avoid contradictory messages. An example from Sri Lanka illustrates the type of conflicting recommendations that could be avoided. A child psychological development project began to promote self-feeding of finger foods. The aim was to stimulate motor development and encourage more proactive feeding in a population that is characterized by high levels of growth faltering in toddlers. Unfortunately, the message conflicted with the recommendations from nutrition programmes in the same area,

which implied that children should be fed with a spoon only. A combined programme, however, would take into consideration the impact of each recommendation on multiple aspects of the well-being of a child.

Potential operational constraints to combined programmes

There may be disadvantages to combined programme models related to either operational constraints or cultural expectations in particular settings.

At the level of the family, there are constraints on the amount of time and other resources available to mothers and family members. Programmes must not over-burden families with additional tasks that make childcare more time-consuming. Programmes aimed at behaviour change must recognize the need to work in small steps and not provide too much information or expect too many additional activities to be adopted at once.

Programmes must ensure that they do not make parents feel at fault for deprivations in the home or community environment. Similarly, programmes must be aware of the potential for creating feelings of inadequacy about care-taking behaviours in the home. Both Richter and Myers also cite the dangers of disempowering parents through ECCD activities that remove culturally-mandated responsibilities from the parent to the childcare centre, or replace the role of the mother during home visits (Richter, 1994; Myers, 1992).

Parents should recognize that the child's own behaviour influences parental behaviour. The findings concerning the behavioural effects of a supplementary feeding intervention in Mexico illustrate this issue (Chavez and Martinez, 1975). Parental behaviours changed in response to the more demanding and engaging behaviour of the supplemented children. (This was perhaps due to the larger body size and faster psychological development of the supplemented children, which led to them being perceived as and responded to as older children, rather than babies.) The authors also noted that the greater activity levels required more precautions to protect the safety of these children, and that the supplemented children were more mischievous, disobedient and even aggressive.

Chavez and Martinez do not describe any negative shift in parents' attitude toward the children. To the contrary, they noted that the supplemented children were perceived as smart and good-looking, generating parental pride. In another cultural setting, however, such behaviour might be considered inappropriate and lead to less willingness to participate in a programme or new activity.

Cultural differences in child rearing may cause difficulties in programming. For example, programme credibility could be jeopardized if one component is inappropriate to the context or produces either no results or unacceptable outcomes. Harkness and Super (1996) noted that parents' interpretations of child behaviours vary across cultures, as does their understanding of children's psychological development. "These culturally organized understandings relate in systematic ways to action—including, for example, styles of talking to children, methods of discipline, or seeking advice from experts." Such cultural belief patterns would also influence motivation of parents to participate in a child psychological development programme and the type of behavioural and developmental outcomes expected from such a programme. For example, parents involved in PRONOEI reported that their children learned to sing and dance in the pre-school, but they hoped the children would also learn to read (Myers et al., 1985).

The community should be involved in the design and implementation of programmes to ensure that objectives are valued by participants, activities are culturally-appropriate, and participation is convenient and within household time and resource limitations.

The answer to this concern is to involve the community in the design and implementation of the programme to ensure that objectives are valued by participants, activities are culturally-appropriate, and participation is convenient and within household time and resource limitations.

Combined programmes can provide a focal point for community action. Above all, it is essential that communities have an early and continuing, meaningful role in the process of identifying needs and planning solutions. This not only ensures appropriate and useful programmes for their clientele, but also community ownership and decision-making, which are the foundation of effective, sustainable implementation.

At the programme level, problems to be avoided include overloading of the supervisory and management systems and the personnel, the facilities, and the people who are responsible for implementing activities in the community. Exist-

ing personnel may not have the expertise for both nutrition and child psychological development interventions. It is obviously important not to sacrifice quality in the interests of combining nutrition and child psychological development, and planners need to develop clear strategies for training, supervision, and monitoring. Tools, curriculum guides, and assessment measures are needed to assist communities in learning about psychological development, assessing community needs, and developing or adapting a relevant curriculum.

Another potential source of difficulty is co-ordination across departments or agencies. Myers (1992) concludes that rather than trying to force organizational integration, the emphasis should be on convergence and ensuring that various services arrive at the same place. Strategies include integrating content of materials, planning collaboratively, focussing on key components, creating inter-organizational activities (training programmes, materials, or experimental projects), and building political will. Also, an emphasis on bottom-up planning and implementation will be helpful, given that integration at this level is less problematic.

Chapter 6

Summary, conclusions and recommendations

Purpose of the review

This review explores the critical relationship between nutritional status and psychological development, and demonstrates the potential of combining interventions that enhance early childhood development and those that improve child health and nutrition into an integrated model of care. The premises that underlie the review are derived from a strong research base and include:

- Malnutrition causes both poor physical growth and psychological developmental delays.
- Malnutrition—measured by growth faltering—is causally related to mortality in infancy and early childhood, and interventions that reduce the incidence of malnutrition can significantly reduce mortality.
- In infancy and early childhood, when children are fully dependent on others for their nutrient intake, the *proximate* causes of malnutrition are: (1) receiving diets of poor quality and inadequate quantity, and (2) inappropriate feeding practices and behaviours, related to food preparation, frequency and interactions. There are, in turn, multiple socio-economic, cultural and psychological determinants of these proximate causes.
- There is evidence that in many communities with endemic malnutrition, both feeding practices and the selection of foods for infants and young children from the food sources that are potentially available within the community are not optimal.
- Many children in developing countries and disadvantaged populations in industrialized countries experience delays in psychological development that negatively affect their school performance, their ability to maximise educational opportunities, and their social functioning later in life.

Key questions addressed by the review

To encourage more widespread development, evaluation and expansion of combined interventions, the review addressed four key questions:

- To what extent and through what means can psychological functioning be improved for children living in disadvantaged environments?
- To what extent and through what means can child physical growth be improved in settings where chronic undernutrition is prevalent?
- To what extent and through what means can nutrition and psychological development be improved simultaneously through combined health, nutrition, and psychosocial interventions?
- Are there effective models for combined interventions, and are these models feasible for implementation on a public health scale?

To what extent and through what means can psychological functioning be improved for children living in disadvantaged environments?

Nutrition and education interventions significantly improve psychological development in disadvantaged populations.

- Model pre-school programmes have demonstrated significant impacts on psychological development. For example, children attending pre-school centre-based programmes gain an average of about eight IQ points by the time they are ready to start school. They are also less likely to repeat primary school grades or be placed in special education classes. There is also evidence that these programmes lead to improved school performance in adolescence, reduced anti-social behaviour, and improved employment opportunities in adulthood.

- Psychosocial interventions for low birthweight infants have successfully prevented or ameliorated developmental delays, a high risk for these infants.
- Food supplementation of infants and young children has significant impact on tests of psychological development. In infancy, the effects of nutritional interventions are most apparent on motor skills, but for older children, effects are seen on a variety of tests.
- Micronutrient interventions to prevent iodine deficiency have dramatic effects on psychological development, as well as the physical stunting associated with this deficiency. There is also solid evidence that correcting iron deficiency anaemia improves learning.
- Breastfeeding is associated with moderately higher levels of psychological development in a number of studies.

Significant improvements in psychological development are achieved through many different mechanisms:

- Child-focused interventions that provide stimulation directly to children in community child care centres;
- Parent-focused interventions, implemented through home visits, which improve parenting skills, including skills in providing stimulation to children;
- Nutrition interventions for infants and young children that are delivered through health services, nutrition services, social services, community organizations, and other mechanisms;
- Micronutrient interventions for infants and children that are provided through food fortification or supplements;
- Food supplementation and/or micronutrient interventions for pregnant women provided through health services, nutrition services, social services, community organizations, and other mechanisms;
- Joint-focused (direct services to child, indirect to parent) and combined (health and psychosocial) interventions that are delivered through health services, nutrition services, social services, community organizations, and other mechanisms.

In efficacy trials, these interventions resulted in statistically significant improvements in measures of psychological development and functional performance. With respect to early childhood care and development (ECCD) interventions, child-centred actions have been more successful in showing impacts on children than parent-focused interventions (although both are efficacious). This generalisation is based on evaluations of programmes in developed countries (mainly the United States). In less developed countries where malnutrition plays a much greater role in developmental delays, parent-focused programmes, with home visiting, have been quite effective.

To what extent and through what means can child physical growth be improved in settings where chronic undernutrition is prevalent?

Nutrition interventions significantly improve physical growth in poor and malnourished populations.

- Protein and energy supplementation in pregnancy can reduce the incidence of intrauterine growth retardation and improve birthweight, with a mean increase of 100 grams.
- Food supplementation of infants and young children has significant impact on physical growth, ranging from 0.8 to 5.0 centimetres on height and 40 to 800 grams on weight. Food supplementation also prevents growth faltering in children who experience high rates of diarrhoeal disease, permitting them to achieve heights and weights that are comparable to peers who do not suffer frequent episodes of diarrhoea.

Other types of nutrition interventions also have documented impacts on physical growth, although it is more difficult to estimate their magnitude from presently available evidence:

- Interventions that change diets and feeding practices improve physical growth. Well-designed and implemented nutrition education programmes can prevent serious malnutrition in communities where children are at high risk, without needing to raise family incomes (Caulfield et al., 1998).
- Interventions to promote breastfeeding improve breastfeeding behaviours, and these, in turn, are linked to improved physical growth.
- Micronutrient interventions do not appear to significantly improve physical growth, with the important exception of iodine and possibly of zinc. Well-controlled intervention trials with

zinc supplementation indicate the potential for small, but significant improvements in height and weight in settings with high rates of stunting.

- Intersectoral programmes to promote improvements in water and sanitation, agricultural production and food security can have positive impacts on physical growth if the intervention is appropriate to the social and economic context.
- Immunization activities, unless they are accompanied by improved health services, generally have not shown an impact on physical growth.

Evaluations of large-scale nutrition programmes have documented the feasibility and effectiveness of interventions to improve physical growth. However, for interventions to fulfil their potential, they must be well implemented, appropriate to the context, and directed to those in need. There is general agreement among professionals in public health nutrition that the *quality* of implementation and management is an important determinant of programme effectiveness.

To what extent and through what means can nutrition and psychological development be improved simultaneously through combined health, nutrition, and psychosocial interventions?

Combined interventions to improve both physical growth and psychological development have even greater impact in disadvantaged populations at risk of malnutrition.

- The stimulation, or psychosocial, component have significant effects on psychological development and language, particularly for younger children. Generally, physical growth is not affected.
- The nutrition component affects both physical growth and psychological development. Nutrition supplementation initially produces stronger effects on motor than mental development among infants, but affects a wide range of skills when children are over age 2 years.
- Combined nutrition and psychosocial interventions have a greater impact on psychological functioning than either intervention alone.
- Caregivers with limited formal education in developed and developing countries can acquire knowledge of nutrition, and feeding and parenting skills.

Combined interventions are delivered through child care centres, with feeding at the centre, or home visits providing parent education for child psychological development and food supplements. We point out that there are only a few well-designed community-based efficacy studies that have investigated the effects of combined interventions and more research is needed.

Are there effective models for combined interventions, and are these models feasible for implementation on a public health scale?

Full-scale programmes that include both nutrition and psychosocial components have been implemented throughout the world, and continue to increase.

- Interventions combining pre-school (stimulation and educational activities) with a minor nutrition component significantly affect psychological development, but have limited effects on physical growth. Most of the formally evaluated programmes use this model.
- The impact on physical growth is larger in programmes that include home visits and supplementary foods for younger aged undernourished children.
- Other promising models include using an already established growth-monitoring programme to teach parents about child psychological development and to promote new parenting skills, and disseminating feeding recommendations with information about psychological development via local media.
- Combined interventions are likely to be more efficient than separate interventions because they are intended for the same population and make use of the same facilities, transportation, and client contacts. From an economic standpoint, the marginal costs are expected to be low, relative to impact.
- From the perspective of the family, a combined approach increases access to services. It may also increase overall effectiveness because families who need early intervention often have a variety of risk factors (e.g. lack of maternal education, low birthweight, poverty), several of which may need to be addressed.

Examples of programme models that can incorporate nutrition, health and psychosocial components

- Incorporation of child psychological development into primary health care through the use of developmental milestones on health cards and the inclusion of simple messages for parents on how to facilitate psychological development.
- Promotion and support of home-based group child care, combined with supplementary feeding for children of working mothers, sometimes with a micro-credit programme.
- A child-to-child strategy in which older siblings learn skills to help improve the psychological development, health, and nutrition of pre-schoolers.
- Community development projects that use home visiting and pre-school programmes as an entry point for other interventions such as income improvements.
- Interventions with high-risk children, such as low birthweight infants, that combine both psychosocial and nutritional care.
- Parent education courses and mothers' groups, including breastfeeding support groups.
- Mass media programmes (radio, TV, videos) that target both physical growth and psychological development.

Conclusions

Although the number of combined programmes that have been evaluated is limited, such programmes are effective, particularly if they are appropriate to the context. There are several conditions under which the greatest impact on growth and development are most likely to be seen.

- Interventions during the earliest periods of life—prenatally, during infancy and early childhood—are likely to have the greatest impact. Interventions to support psychological development after this particularly vulnerable early period, however, are also effective.
- The children in greatest need due to poverty or parents' lack of knowledge are generally the ones who show the greatest response to growth and development interventions. Identifying the families and children who are mostly likely to benefit from such interventions should improve outcomes. There is also evidence that certain positive characteristics or resources of families (such as maternal education) contribute to a greater response.
- Growth and development programmes that utilize several types of interventions and more than one delivery channel are more efficacious than those that are more restricted in scope. Types of interventions include nutrition education on diet and feeding practices, providing supplementary foods or micronutrient supplements, teaching parents about child development milestones, demonstrating cognitive stimulation activities or other activities to improve parenting skills. Types of delivery channels are individual home visits, group counselling, childcare centres and mass media.
- Greater effects are usually seen with interventions of longer duration and higher intensity. However, positive effects of short-term interventions, particularly with micronutrient supplementation, have also been demonstrated.
- Combined programmes could be more efficient at delivering services through reductions in delivery costs, less duplication of services, and appropriate identification of those who are most likely to benefit. There are also likely to be savings for families as a result of easier access when services are combined and families are more likely to be motivated to seek those services.
- Programme efficacy and effectiveness appear to be greater when parents are more involved.

Issues affecting programme success

Despite the success of interventions, children who are nutritionally or socio-economically disadvantaged never fully catch up to the level of well-nourished, more privileged children. Over time, children in disadvantaged environments become progressively more disadvantaged with respect to outcome measures on psychological developmental tests, and these test scores reflect the progressive social and educational disadvantages that they suffer. In many cases, the effect of interventions is to prevent or slow down the progressive deterioration that is a common fate of children in deprived environments.

Supplementary feeding or increased stimulation during relatively short periods of children's lives (such as periods of malnutrition) will not

obviate all the difficulties of growing up in a disadvantaged environment. The positive effects of ECCD and nutrition interventions cannot be expected to persist indefinitely in the face of the daily effects of such an environment. There is a need for continuing programmes of support that are tailored to the changing needs of children and adolescents.

Recommendations

We need to develop and test a model of combined interventions that could reach a large proportion of children who are at risk of growth and development faltering.

Appropriate feeding (food and practices) and responsive parenting (e.g. attentive listening, proactive stimulation, and appropriate responses) need to be promoted where children are suffering from malnutrition and developmental delays due to poverty. The review points to the value of interventions that *combine* activities to support both.

A necessary first step is to further develop and test a model that combines nutrition and psychosocial interventions. The model should be likely to be effective and feasible within the context of a public health programme that is delivered through the health services or community-based programmes. It should focus on children from age 0-3 years, their most vulnerable years. It should seek to improve the health and development broadly among children, rather than be limited to children in particular risk groups or with identified disabilities. The intervention should identify ways to deliver and strengthen the counselling of caregivers in order to improve their knowledge and skills about appropriate foods and feeding practices, including breastfeeding, and help them provide more responsive and stimulating care to enhance the psychological development of their children. The counselling should also be specifically related to the child's changing nutritional requirements and readiness to learn new skills as he or she grows and develops. Whenever necessary, the intervention should also provide supplementary foods and/or nutrient supplements.

To operationalize this type of intervention, the following steps are suggested:

- Develop a generic counselling package, with guidelines on how to adapt it to local cultural and environment conditions.
- Define the most appropriate approach to presenting this information and building skills based on principles of modelling, feedback, and culturally appropriate communication.
- Define special groups of children or conditions and identify particular information for those groups (e.g. malnourished children).
- Identify mechanisms and channels for the delivery of the package (e.g. growth promotion programmes, health service contacts, community health worker programmes, breastfeeding promotion or reproductive health programmes, or other community organizations).
- Develop guidelines for identifying the families who need additional supports in order to implement the recommended behaviours (e.g. supplementary foods, micronutrient supplements, and other types of social support).
- Develop tools for training, monitoring, and supervision of the counselling and support package.
- Develop evaluation tools, including methods

Rationale for combined nutrition and development interventions

- **Many households in conditions of poverty potentially have the resources to provide adequate diets and use good feeding practices of the type that support normal growth. What they lack are knowledge and skills about how to do this within their local environmental and cultural context.**
- **Many other households in conditions of poverty are more severely constrained economically. In addition to knowledge and skills, they require assistance in the form of supplementary, nutritious foods and/or nutrient supplements for their infants and small children, and for consumption by mothers during pregnancy and lactation.**
- **An important factor in developmental delays associated with malnutrition is the evolution of the behavioural transactions between the malnourished child and his or her caregivers, in which the child becomes progressively more apathetic and less demanding and caregivers provide less stimulation and responsive interactions.**
- **Feeding is a central aspect of caregiving in infancy and early childhood, and the teaching of feeding skills provides an opportunity to teach other caregiving skills, including responsive parenting to provide stimulation for psychological development.**

for assessing psychological development that are culturally appropriate.

- Identify mechanisms for strengthening family resources for providing responsive care and stimulation, including greater control of caregivers over resources, time availability, and infrastructure systems, such as improved water and sanitation.
- Identify mechanisms and channels for supporting and facilitating family behaviour change with respect to appropriate feeding and responsive parenting through activities directed to the community (e.g. communication and community development activities).

We should develop and implement new activities to promote appropriate feeding and responsive parenting in existing child health programmes.

We should expand and strengthen the health, nutrition, and breastfeeding components of existing early childhood care and development (ECCD) programmes.

Health and nutrition service infrastructures and community-based outreach programmes provide a potential basis for new and expanded packages of nutrition, health promotion and child development activities. This requires bringing together expertise in child psychological development, health services, and nutrition to develop a package of integrated activities.

Activities could be incorporated into well-child clinics, primary health care consultations for childhood diseases, prenatal care, and nutrition programmes, such as growth monitoring, nutrition education, breastfeeding promotion, and nutrition rehabilitation centres. Health staff could work with community agencies, non-governmental organizations (NGOs), and other groups to incorporate appropriate feeding and parenting education into on-going community programmes. Informational materials about appropriate feeding and responsive parenting could be utilized and disseminated by the educational sector.

Actions outside the health sector

The need to address the determinants of malnutrition in children has been effectively articulated in a number of international arenas, including the International Conference on Nutrition (FAO and WHO, 1992) and the World Food Summit (1996). We note that there are also actions that can be taken by the health sector in support of non-health sector activities. The health sector has an important role to play in creating and disseminating informational materials about the close relationship of appropriate feeding and responsive parenting for the child's psychological development. It can also motivate and support the educational sector and the media to provide information and support to families on appropriate feeding and responsive caregiving.

ECCD and day care programmes afford vital opportunities to address problems of malnutrition and promote physical growth. However, it appears that the nutrition component of these programmes is often weak in comparison with activities aimed at the promotion of psychological and social health. We recommend that high priority be given to efforts to identify ways to expand and strengthen this component, particularly in relation to family and caregiver behaviours.

We need to design an expanded research agenda to compare and evaluate the effectiveness of different content, programme venues, and delivery channels.

The research community must be mobilized. Research efforts are required not only to address critical gaps in knowledge, but also to evaluate proposed programmes and their components, to identify means of overcoming barriers to implementation, and to develop new and more efficient methods for institutionalising and sustaining programmes.

Research and development should focus on combined (integrated or convergent) nutrition, health, and psychosocial interventions for children from 0-3 years of age. The interventions developed should involve the family, which is the child's primary caregiving system. Support for the interventions (e.g. technical background, training materials, tools for evaluation and monitoring) should also be developed.

As it is difficult to draw conclusions for programme implementation from individual field trials, a research agenda to evaluate different approaches and to clarify operational issues should be developed. The intervention research agenda should include comparisons of different channels or types of delivery mechanisms (e.g. health workers, parent support groups, and home visiting). The research must be conducted in developing countries in collaboration with established in-country investigators.

Annex

Seven Programme Models

1. Integrated Child Development Services (ICDS), India

Objectives

- Improve nutritional and health status of children under age 6.
- Lay the foundation for proper child physical growth and psychological development.
- Reduce mortality, morbidity, malnutrition and school dropout rates.
- Achieve effective coordination of policy and implementation.
- Enhance the mother's ability to look after the normal health and nutritional needs of the child.

Programme participants and components

- 3- to 6-year-olds.
- Non-formal pre-school education provided courtyard centres.
- Supplementary feeding for children, malnourished children, pregnant and nursing women.
- Health and nutrition education, and growth promotion.
- Health services and links with primary health care: immunization, vitamin A supplementation, referral, treatment of minor illness.

Personnel

- 300 000 Anganwadi workers (AWW, or local women selected by government) and equal number of helpers.
- AWWs expected to have matriculated (10 years of education) and live in the community but criteria are relaxed (5–8 years of education) if necessary.
- AWWs paid a minimal stipend.

Training

- Formerly three-month pre-service training in one of over 300 training centres. Now replaced with 3 phases totalling 3 months of institutional and 4 months of community-based training.
- Short refresher training courses.

Supervision and management

Each child development programme officer is responsible for implementation and management of about 100 centres, covered by 5 supervisors, who in turn supervise 20 AWWs.

Responsible agency

Department of Women and Child Development in the Ministry of Human Resource Development.

Implementation

1975 to present. 3 907 centres operational in 1995.

Coverage

17.8 million children (under 6 years) and 3.8 million expectant and nursing mothers from disadvantaged groups and communities. The largest programme of its kind in the world. Almost 70 percent of country's community development blocks.

Cost

$10 to $22 per child per year (or 1/15 minimum wage).

Effectiveness

Evaluation design

- Numerous small studies and a national evaluation.
- Adequacy designs, with little control for self-selection biases in some studies.

Impact on physical growth

- National evaluation found lower levels of undernutrition in ICDS areas (about 2 percentage points lower Grade III and IV; statistical significance and basis of comparison groups unknown).

- Evaluation of USAID-assisted sites in Panchmahals and Chandrapur found reductions in infant and toddler mortality rates and improvements in weight-for-age, despite occurrence of drought. Changes were seen over a 10-year period, with no comparison groups.

Impact on psychological development

- National Institute of Nutrition evaluation compared beneficiaries, defined as children who attended regularly (3 times/week for 6 months) to non-participants in same communities. Beneficiaries scored higher on cognitive tests than non-participants, but still lower than expected for their chronological age, especially among the older children. No relationships were found between weight-for-age and test scores.
- Chaturvedi and colleagues (1987) compared 6- to 8-year-old children in ICDS and control communities, and found significant differences in percent of children in school, age of school entry, and for females, Raven's Progressive Matrices Test scores.

Other outcomes

- Reductions in infant mortality rates and increase in immunisation coverage in ICDS vs. non-ICDS areas.
- Higher primary school enrolment, especially among girls.

Factors influencing effectiveness

- AWWs' responsibilities include knowing and visiting homes of malnourished children, making them accountable for reaching needy families.
- AWWs reported to be over-burdened.

Sources: ICDS, 1995; Myers, 1992; Tandon, 1989; Consultative Group on Early Childhood Care and Development (CGECCD), 1993; ACC/SCN, 1991; Vazir and Kashinath, 1995; USAID, no date; Chaturvedi et al., 1987.

2. Head Start, U.S.A.

Objectives

- Provide comprehensive child development services for low-income children and their families.
- Meet pre-school children's educational, health, nutritional, and psychological needs.

Programme participants and components

- 3- to 5-year-olds.
- Pre-school education (usually part-day for the duration of school year). At least 90 percent must be from families below poverty line, 10 percent disabled. Most programmes have waiting lists and selection criteria vary, but generally reflect need.
- Multi-cultural, bilingual curriculum.
- Meals/snacks provide at least one-third of daily nutritional needs.
- Health care services: physical exam, assessments of growth and immunisation status, vision, hearing, speech, anaemia and other prevalent health problems, with referral to free medical care.

Personnel

One-third of employees are parents of current or former Head Start students.

Training

Not specified.

Supervision and management

Grants are awarded to local public agencies, private non-profit organizations and school systems to operate programmes at the community level.

Responsible agency

U.S. Department of Health and Human Services (DHHS).

Implementation

1964 to present. In 1994, there were 1 405 grantees and 40 295 Head Start classrooms. Programmes vary since locally operated. Recent initiatives include Head Start transition projects that continue support services through third grade, family service centres to provide literacy, treatment of substance abuse and employment programmes for families, and home-based programmes for children under 3 years of age.

Coverage

In 1995, 622 000 children or about 30 percent of eligible 3- to 5-year-olds.

Cost

$4 000 per child per year (Currie and Thomas, 1996).

Effectiveness

Evaluation design

- Most studies suffer from selection biases and lack of appropriate comparison groups.
- A recent analysis of two national data sets had a high plausibility design comparing siblings who did and did not participate (to control for unobservable differences in families and to control for observable child characteristics) and comparing the effect of other pre-schools relative to no pre-school (Currie and Thomas, 1995; Currie and Thomas, 1996).

Impact on physical growth

- No impact seen on height-for-age. (None was expected since not a period or population vulnerable to active stunting).

Impact on psychological development

- Positive effects noted on the Peabody Picture Vocabulary Test (PPVT). Effects persisted into and translated into improved school attainment for white and Hispanic (especially of Mexican origin) children but not African-American children.
- By various measures, Head Start closed one-fourth to two-thirds of the gap between children attending the programme and their more advantaged peers.

Other outcomes

- Currie and Thomas (1995) extrapolate that enrolment increased future expected wage by 4 percent and chance of completing school by 5 percent.
- Any pre-school experience, including Head Start, was associated with improved immunisation status.

Factors influencing effectiveness

- Database did not allow analysis of programme characteristics.
- Some evidence that children of mothers with higher test scores benefited more from Head Start.
- Ethnic and language characteristics of home influenced impact.

Sources: Currie and Thomas, 1995; Currie and Thomas, 1996; Lee et al., 1988; The Future of Children, 1995.

3. PANDAI (Child Development & Mother's Care) Project, Indonesia

Objectives

- Improve child growth and development through changing child care-taking behaviour and improving home and environmental stimulation.
- Increase parental sensitivity to children's needs and capabilities.

Programme participants and components

- 0- to 5-years-old, but materials developed specifically for children up to 36 months.
- Curriculum based on 36 developmentally sequenced items or milestones that form the basis of the Child Development Card (KKA), given to parents (similar to growth monitoring card).
- Home-visits to improve parent-child interactions, to teach parents to interact with child in ways to stimulate learning, and to teach parents to monitor development of child with KKA.

Personnel

Kaders, women from community who are already involved as volunteers in the local health centre activities, conducted home-visits and assessments.

Training

Kaders given additional training on appropriate child care-taking behaviours, their importance for child development, and use of Child Development Chart to assess child's progress.

Supervision and management

Kaders supervised by local health centre staff, who in turn are supervised by a medical doctor and psychologist.

Responsible agency

Ministry of Health and Diponegoro University, Semarang, Indonesia.

Implementation

Initial pilot test with 150 children and illustrated materials based on the Portage curriculum. Now expanded to wider area (but less intensive) as a component of nation-wide Child Development Programme (BKB). Added to on-going nutrition education and growth promotion programme implemented in communities.

Coverage

Not specified.

Cost

Not specified.

Effectiveness

Evaluation design

- Pre- and post-test evaluation of impact of 18-month pilot intervention with 150 children, compared to 150 control children from communities without the intervention.
- Full-scale programme has not yet been evaluated.

Impact on physical growth

- No significant impact seen on weight-for-age.
- Some evidence of improvements seen in child feeding practices and reported dietary intake.

Impact on psychological development

- Post-test scores for mental and motor development significantly improved relative to pre-test among intervention group only.
- Greatest effects were for motor development of younger children.
- Significant improvements seen in parental behaviour in intervention group, measured by HOME test, with improved scores for verbal and emotional responsiveness, play materials, and parental involvement.

Other outcomes

- Qualitative assessments indicated that mothers and fathers were motivated by the intervention and requested more information.
- Some spill-over effects on neighbours were noted.

Factors influencing effectiveness

- The intensity of this pilot intervention and the fact that kaders chose as participants only 4 or 5 families that they knew from their on-going community health activities had an effect.
- Cannot be considered as an evaluation of a full-scale programme. However, it did generate enough interest that other parts of the country asked to become involved and expand the programme.

Sources: Unpublished materials provided by Dr Satoto, Diponegoro University, Semarang, Indonesia, many of which were jointly prepared with Dr Nancy Colletta, University of Maryland, Baltimore, MD.

4. PRONOEI, Peru

Objectives

Not specified.

Programme participants and components

- 3- to 5-year-olds.
- Parents and community members involved in parent committees.
- Non-formal pre-school held 4–5 mornings per week, using Piagetian curriculum.
- Snack or noon meal.
- Some income-generating projects as spin-off.

Personnel

- Animators (men and women selected from community) run the pre-school and are paid minimal incentive by Ministry of Education, which is supposed to be supplemented by community.
- Mothers take turns preparing the snack or meal for the children.

Training

Little training provided, although guidance is to be given by coordinators. Increasingly, animators have experience as an assistant before becoming the animator.

Supervision and management

Teacher coordinators responsible for training, supervising and advising animators. Coordinators visit 6–24 communities 5 times/year. Parent committees also involved in management.

Responsible agency

Ministry of Education.

Implementation

Initiated on small scale in Puno in 1967, expanded to Department of Puno 5 years later, subsequently expanded to 4 Departments. Site often donated by community members, and some built by community with materials provide by donors.

Coverage

About 2 000 PRONOEI in 4 regions receiving USAID assistance in 1984, which represents about one-third of all PRONOEI. Enrolment from 20–32 (average 29) but not all attend regularly.

Cost

$28 per child per year excluding community con-

tribution; $40 including in-kind contributions (1985). (Also estimated as 1/14 of minimum wage or 1/40 of GNP per capita.)

Effectiveness

Evaluation design

- Testing of mental, motor and social development with locally developed scales.
- Comparison of PRONOEI and non-PRONOEI communities in 3 Departments. In two departments, the non-participant mothers were better educated.
- Pre-/post-test comparisons available on a small sample.

Impact on physical growth

- Effects on anthropometric indicators were not seen, except that the gap between boys' and girls' nutritional status was less in some PRONOEI groups.
- Nutritional supplementation has not been a consistent focus of the programme, amounts provided are not substantial, and children are not in period of active growth faltering, so the lack of effect is not surprising.

Impact on psychological development

- In Puno, where the programme is well established and control group was comparable, PRONOEI children scored significantly higher than controls on all three subscales.
- No differences seen in the other two departments except for higher scores for PRONOEI children on social sub-scale in one department.
- Pre-test/post-test comparisons suggest greater improvement over 5 months among PRONOEI children, among those who begin with very low level of ability, and especially social skills.

Other outcomes

- Differences in school progress and performance in first three years of primary school were not found, but this may reflect poor quality of the primary schools themselves.
- Some effects on community such as attention to education, nutrition and health topics at community meetings.

Factors influencing effectiveness

- Low attendance (due to illness, distance, parental apathy, lack of food supplementation).
- Lack of trained coordinators, and support to animators.
- High turnover of animators, lack of payment by community.
- Location in remote communities.

Sources: Myers et al., 1985; Myers, 1992.

5. Programa de Alimentacao de Pre-escolar (PROAPE), Brazil

Objectives

Not specified.

Programme participants and components

- 3- to 6-year-olds.
- Snack, including milk.
- Supervised psycho-motor activities.
- Health component: check-ups, immunisation, dental care, hygiene, and visual examinations.

Personnel

- Combination of trained personnel (usually para-professionals from the community) and parents.
- Staffing varied in different areas but generally included paid staff.

Training

Not specified.

Supervision and management

Not specified.

Responsible agency

Ministries of Health and Education.

Implementation

Pilot began in 1977. Expanded to 10 other states in 1981. Held in community sites with groups of about 100 children. Not community-controlled. Not currently operating—this is an example of a programme shown to result in cost savings (see below) by government evaluations that was nevertheless discontinued for other reasons.

Coverage

10 states, with reportedly large numbers of children.

Cost

$28 per child per year.

Effectiveness

Evaluation design

- Compared participants and non-participants in various locations.
- Other aspects of design and comparison groups not known (reports cited by Myers not available).

Impact on physical growth

- Marginal impact seen as expected given factors cited for Head Start and PRONOEI.

Impact on psychological development

- Combined repetition and dropout rate of 39 percent for PROAPE children vs. 52 percent for controls in first grade, and 27 percent vs. 44 percent in second grade. Total cost for second grade graduate 11 percent less for PROAPE participants (including cost of PROAPE).
- In another evaluation, 73 percent PROAPE children passed first grade vs. 53 percent of children with no pre-school experience. Cost per first grade graduate was 17 percent lower for PROAPE participants.

Other outcomes

Not specified.

Factors influencing effectiveness

Not specified.

Source: Myers, 1992.

6. Hogares Comunitarios de Bienestar (Homes of Well-Being), Colombia

Objectives

- Improve psychosocial, moral, and physical development of children under 7 years (directed to poorest sectors).
- Provide stimulation and support for socialisation.
- Improve nutrition and living conditions.
- Strengthen the responsibility of parents in combination with the community for care of children.

Programme participants and components

- 2- to 5-year-olds (can have up to 2 children less than 2 years of age per centre).
- Centres in 1 042 municipalities; 882 000 children; 54.3 percent of target population of poorest families.
- Community mothers (CM) hold pre-schools for up to 15 children from 0–7 five days a week.
- CM provide love and protection, educational activities, and food (68 percent of requirements).
- Association of Parents (up to 25 homes) is responsible for the programme and receives funding from the state.
- Children were weighed and measured on average three times a year.

Personnel

Community mothers.

Training

Community mothers receive training prior to starting.

Supervision and Management

Centres supervised by Association of Parents, and a committee for oversight. Association supervised and trained by a Centre for the Zone.

Responsible agency

Colombian Institute for Family Welfare.

Implementation

Not specified.

Effectiveness

Evaluation design

- Nation-wide probability sampling of community homes: 4 762 day care homes, 798 community associations, 69 000 children with a sub-sample of 23 810 children, and a slightly smaller number of parents.
- Two types of analysis: Description of day care homes, community associations, children and parents; and multivariate analysis of multiple influences on children. No control groups.
- Analysis examined the relation of quality of service and length of exposure to child nutritional status, health, and psychosocial development. A second analysis compared quality of programme to overall child outcomes.

Impact on physical growth

- In general, no evidence for improvement in nutritional status.
- Rates for malnutrition lower in children from

24–47 months living in particular areas with very poor parents, and in day care centres in which the dietary recommendations of ICBF were met.

Impact on psychological development

- Qualitative development scale (Escala de Valorizaci Cualitativa del Desarollo Infantil) to classified children in terms of 12 processes into three categories: at risk (three or more processes at risk), normal, and advanced.
- Higher percent of at-risk children found at younger ages: 8.6 percent at risk at age 3 versus 0.8 percent for age 6. However, there was no relation between time of exposure and percent at risk.

Other outcomes

- A significant association (r=0.17) between quality of the programme and degree of well-being based on a global indicator of health, nutrition, and psychosocial development was found.
- Quality was defined by health conditions of day care home, practice of evaluating psychosocial development, knowledge of the community mother (CM) about child care, food prepared for the children, attitudes of CM toward children, keeping records on children, and the characteristics of the CM's family.
- Families had low levels of involvement in the programme, contrary to the stated goals of the project.

Factors influencing effectiveness

- In 86 percent of day care homes, the menu was correct, but in the visits, only 29 percent of community mothers prepared the lunch food adequately.
- Some community mothers never trained (14 percent), and conditions of houses were poor.
- About 28 percent of community mothers never planned any pedagogical activities.
- The longer the community mother had been running the centre, the lower the percent of children at risk of developmental delay.

Sources: ICBF, 1997; Instituto Colombina de Bienestar Familiar, Bogota, Colombia, 1997.

7. Integrated Programme for Child and Family Development (IFBECD), and Family Development Programme (FCP), Thailand

Objectives

- Enhance public health and nutrition service with other aspects of child development using health "pink books" revised to include ECCD messages.

Programme participants and components

- 0- to 6-year-olds.
- Home-based, centre-based and mobile ECCD programmes, enhanced by volunteers.
- Non-formal education including information on parenting and family life education.
- Primary education incorporating child-to-child messages for 5th and 6th graders including topics such as cleaning, making toys, playing, reading, food and nutrition, etc.
- Toy library.
- Agricultural extension to increase food security.

Personnel

Trained child development worker in the community (also often the health worker) and women's groups in the community.

Training

Not specified.

Supervision and management

Not specified.

Responsible agency

Initially a partnership of the Government of Thailand, UNICEF, NGOs, and a university under a rotating committee secretariat, with partners from several parts of government (e.g. Ministries of Health and Agriculture). Now run by National Institute for Child and Family Development, with many new partners as project expanded to include youth and adolescence. Local community organizations selected volunteers for project.

Implementation

Pilot began in 1990. Expanded to 16 provinces in 1992, and expanded to all 75 provinces in 1995 as FCP following government commitment. Current phase to terminate in 1998.

Coverage

All provinces and districts except Bangkok (FCP). More than 23,739 children under age 6 years, 3 192 families, and some older children and youth.

Cost

Not specified.

Effectiveness

Evaluation design

- Pre/post comparison and treatment and control communities in two provinces for first phase of the project (IFBECG).
- Two different sites or provinces were evaluated—one high intensity, and one low intensity.

Impact on physical growth

- High intensity: Both groups increased in nutritional status.
- Low intensity: No effects on growth overall, except that greatest changes seen in poorest villages.

Impact on psychological development

- High intensity: Programme villages showed an increased proportion of average and bright children, but both groups improved.
- High intensity: Parents' perceptions of children's developmental level improved more in programme villages.
- Low intensity: IQ scores improved modestly in both groups. In programme sites, fewer children had a decline in IQ scores over time.
- Low intensity: Home scores improved more in programme sites.

Other outcomes

Not specified.

Factors influencing effectiveness

- Prepared materials that could be used by all workers.
- Difficult to have workers focus on psychosocial care rather than physical care and growth.
- Organization and coordination between various groups, including funding for purposes of coordination, formed a spirit of cooperation.
- Strong village organization builds on in implementing activities.
- Political commitment shown by government.
- Focus lost when project moved from emphasis on 0- to 6-year-olds to the larger FCP approach which targeted 0- to 18-year-olds.
- Workers were unclear of roles, there was insufficient time to do all of the projects, and only 32 percent of workers felt that they understood the purpose of the project. Many workers felt that this was simply an additional job added to their already overloaded job, and little occurred.

Source: Herscovitch, 1997.

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