'It's not just about food': mother–infant interaction and the wider context of nutrition

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Abstract

In recent years, attention has increasingly focused on the wider context of nutrition, rather than simply on calorie and nutrient intake. Recent estimates put the figure of people in the world living in extreme poverty (an income of less than \$1 a day) at 1.1 billion. This has significant implications for nutritional deficiencies in infants and young children. In this paper, we will show how the physical growth and psychological development of infants and children are intimately linked, and how many of the same aetiological factors (such as caregiver sensitivity, psychosocial support, communicative exchange between infant/child and their caregiver) are implicated in both domains. Preliminary evidence indicates that community-based interventions impact on the mother–infant relationship as well as infant physical growth, and contribute to the increasing sense of how aspects of the early relationship between infants and their caretakers are crucial to any complete understanding of infant growth and development. The paediatric food-based dietary guidelines (PFB DGs) include guidelines relating to the mother–infant relationship and may thus prove to be a significant tool in community interventions.

Keywords: mother–infant interaction, nutrition, South Africa, paediatric food-based dietary guidelines.

A significant contributing factor to the optimal functioning of any society is the physical and psychological health of its inhabitants. The prenatal period and the first 2 years of post-natal life are the two

periods of the most rapid growth, and deficiencies (nutritional or psychological) during this time often have sequelae evident during the rest of the life course. When deficiencies in infancy continue through childhood their impact is often felt in additive ways, increasing the risk exponentially for later disturbances in physical and psychological functioning.

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In this paper, we will provide support for the paediatric food-based dietary guideline (PFBDG) 'Enjoy time with your baby' that appears for babies in both the 'birth–6 months' and '>6–12-month-old age' categories. We do this by illustrating how the physical growth and psychological development of infants and children are intimately linked, and how many of the same aetiological factors (such as caregiver sensitivity, psychosocial support, communicative exchange between infant/child and their caregiver) are implicated in both domains. This will be done in order to illustrate how any attempt to artificially separate them (other than for heuristic purposes) will prove unsuccessful. In presenting the argument, we will build a case for the impact of nutritional deficiency on infant and child development, the interactional capacities of the infant and how disturbances in the early mother–infant relationship contribute to particular negative child outcomes, and finally show how nutritional intake and the interaction between caregiver and infant and child are intimately linked. This paper is not an extensive review of all the factors that contribute to disturbances in the mother–infant relationship and as a consequence poor physical outcome. Factors such as gender inequality, violence against women, social adversity and poverty, all contribute to many of the issues raised in this paper. Maternal depression for instance is related to social support (Cooper *et al.* 1999), which in turn is related to the position of women in many societies. The role of poverty and gender inequality is in no way being ignored or deemed to be less importance. Rather, the focus of this paper is on the link between the physical growth and psychological development of infants and children, and the possible mechanisms mediating this relationship.

Nutrition and infant and child development in the developing world

Perhaps the most sensitive indicator of a child's nutritional and health status is that of physical growth (Richter *et al.* 1994). As an indicator of the qualities of the early environment, physical growth is a proxy and not a direct measure of adequate nutrition (Desjarlais *et al.* 1995). This is important when conceptualizing

physical growth in a holistic way and seeing it as dependant on nutritional intake as it is on the quality of the caregiving environment.

Levels of nutritional deficiency and malnutrition in the developing world are particularly high. Protein-energy malnutrition (PEM) affects the life of about a quarter of the world's population (800–1000 million) on a daily basis, and about 15 million people die each year as a direct result of malnutrition (World Health Organization n.d.). Because of PEM, 150 million children in the world are underweight while 182 million are stunted (World Health Organization n.d.). According to Pelletier *et al.* (1995), malnutrition is implicated in more than half of the 10 million child deaths in the developing world, and furthermore causes significant disability and disease in those children that survive.

Poverty and poor nutritional intake are significant causes of the high levels of poor infant and child physical growth. Malnutrition has been shown to decrease cellularity of the brain, particularly if the malnutrition occurred during pregnancy (as is evidenced by low birthweight) and in the post-natal period (Read 1982). Throughout the world, infant and child physical growth is related to socio-economic status. Across age groups, infants and children from higher socio-economic groups weigh more and are taller than those from lower socio-economic groups (Baumeister *et al.* 1991). Poor nutrition has been implicated in delayed cognitive development (Lasky *et al.* 1981; Pollitt *et al.* 1993); long-term damaging effects on infant and child intellectual and psychological development (Cheung *et al.* 2002; Grantham-McGregor 2002); severe infection (Black *et al.* 1984); and because undernutrition is a major contributor to the chances that the infant and child will succumb to a life-threatening disease, it is estimated that poor nutrition accounts for about 70% of under-5 mortality in the developing world (Richter *et al.* 2004),

Complexities of nutritional intake

A simplistic model might suggest a clear linear relationship between nutrient intake and later physical development. If there is sufficient food, physical development will move along on track; a lack of food

will have negative implications for physical development, while too much food will result in obesity. The relationship, however, is by no means a simple causal one, but rather a complex interaction between various factors – related in turn to food; mother–infant interaction; family factors such as parental control, infant and child temperament and disposition; environmental and cultural factors; and genetic factors.

Evidence exists that the feeding methods and behaviour of parents can directly influence both the quality and quantity of children's nutritional intake (Richter *et al.* 1994). Infants and very young children are not able to regulate their feeding and food intake independent of their caregiver, while even in toddlers and older children their ability to self-regulate food intake is strongly dependant on parents, family and interactions with peers (Birch & Fisher 1998). As Scheper-Hughes (Scheper-Hughes 1991) has so eloquently demonstrated, when infant mortality rates are high, the provision of adequate care and nutrition becomes part of a complex internal psychic process in which caregivers may strive to protect themselves from the trauma of potential bereavement by choosing not to engage with their infant.

An interesting phenomenon in the developing world is that infant anthropometric data in the first 6 months resembles that of developed countries (Birch & Fisher 1998). Richter and Norris attribute this to almost universal breastfeeding (Richter *et al.* 2004). The drop-off in weight after 6 months (Reifsnider 1998) is attributed to factors such as infection, poor weaning and low levels of stimulation.

In many parts of the world, extreme poverty and an absolute lack of access to food results in severe malnutrition. In cases of an extreme lack of food and resulting malnutrition, the relationship between nutritional deficiency and compromised development seems to be causal. As malnutrition lessens, the relationship appears to be less directly causal, with outcomes strongly associated with other environmental factors (Baumeister *et al.* 1991).

In the light of this, the ability of the caregivers to communicate with their infants, and to notice attempts at communication by their infants becomes central in how the infants and children experience feeding. Any complete understanding therefore of

infant and child nutrition and the mechanisms by which nutritional status is understood, has to include a discussion of the nature of the early interactional capacities of the infant, and how these contribute to the way in which mother–infant interaction evolves.

The interactional capacities of the infant

The emerging processes of self and mutual regulation and social capacities make infants particularly vulnerable to early disruptions to interactions with their caregivers (Brazelton *et al.* 1974). Infants are born as social creatures primed for interaction with others (Murray & Andrews 2000), evidenced by the fact that they are able to distinguish their mother's voice from that of a stranger at 15 h old (Meltzoff & Moore 1977); are able to imitate facial expressions in the first hour after birth (Field *et al.* 1982); and prefer their mother's face to that of a stranger (Tronick *et al.* 1980). By 3 months of age, the capacities of the infant are even more sophisticated, having developed the ability to engage in complex turn-taking in interaction with an interactive partner (Beebe & Lachmann 2002). Research has also shown how the infant develops the ability to express and regulate emotions through interactions with others (Tronick 1989; Denham 1998).

The way in which the mother responds to the emotional communication of the infant either facilitates or impedes the development of emotional regulation (Murray *et al.* 1997). Numerous commentators have demonstrated how, from the first hours of its life, the infant is not a passive recipient and contributes to the interaction with their caregiver (DeCasper & Fifer 1980). The capacity of infants to engage in well-organized, mutually reciprocal, face-to-face exchange, and their sensitivity to any disruptions in their interpersonal environment (Murray *et al.* 1997), is of particular importance when considering how mother–infant interaction can contribute to physical development and optimal infant and child nutrition.

Having established both the infants' contribution to interactions with their caregivers, as well as the exquisite sensitivity of infants to disruptions, a case has to be made for how such interactive processes

come to express themselves at the level of physical development. This will be done by briefly looking at three areas: breastfeeding; non-organic failure to thrive (NOFTT); and the points of interaction between the child, the family and the delivery of programmes (macro and micro systems), and maternal mood and infant physical development.

Breastfeeding and development

In the developing world where food resources are often scarce, fortified formula is expensive, and where affordable, clean water is not readily available, breastfeeding is almost universal and the recommended method of feeding for newborn infants (World Health Organization 1998). In developing countries, breastfeeding has been linked to preventing infant morbidity (Howie *et al.* 1990) primarily caused by infections and malnutrition (Feacham & Koblinsky 1984; Habicht *et al.* 1986), while Welsh and May (Welsh & May 1979) have demonstrated the unique immunological properties of breast milk.

Little research has been conducted on the effects of breastfeeding on psychological development in the developing world. Although some research on this topic has been conducted in the developed world, many of the studies have been inconclusive and subject to different interpretations. These problems stem from limitations in research designs. Having said this, the strongest benefits of breastfeeding may be in terms of how it contributes to the quality of the mother–infant interaction (Richter *et al.* 1994). De Andraca *et al.* (1998) have shown how there is increased visual contact of infants with their mothers during breastfeeding than when bottle fed. Jelliffe and Jelliffe (Jelliffe & Jelliffe 1978) have demonstrated the receptivity of the mother's hormonal system to the presence of the infant and the act of sucking, while it has also been shown that maternal reactivity towards stress is blunted by infant suckling (Walker *et al.* 2004).

Max-Neef has described breastfeeding as a *synergic satisfier* (Max-Neef 1991). This means that breastfeeding not only satisfies a given need (usually described as nutrition or subsistence) but also stimulates and

contributes to the simultaneous satisfaction of other needs such as the need for affection and protection.

Infant and child weight gain and NOFTT

Early research conducted on infants who fail to thrive, typically examined the role of organic factors such as fetal abnormality, low birthweight and illness (Chatoor *et al.* 1997). There is an increasing acceptance that a variety of physiological and environmental factors contribute to infant nutritional status and feeding disorders that may develop (Benoit & Zeanah 2000). As Chatoor points out (Chatoor *et al.* 1997), failure to thrive describes a symptom rather than a disorder, and thus should be described as a symptom of a number of potential underlying disorders. When the impairment is as a result of non-organic factors, it is known as NOFTT. The proximate aetiology of NOFTT is insufficient nutrition (Benoit & Zeanah 2000), but there is often a complex interaction of various factors (Frank & Zeisel 1988). One of the hypothesized non-organic factors in the etiology of NOFTT is impaired parent–child interaction (Skuse *et al.* 1994). Given that infant feeding is such an interactive process, one of the hypotheses is that anything that interferes with, for example, the ability of the mother to be sensitive and responsive to cues from her infant during feeding, may then play a role in undernourishment and NOFTT and be implicated in later growth difficulties.

Macro systems and microsystems: three points of interaction

The nature of the interaction between nutrition, the broader environment and micro level variables, such as the mother–infant interaction, has received significant recent attention (Skuse *et al.* 1992). In a review of interventions for physical growth and psychological development, the World Health Organization has outlined how psychological development and nutrition interact at three different points: at the level of the child; between the child and their family; and in the design and delivery of programmes (World Health Organization n.d.).

Child

The relationship between physical growth, care and psychological development is particularly evident in the early years, and given that the model is an interactive one, the role of the child is central. Growth deficient children have been shown to have more difficulties with feeding, to be more chaotic at meal times and perceived by parents to be more difficult to console when distressed, as being both stressed and more inflexible, and more difficult to manage (Singer *et al.* 1990; Heffer & Kelley 1994; Bithoney *et al.* 1995). The interactive nature of nutrition and psychological development is also evident from research conducted into interventions aimed at alleviating nutritional or psychosocial deficiency. It has been shown that purely nutritional interventions may have psychological benefits, while intervention models focusing on psychosocial stimulation may have important effects on physical growth (Super *et al.* 1990; Martorell & Young 1997).

Child and family

At the level of the child and family, both situational and family variables are important, in addition to characteristics and behaviours of infants and children and their caregivers. Situational variables such as family impoverishment, family stresses, maternal education and lack of education have all been implicated (for example) in the etiology of NOFTT (Gagan *et al.* 1984).

Child and caregiver characteristics and behaviour are critical components in the interaction between physical and psychological development. Studies have reported associations between malnutrition and low levels of home stimulation, low sensitivity and responsiveness (Cravioto *et al.* 1975; Cravioto & Delicardie 1976), disturbed attachments (Valenzuela 1990), and attachment status as related to catch-up growth following discharge from a treatment unit (Richter *et al.* 1990). Graves (Graves 1976, 1978) found an association between undernourished infants and frequency measures of attachment behaviours such as distance interaction, approach behaviour and physical interactions. Undernourished infants were also less competent in manipulation of toys during play and were

more passive when in contact with their mothers. Chavez and Martinez (Chavez *et al.* 1979) and Chavez *et al.* (1975) conducted a study in a Mexican village and found that undernourished infants were less active, less independent, explored less and were less able to elicit interaction from their caregivers during play and as a consequence were more demanding towards their mothers at 18–24 months.

A child who is able to engage with their caregiver may be more successful in asking for and receiving food (Engle & Ricutiti 1995). On the other hand, a child who finds it difficult to demand and obtain food, and who then begins to experience the effects of undernutrition, may begin to experience fatigue, a lack of motivation to explore the environment or make demands for food, thus setting in motion a negative cycle, which may in some cases become extended to all adults and not solely the caregiver. This is in much the same way as Field *et al.* have demonstrated with regard to the infants of depressed mothers who develop a 'depressed like' style of interaction, which is generalized to interactions with other 'non-depressed' adults (Field *et al.* 1985).

While the proximal elements of interaction (the minutiae of mother–infant interaction for instance) are central during infancy, as children grow into toddlerhood and beyond, more social aspects of eating and nutritional intake come to the fore. Birch and Fisher have shown that eating for children is a social occasion, with the behaviour of people in that environment serving as models for the developing child (Birch & Fisher 1998). In addition, caregivers and the family environment are instrumental in shaping children's eating habits and intake of food, through choice of feeding method, direct modeling influences and through how they interact with children during eating (Birch *et al.* 1980). Harper and Sanders have observed how toddlers are more likely to put food in their mouths following the example of their mothers compared with the same modeling behaviour of a stranger (Harper & Sanders 1975). Birch and Fisher have also shown how excessive levels of parental control in the early years may affect children's ability to regulate energy intake and the amount of food consumed (Birch & Fisher 1998), and that in non-controlling, non-coercive conditions chil-

dren have the ability to self-regulate the amount of food and energy consumed (Johnson 2000).

Delivery of programmes

The World Health Organization and United Nations Children's Emergency Fund (UNICEF) are increasingly emphasizing intervention strategies aimed at infants and young children that combine nutritional, health and psychosocial aspects (Cooper *et al.* 1999). UNICEF has been instrumental in developing a conceptual model that places care at the centre of any intervention aimed at meeting the needs of the child (Engle & Ricutiti 1995). In this model, care is defined as the meeting of the needs of the child (physical, mental and social), through the provision of time, attention and support to the child. Care is conceptualized as the link between food and health resources, and the child's physical growth and psychological development (Engle & Ricutiti 1995). A number of studies have been instrumental in illustrating the critical link between both nutritional supplementation and psychosocial stimulation. In a study conducted in Jamaica with stunted and non-stunted children, Grantham-McGregor *et al.* were able to show the benefits of a combination of supplementation and stimulation over interventions that consisted solely of nutritional supplementation or simply stimulation (Grantham-McGregor *et al.* 1991). Van der Gaag was also able to show how in Bogota (Colombia) children at age 7 years who, as infants, had received both supplementation and stimulation had better reading readiness scores, better mathematics scores and basic knowledge and the results were especially strong for children of fathers of low to moderate levels of education and literacy (Van der Gaag 1993).

Early mother–infant interaction and infant physical development: evidence from South Africa and the developing world

The early growth of infants and children is characterized by marked individual differences, even among infants and children living in adverse environments. Barbarin and Richter (Barbarin & Richter 2001)

argue that early differences may need to be explained at the proximal level of personal experience. An example of such proximal factors might be maternal sensitivity and childcare competence. Patel *et al.* argue that in low-income countries, because of the hostility of the early environment, maternal competence in childcare is likely to have a greater role in infant and child physical well-being than might be the case in wealthier countries (Patel *et al.* 2004). Because poverty, overcrowding and poor sanitation are common in low-income countries, poor maternal care has the potential to result in greater risk to a child's physical health (Rahman *et al.* 2002). In a review, Zeitlin *et al.* confirmed this by showing how caregivers having a positive attitude to the child as well as their own psychological adjustment were important variables that influenced growth, and this was particularly true for families living in deprived conditions (Zeitlin *et al.* 1990).

Maternal mood and compromised infant and child physical development

One particular area of maternal psychopathology that has been investigated as a risk factor for poor growth is maternal depression. This may be particularly true in developing countries, where poverty and violence contribute significantly to an adverse environment (Galler & Ramsey 1985). In addition, Richter and Griesel have argued that the conditions associated with malnutrition are the same conditions that are likely to give rise to depression and thus compromise interaction with an infant (Richter *et al.* 1994).

For Galler and Ramsey, dysfunctional patterns of early mother–infant interaction are significantly involved in the etiology of malnutrition (Galler & Ramsey 1985). Most likely the interaction would be more of a transactional one (Lester 1979), where the impairment in the infant's ability to elicit positive social interactions (because of undernutrition) occurs in tandem with the mother's difficulties in sensitive and responsive caregiving, resulting in maladaptive interactions between the pair (Richter *et al.* 1990), while Cooper *et al.* have shown how post-partum depression can interfere with the mother's feeding of her infant (Cooper *et al.* 1993).

Physical development of infants is a particular concern in Asia. In what is known as 'the Asian enigma', the nutrition of children in South Asia has been found to be poorer than those of children in Africa, despite similar economic circumstances (Bamalingaswami *et al.* 1996). Recently, research reports have suggested that in South Asia, post-partum depression may contribute to problems in child physical development. In a study of low income women in Goa, the presence of post-partum depression at 2 months was found to be significantly associated with low infant weight and with shorter infant length at 6 months, after taking account of birthweight and parental education (Patel *et al.* 2003). Rahman *et al.* found that in rural Pakistan, infants of mothers depressed in the prenatal and the post-natal period showed growth retardation at several time points in the first year of life (Rahman *et al.* 2004). In addition, chronic depression carried a greater risk for poor outcome than did episodic depression, while maternal mental state was also associated with a higher risk of diarrhea in infants. Based on these findings, Rahman estimated that the incidence of infant stunting in rural Pakistan would be reduced by 30% if maternal depression were eliminated from this population (Rahman 2005). These findings, if applicable beyond South Asia, could have important clinical implications for the care of infants across the developing world.

In a South African study investigating the relationship between maternal depression and infant growth, there was no relationship between maternal depression at 2 months and infant weight at 2 months, but there was a relationship between depression at 2 months and infant weight at 18 months, a relationship which disappeared, however, when birthweight was factored in (Tomlinson *et al.* 2006). It is unclear what mechanisms there may be to explain this non-replication of the South Asian findings.

Interventions

The mother–infant intervention programme, Khayelitsha, Cape Town

In the light of the evidence presented, it is clear that optimal physical development depends on more than

simply nutritional intake. In theory therefore, psycho-social interventions aimed at improving the mother–infant relationship may have beneficial effects at both the socio-emotional level as well as the physical. At present, there have been no randomized controlled trials assessing the effectiveness of early mother–infant programmes in South Africa. The question arises whether such a mother–infant intervention could be of benefit in a peri-urban population characterized by high levels of social adversity. Cooper *et al.* have produced preliminary evidence of the benefit of a community-based mother–infant intervention delivered by trained community workers (Cooper *et al.* 2002). The study was carried out in Khayelitsha, a peri-urban settlement on the outskirts of Cape Town, by four community-based workers who were trained to provide the mother with emotional support and to encourage her in sensitive responsive interactions with her infant. A major aspect of the intervention was the attempt to sensitize the mother to her infant's individual capacities and sensitivities. The intervention was delivered to the women in their homes in sessions lasting approximately an hour. Women were visited twice antenatally, twice weekly for 4 weeks post-partum, weekly for 8 weeks, fortnightly for a month and then monthly for 2 months.

One of the benefits of the intervention was more positive engagement during feeding of mothers who had received the intervention. In addition, and of crucial importance for this paper, infants in the intervention group were significantly heavier and taller than those in the comparison group (Cooper *et al.* 2002). This pilot study produced preliminary evidence of the benefit of a community-based mother–infant intervention delivered by trained community workers, sufficient to warrant a formal controlled evaluation of this treatment. This team has recently completed a larger controlled evaluation and is at present analysing these findings.

Conclusions

The implications of the extensive literature on the early capacities of infants, the impact of early disturbances on the mother–infant relationship on infant

physical growth, and of some preliminary evidence that community-based interventions impact on both the mother–infant relationship and infant physical growth, all contribute to the increasing sense of how early relational issues between infants and their caregivers are crucial to any complete understanding of infant growth and development. The strong theoretical and empirical support for the integration of physical and psychological development in infancy, with the interactions of infant with their primary caregivers has fundamental implications for interventions. Programmes that deal with only one aspect, rather than addressing them holistically are likely to yield very disappointing results. They are wasteful of scarce resources, and, ultimately, they will fail to improve the positive outcomes they are intended to support. In this regard, the PFB DGs may prove to be a successful educational tool in interventions.

Guidelines for facilitating good interaction between children and their caregivers – focusing on nutrition

In the light of this extensive evidence, what are the implications for actual practice? Listed below are a number of recommendations for facilitating good interaction between infants, children and their caregivers. The recommendations are phrased as advice to mothers but this is for heuristic purposes only. In practice, there are many different ways in which each recommendation can be used, based on context, resources and, very importantly, cultural factors. These recommendations are not intended as a 'recipe book' of ideal communication between mothers and infants, but rather general principles that are supported by evidence.

1. Express and physically demonstrate love, warmth and affection to your child. When feeding your infant, create a quiet and safe space in which intimacy and closeness can be shared between you and your baby. It is a time when you can indulge in extended gazing into each other's eyes caressing of the hands and limbs of your baby.
2. Be observant and thoughtful and provide support, awareness and sensitive reading of the infant's changing attentions, needs and emotions and articulate these for the baby. Notice the behavioral cues that indicate baby is getting hungry. Not all crying is a call for food. Babies cry to attract attention, to be held, when in pain or discomfort, wet or cold, and when tired or sleepy.
3. Respond to the infant's initiative. Allow the infant to direct conversations, games and activities. Follow the baby's lead when his or her attention is drawn to a particular object. Name it and talk about it.
4. Encourage games of disappearance and re-appearance, such as 'peek-a-boo' which encourage the mastery of the concept of object constancy, which informs the infant that objects do not disappear when they are out of view but that they continue to exist and can reappear when uncovered.
5. Allow time for the disruption of routines such as feeding and bathing when the infant's attention has been drawn to interesting objects.
6. Notice when the infant's attention has been drawn to an interesting object and then follow the infant's gaze, locate his source of interest or attention and follow this up by talking to him about his interest in this and intentions for it.
7. Mealtimes offer valuable opportunities for conversations. Encourage extended reciprocal conversations with your child in which each of you take turns to speak and tell your story.
8. Interest the infant in different objects in the home environment. Offer the infant different foods to explore. There are a wide number of objects, which the infant can mouth, that could be kept aside, clean and available for this purpose. Mouthing objects is the normal way in which infants explore objects in their world at this stage.
9. Children need consistency and predictability, so some routine is important. Try to create a time and space that is tension free for meals to be enjoyed by the child and all at home.
10. Encourage the child in his or her attempts to master the skills of feeding.
11. Within reason, allow the child to guide you with respect to his or her preferences in food. Children's tastes vary enormously.

12. Respect the child's developing sense of urgency by listening, following the need, reading the cues, allowing the child to learn and express when they are hungry or satiated. Avoid forcing the child to eat all that is on the plate. Avoid power struggles over food. Wherever possible provide limited sensible choices of food for meals.

References

- Bamalingaswami V., Jonsson U. & Rohde J. (1996) *Commentary on Nutrition, Progress of Nations*, pp 10–17. UNICEF: New York.
- Barbarin O.A. & Richter L.M. (2001) *Mandela's Children: Growing Up in Post-Apartheid South Africa*. Routledge: New York.
- Baumeister A., Kupstas F. & Klindworth L. (1991) The new morbidity: a national plan of action. *American Behavioral Scientist* **34**, 468–500.
- Beebe B. & Lachmann F.M. (2002) *Infant Research and Adult Treatment: Co-Constructing Interactions*. The Analytic Press: Hillsdale, NJ.
- Benoit D. (2000) Feeding disorders, failure to thrive, and obesity. In: *Handbook of Infant Mental Health*, 2nd edn (ed. C.H. Zeanah Jr), pp 339–352. Guilford Press: New York.
- Birch L.L. & Fisher J.O. (1998) Development of eating behaviours among children and adolescents. *Pediatrics* **101**, 539–549.
- Birch L.L., Zimmerman S. & Hind H. (1980) The influence of social-affective context in preschool children's food preferences. *Child Development* **51**, 856–861.
- Bithoney W., Van Sciver M., Foster S., Corso S. & Tentindo C. (1995) Parental stress and growth outcome in growth-deficient children. *Pediatrics* **96**, 707–711.
- Black R.E., Brown K.H. & Becker S. (1984) Malnutrition is a determining factor in diarrheal duration, but not incidence, among young children in a longitudinal study in rural Bangladesh. *American Journal of Clinical Nutrition* **39**, 87–94.
- Brazelton T.B., Koslowski B. & Main M. (1974) The origins of reciprocity. In: *The Effects of the Infant on its Caregiver* (eds M. Lewis & L. Rosenblum), pp 49–70. Wiley-Interscience: New York.
- Chatoor I. (1997) Feeding disorders of infants and toddlers. In: *Handbook of Child and Adolescent Psychiatry, Vol. 1: Infants and Preschoolers: Development and Syndromes* (eds S. Greenspan, S. Wieder & J. Osofsky), pp 367–386. John Wiley: New York.
- Chavez A. & Martinez C. (1979) Behavioural effects of undernutrition and food supplementation. In: *Proceedings of the International Nutrition Conference on the Behavioural Effects of Energy and Protein Deficits* (ed. J. Brozek), pp 216–228. Department of Health, Education and Welfare: Bethesda, MD.
- Chavez A., Martinez C. & Yashine T. (1975) Nutrition, behavioral development and mother-child interaction in young rural children. *Federation Proceedings* **34**, 1574–1582.
- Cheung Y.B., Khoo K.S., Karlberg J. & Machin D. (2002) Association between psychological symptoms in adults and growth in early life. *British Medical Journal* **325**, 749–752.
- Cooper P., Landman M., Tomlinson M., Molteno C., Swartz L. & Murray L. (2002) The impact of a mother-infant intervention in an indigent peri-urban South African context: a pilot study. *British Journal of Psychiatry* **180**, 76–81.
- Cooper P.J., Murray L. & Stein A. (1993) Psychosocial factors associated with the early termination of breast-feeding. *Journal of Psychosomatic Research* **37**, 171–176.
- Cooper P.J., Tomlinson M., Swartz L., Woolgar M., Murray L. & Molteno C. (1999) Postpartum depression and the mother-infant relationship in a South African peri-urban settlement. *British Journal of Psychiatry* **175**, 554–558.
- Cravioto J. & Delicardie E.R. (1975) Mother-infant relationship prior to the development of clinically severe malnutrition in the child. In: *Proceedings of the Western Hemisphere Nutrition Congress IV* (eds P.L. White & N. Selvey), pp 126–137. Massachusetts Publishing Series Group: Boston, MA.
- Cravioto J. & Delicardie E.R. (1976) Malnutrition in early childhood and some of its later effects at individual and community levels. *Food Nutrition* **2**, 2–11.
- De Andraca I., Peirano P. & Uauy R. (1998) Nutrition and care in the preterm and neonatal periods and later development: human milk is best for optimal mental development. In: *Nutrition, Health, and Child Development: Recent Advances and Policy Recommendations*, pp 43–68. Pan American Health Organization, Tropical metabolism research unit of the University of West Indies Mona and the World Bank: Washington, DC. Scientific Publication No. 566.
- DeCasper A. & Fifer W. (1980) of human bonding: newborns prefer their mother's voice. *Science* **208**, 1174.
- Denham S.A. (1998) *Emotional Development in Young Children*. Guilford Press: New York.
- Desjarlais R., Eisenberg L., Good B. & Kleinman A. (1995) *World Mental Health: Problems and Priorities in Low-Income Countries*. Oxford University Press: New York.
- Engle P.L. & Ricutti H.N. (1995) Psychosocial aspects of care and nutrition. *Food and Nutrition Bulletin* **16**, 356–377.
- Feacham R.G. & Koblinsky M.A. (1984) Interventions for the control of diarrhoeal diseases among young children:

- promotion of breast-feeding. *Bulletin of the World Health Organisation* **62**, 271–291.
- Field T., Woodson R., Greenberg R. & Cohen D. (1982) Discrimination and imitation of facial expressions by neonates. *Science* **218**, 179–181.
- Field T., Sandberg D., Garcia R., Vega-Lahr N., Goldstein S. & Guy L. (1985) Prenatal problems, postpartum depression, and early mother–infant interactions. *Developmental Psychology* **12**, 1152–1156.
- Frank D.A. & Zeisel S.H. (1988) Failure to thrive. *Pediatric Clinics of North America* **35**, 1187–1207.
- Gagan R.J., Cupoli J.M. & Watkins A.H. (1984) The families of children who fail to thrive: preliminary investigations of parental deprivation among organic and non-organic cases. *International Journal of Child Abuse and Neglect* **8**, 93–103.
- Galler J.R. & Ramsey F. (1985) The influence of early malnutrition on subsequent behavioural development: VI. The role of the microenvironment of the household. *Nutrition and Behavior* **2**, 161–173.
- Grantham-McGregor S. (2002) Linear growth retardation and cognition. *Lancet* **359**, 542.
- Grantham-McGregor S.M., Powell C.A., Walker S.P. & Himes J.H. (1991) Nutritional supplementation, psychosocial stimulation, and mental development of stunted children: the Jamaican study. *Lancet* **338**, 1–5.
- Graves L. (1976) Nutrition, infant behaviour and maternal characteristics: a pilot study in West Bengal, India. *American Journal of Clinical Nutrition* **29**, 305–319.
- Graves L. (1978) Nutrition and infant behaviour: a replication study in the Katmandu Valley, Nepal. *American Journal of Clinical Nutrition* **31**, 541–551.
- Habicht J.P., Davanzo J. & Butz W.P. (1986) Does breast-feeding really save lives, or are apparent benefits due to biases? *American Journal of Epidemiology* **123**, 279–290.
- Harper L.V. & Sanders K.M. (1975) The effects of adult's eating on young children's acceptance of unfamiliar foods. *Journal of Experimental Child Psychology* **20**, 206–214.
- Heffer R. & Kelley R. (1994) Nonorganic failure to thrive: developmental outcomes and psychosocial assessment and intervention issues. *Research in Developmental Disabilities* **15**, 247–268.
- Howie P.W., Forsyth J.S., Ogston S.A., Clark A. & DuFlorey C. (1990) Protective effect of breast feeding against infection. *British Journal of Medicine* **300**, 1–11.
- Jelliffe D.B. & Jelliffe F.P. (1978) *Human Milk in the Modern World*. Oxford University Press: Oxford.
- Johnson S.L. (2000) Improving pre-schoolers self-regulation of energy intake. *Pediatrics* **106**, 1429–1435.
- Lasky R.E., Klein R.R., Yarborough C., Engle P.L., Lechtig A. & Martorell R. (1981) The relationship between physical growth and infant behavioural development in rural Guatemala. *Child Development* **52**, 219–226.
- Lester B.M. (1979) A synergistic approach to the study of prenatal malnutrition. *International Journal of Behavioral Development* **2**, 377–393.
- Martorell R. (1997) Undernutrition during pregnancy and early childhood: consequences for cognitive and behavioral development. In: *Early Child Development: Investing in Our Children's Future* (ed. M.E. Young), pp 39–83. Elsevier: Amsterdam.
- Max-Neef M. (1991) *Human Scale Development: Conception, Application and Further Reflections*. The Apex Press: New York.
- Meltzoff A.N. & Moore M.K. (1977) Imitation of facial and manual gestures by human neonates. *Science* **198**, 73–75.
- Murray L. & Andrews L. (2000) *The Social Baby*. CP Publishing: Surrey.
- Murray L. & Cooper P.J. (1997) The role of infant and maternal factors in postpartum depression, mother–infant interactions, and infant outcome. In: *Postpartum Depression and Child Development* (eds L. Murray & P.J. Cooper), pp 111–135. The Guilford Press: New York.
- Patel V., DeSouza N. & Rodrigues M. (2003) Postnatal depression and infant growth and development in low-income countries: a cohort study from Goa, India. *Archives of Disease in Childhood* **88**, 34–37.
- Patel V., Rahman A., Jacob K.S. & Hughes M. (2004) Effect of maternal mental health on infant growth in low income countries: new evidence from South Asia. *British Medical Journal* **328**, 820–823.
- Pelletier D.L., Frongillo E.A., Schroeder D.G. & Habicht J.P. (1995) The effects of malnutrition on child mortality in developing countries. *Bulletin of the World Health Organization* **73**, 443–448.
- Pollitt E., Gorman K.S., Engle P.L., Martorell R. & Rivera J. (1993) Early supplementary feeding and cognition: effects over two decades. *Society for Research in Child Development* **58**, 1–99 (Monograph Series. 235).
- Rahman A. (2005) *For the Sake of the Child, Look After the Mother*. ID21 insights: Communicating development research. Available at: <http://www.id21.org> (accessed 15 January 2006).
- Rahman A., Harrington R. & Bunn J. (2002) Can maternal depression increase infant risk of illness and growth impairment in developing countries? *Child: Care Health and Development* **28**, 51–56.
- Rahman A., Iqbal Z., Bunn J., Lovel H. & Harrington R. (2004) Impact of maternal depression on infant nutritional status and illness. *Archives of General Psychiatry* **61**, 946–952.
- Read M.S. (1982) Malnutrition and behaviour. *Applied Research in Mental Retardation* **3**, 279–291.

- Reifsnider E. (1998) Reversing growth deficiency in children: the effect of a community based intervention. *Journal of Pediatric Health Care* **12**, 305–312.
- Richter L. & Griesel R. (1994) Malnutrition, low birth weight and related influences on psychological development. In: *Childhood and Adversity: Psychological Perspectives from South African Research* (eds A. Dawes & D. Donald), pp 66–91. David Philip: Cape Town.
- Richter L. & Norris S. (2004) Nutrition. In: *Psychology, an Introduction* (eds L. Swartz, C. De la Rey & N. Duncan), pp 437–447. Oxford: Cape Town.
- Richter L., Bac M. & Hay I. (1990) Psychological aspects of the health care of young children. *South African Family Practice* **11**, 490–497.
- Scheper-Hughes N. (1991) Social indifference to child death. *Lancet* **337**, 1144–1147.
- Singer L.T., Song L.Y., Hill B.P. & Jaffe A.C. (1990) Stress and depression in mothers of failure to thrive children. *Journal of Pediatric Psychology* **15**, 711–720.
- Skuse D. & Bentovim A. (1994) Physical and emotional maltreatment. In: *Child and Adolescent Psychiatry: Modern Approaches* (eds M. Rutter, E. Taylor & L. Hersov), pp 209–229. Blackwell Science: Oxford.
- Skuse D., Wolke D. & Reilly S. (1992) Failure to thrive: clinical and developmental aspects. In: *Child and Youth Psychiatry, European Perspectives, Vol. II. Developmental Psychopathology* (eds H. Remschmidt & M. Schmidt), pp 46–71. Hans Huber: Stuttgart.
- Super C.M., Herrera M.A. & Mora J.O. (1990) Long term effects of food supplementation and psychosocial intervention on the physical growth of Colombian infants at risk of malnutrition. *Child Development* **61**, 29–49.
- Tomlinson M., Cooper P.J., Stein A., Swartz L. & Molteno C. (2006) Postpartum depression and infant growth in a South African peri-urban settlement. *Child: Care, Health and Development* **32**, 81–86.
- Tronick E.Z. (1989) Emotions and emotional communication in infants. *American Psychologist* **44**, 112–119.
- Tronick E.Z., Als H. & Brazelton T.B. (1980) Monadic phases: a structural descriptive analysis of infant-mother face-to-face interaction. *Merrill-Palmer Quarterly of Behaviour and Development* **26**, 3–24.
- Valenzuela M. (1990) Attachment in chronically underweight young children. *Child Development* **61**, 1984–1996.
- Van der Gaag J. (1993) *School Performance and Physical Growth of Underprivileged Children: Results of the Bogotá Project at Seven Years*. World Bank: Washington, DC.
- Walker C.D., Deschamps S., Proulx K., Tu M., Salzman C., Woodside B, *et al.* (2004) Mother to infant or infant to mother? Reciprocal regulation of responsiveness to stress in rodents and the implications for humans. *Journal of Psychiatry and Neuroscience* **29**, 364–382.
- Welsh J.K. & May J.T. (1979) Anti-infective properties of breast milk. *Journal of Pediatrics* **94**, 1–9.
- World Health Organization. (1998) *Postpartum Care of the Mother and Newborn: A Practical Guide*. World Health Organization: Geneva.
- World Health Organization. (n.d). *Turning the Tide of Malnutrition: Responding to the Challenges of the 21st Century*. Available at: http://www.who.int/nut/documents/nhd_brochure.pdf (accessed January 2006).
- Zeitlin M., Ghassemi H. & Mansour M. (1990) *Positive Deviance in Child Nutrition*. United Nations University Press: Tokyo.